

Anatomia Britannica; a system of anatomy and physiology, selected from the works of Haller, Albinus, Monro, etc.

Contributors

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Albinus

Monro.

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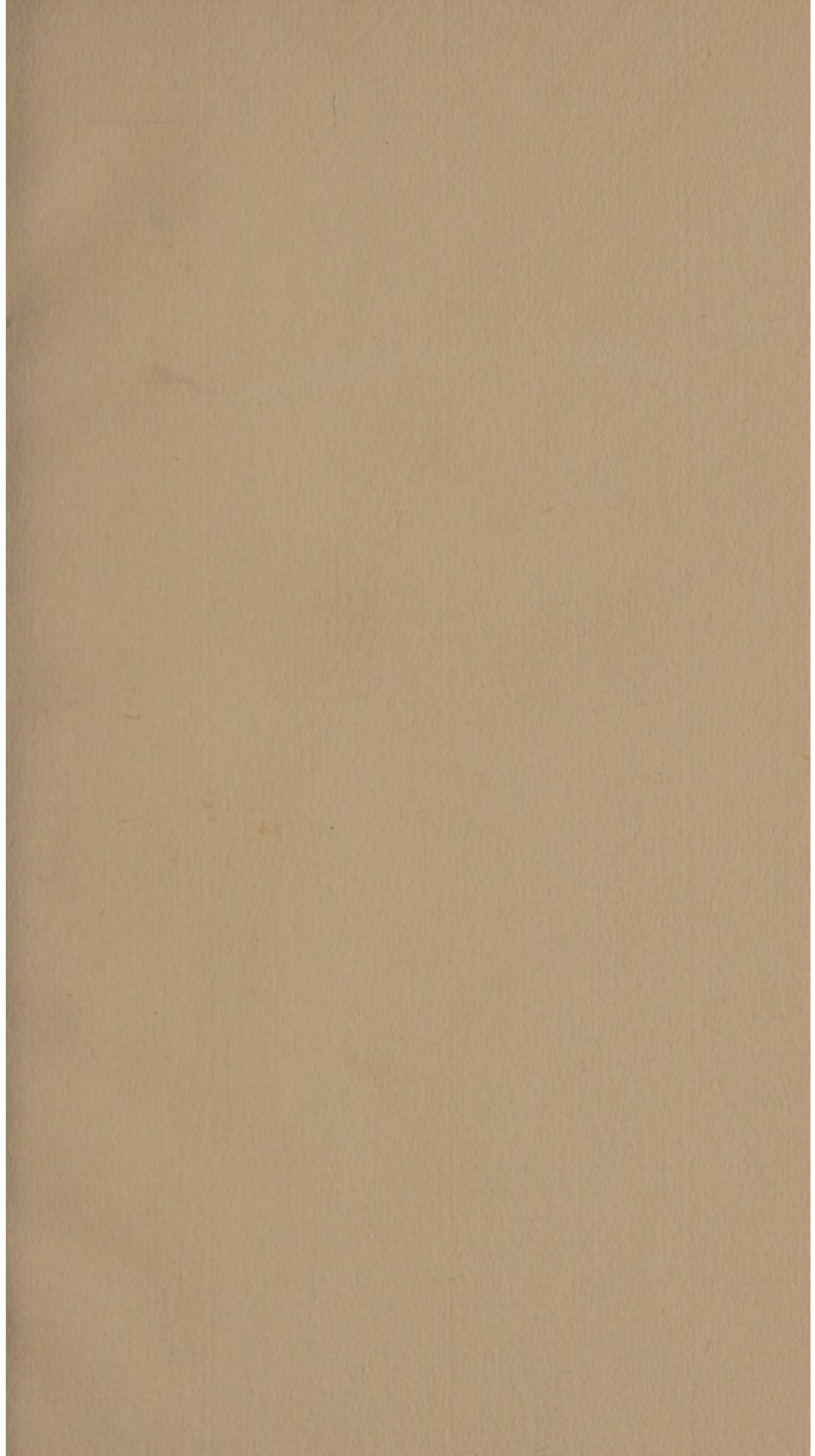
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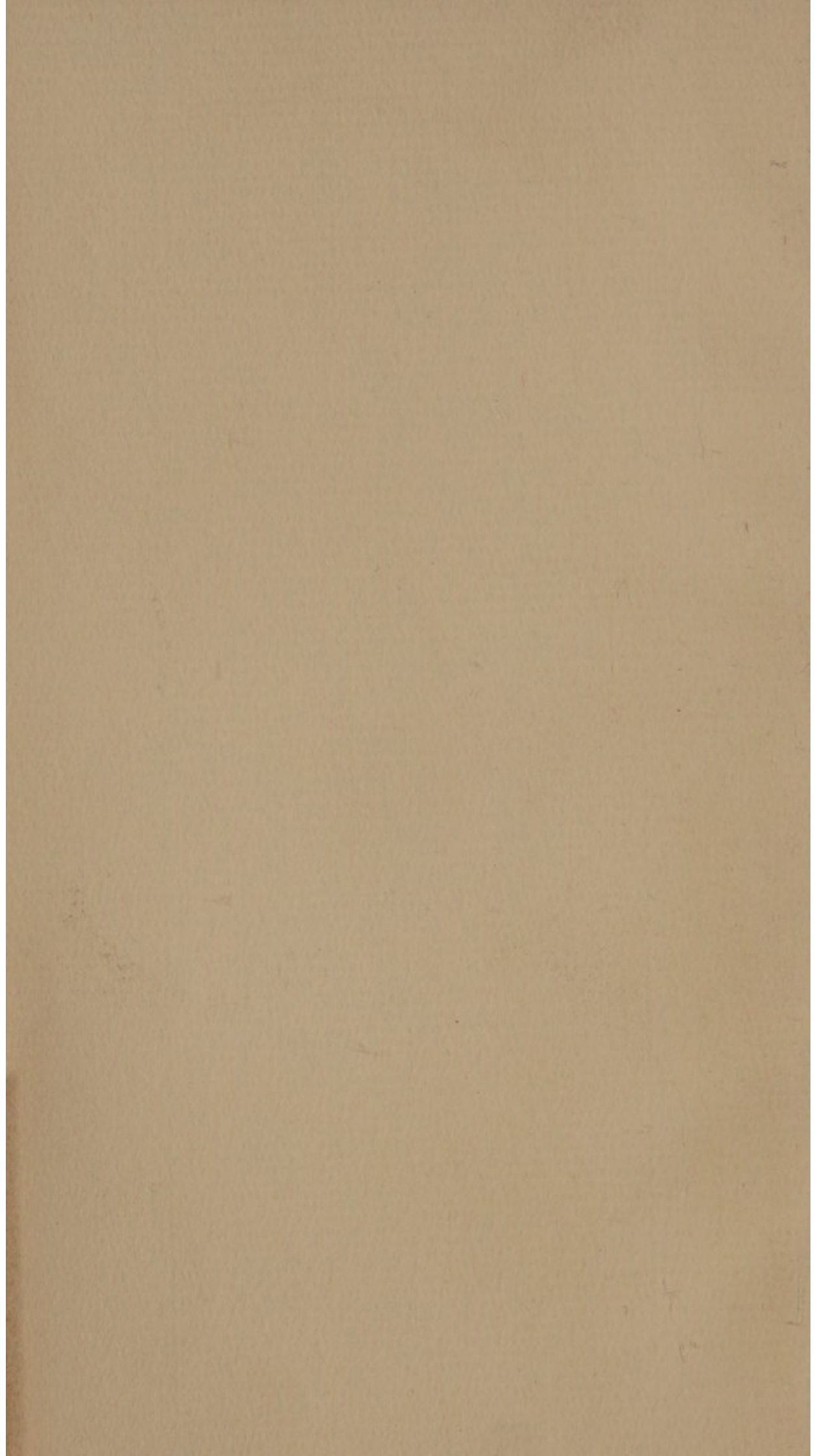


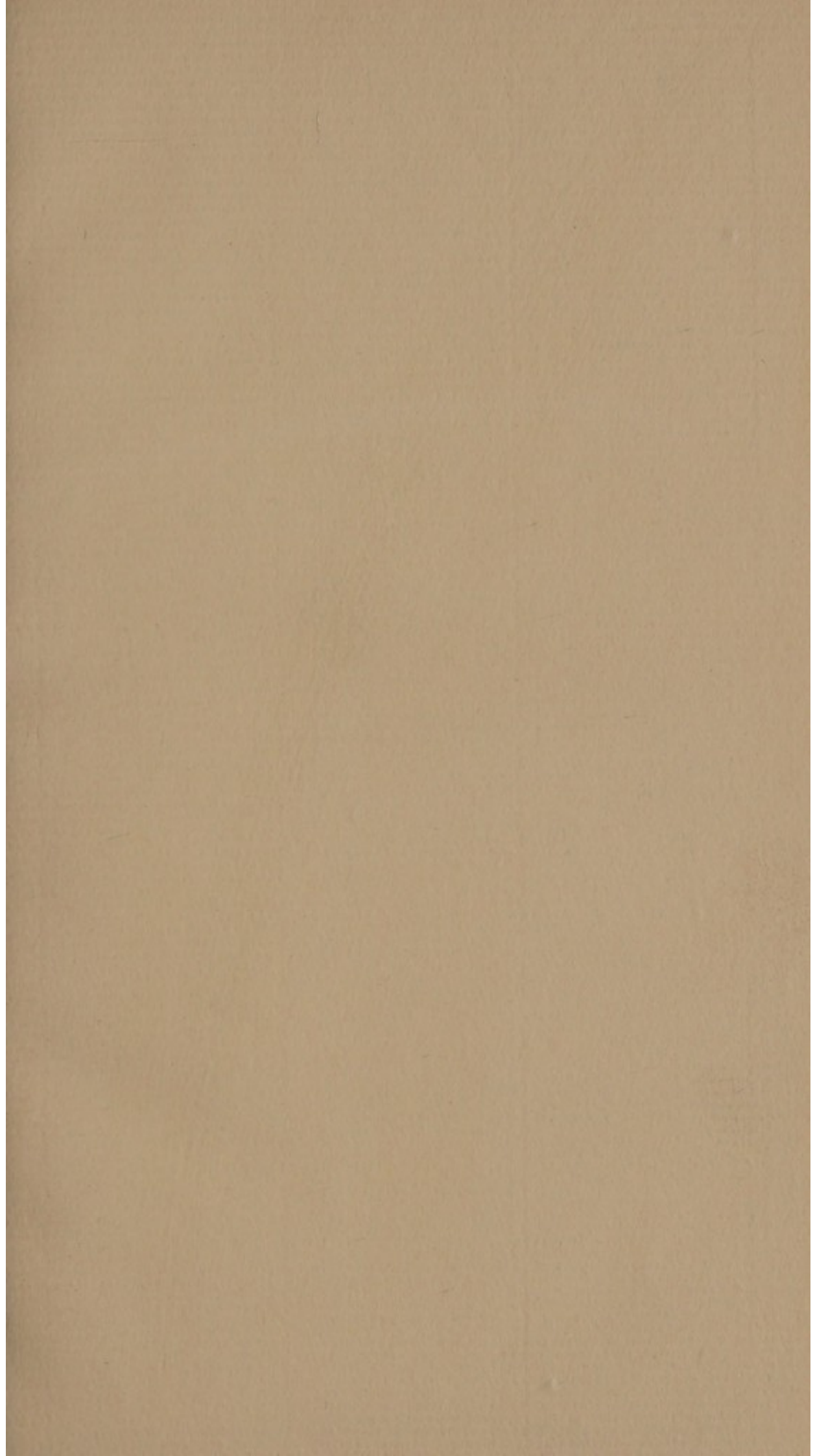
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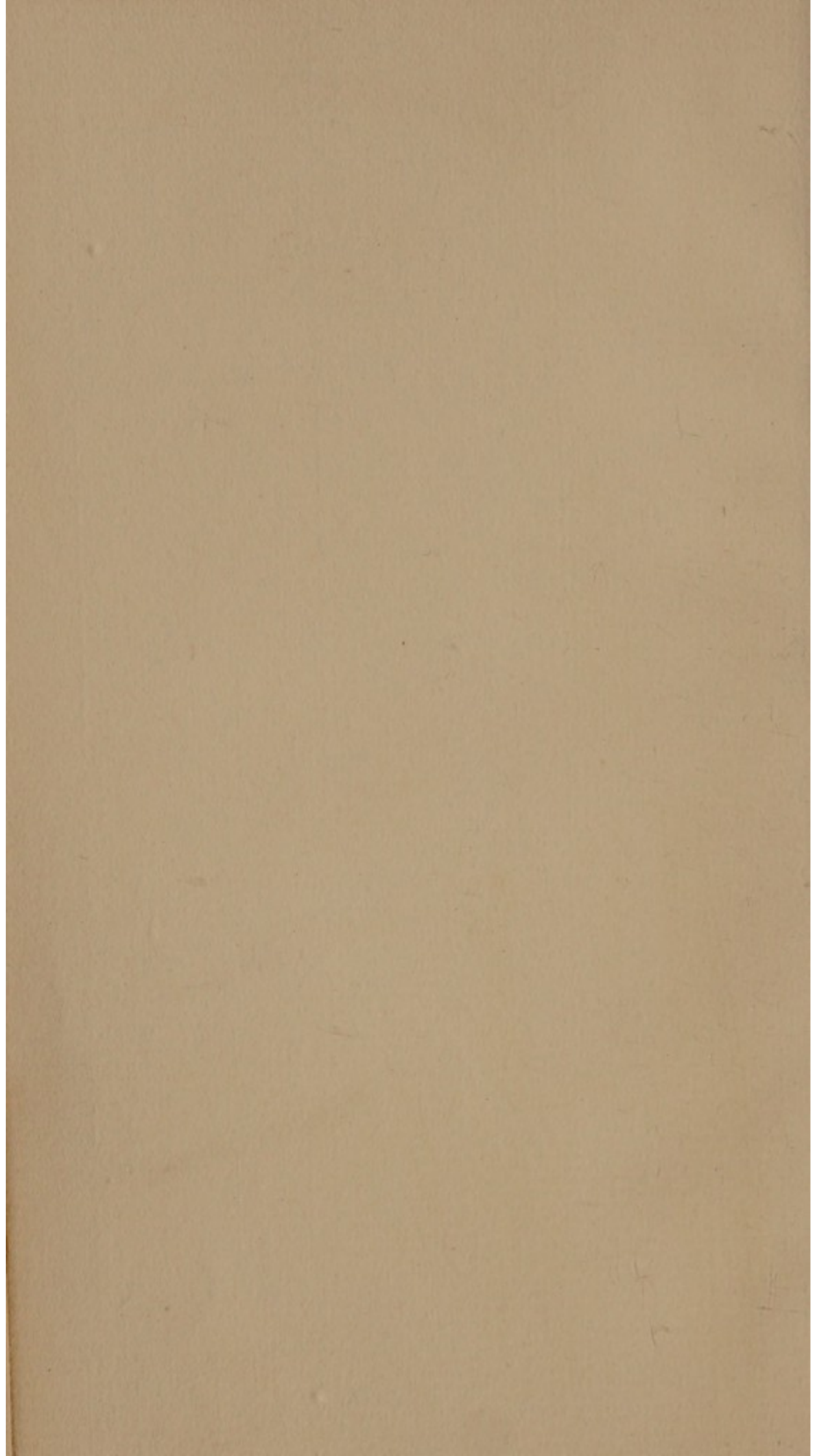


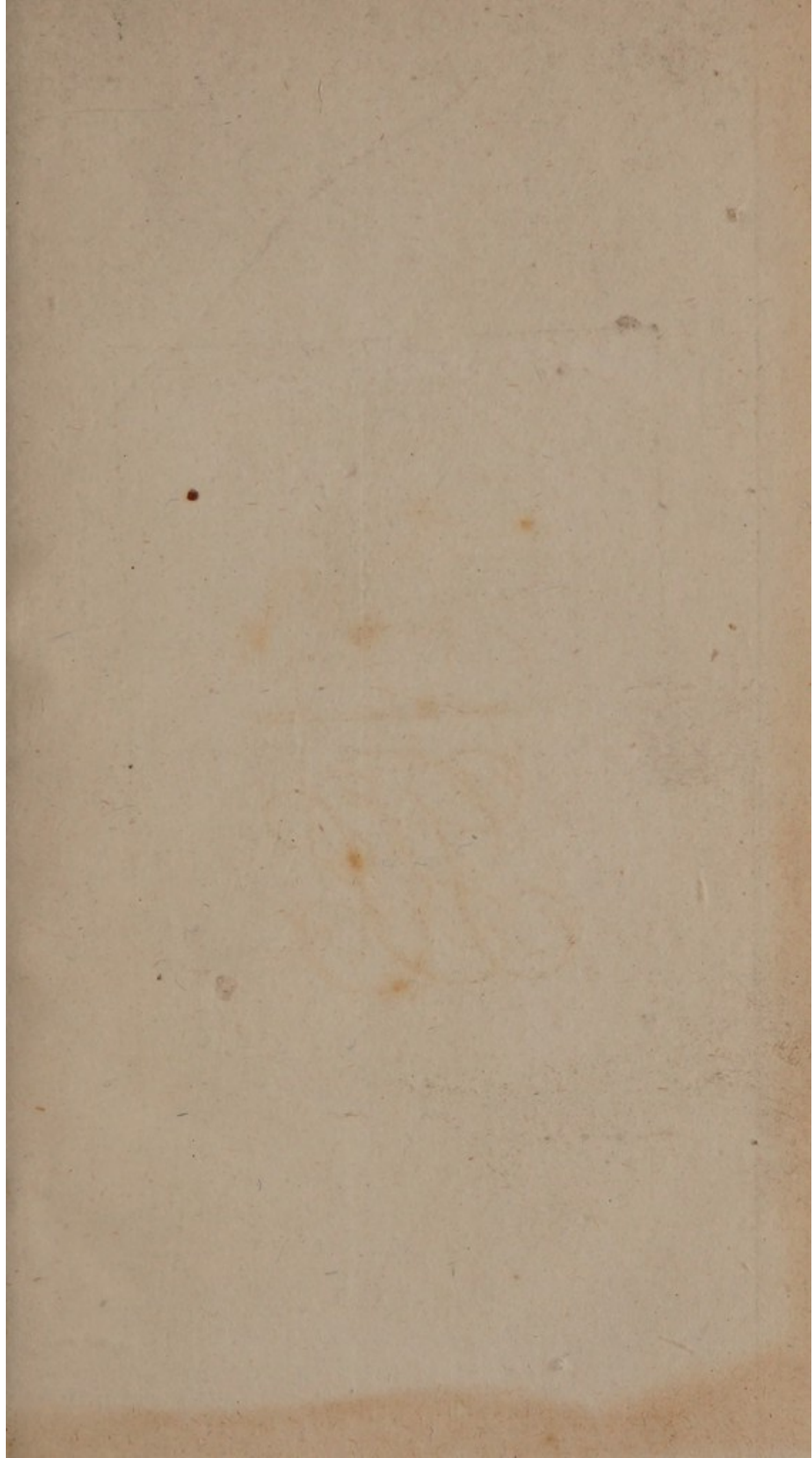
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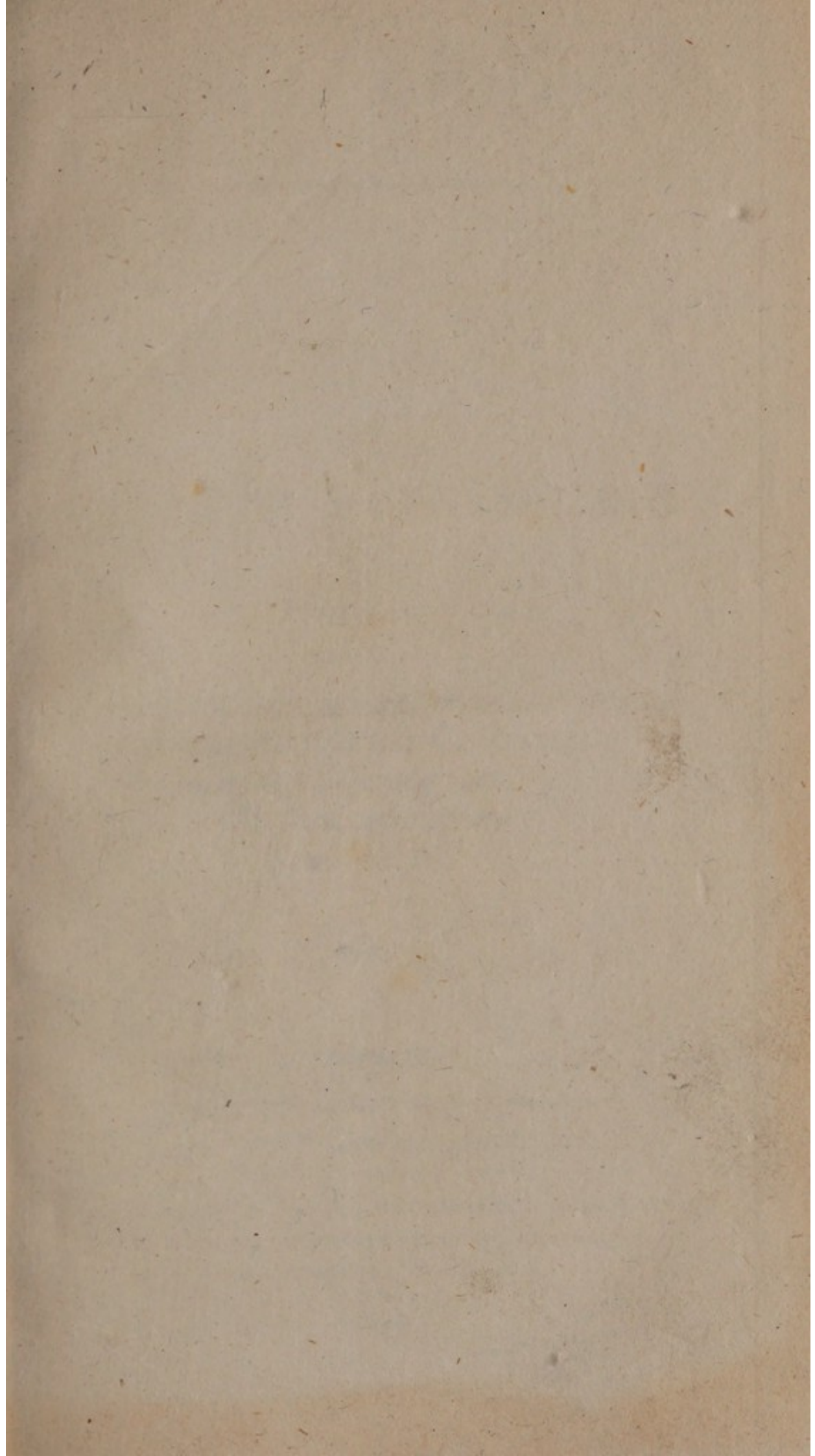












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LANSDOWNE
ANATOMIA BRITANNICA.

A
SYSTEM
OF
ANATOMY AND PHYSIOLOGY,

SELECTED FROM THE WORKS OF

*HALLER, ALBINUS, MONRO, WINSLOW, HUNTER,
SOEMMERRING, SCARPA, CRUIKSHANK,
MASGAGNI, MURRAY, WALTER,
SABATIER, MECKEL, ZINN,
&c. &c. &c.*

VOL. I.

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1805.

ANATOMY

BRITISH MUSEUM

ANATOMY

ANATOMY AND PHYSIOLOGY

THE HISTORY OF THE HUMAN BODY

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ADVERTISEMENT.

IT is certainly unnecessary to detail the motives which have induced this publication. The incompleteness, inaccuracy, and omissions of the most popular English Systems of Anatomy are sufficiently well known. The expensiveness of some of them also is highly blameable.

The first of the Systems alluded to is that of Mr. John Bell. A work not only expensive, though avowedly unfinished, but, what is perhaps still worse, inaccurate and extremely omissive. As an illustration of this, it is only necessary to remark, that, in the description of the Bones given in that book, the Teeth are omitted; in that of the Muscles,

all those connected with the female organs of generation, namely the Erector Clitoridis, the Sphincter Vaginæ, the Depressor Urethræ Muliebris, the Transversus Perinei, the Transversus Perinei Alter, the Sphincter Ani, and the Levator Ani; as well as the Laxator Tympani Minor, the Anomalous Maxillæ Superioris, the Musculus Glandulæ Thyroideæ, the Thyreo-Epiglottideus Major, the Thyreo-epiglottideus Minor, the Aryteno-epiglottideus, the Thyreo-arytenoideus Minor, the Compressor Prostatae and the Curvator Coccygis, are altogether forgotten; in the description of the Brain, the Cerebellum also is totally neglected. Such inaccuracies and omissions as these render that unnecessarily expensive work not only less useful to Students of Anatomy, but tend even to mislead them.

The only other elementary book that we shall mention, is a small work which, to the regret of every Anatomical Professor in London, is in too common use among their pupils. It is at once inaccurate, omissive, trivial, and unworthy of consideration.

The Work at present offered to the public has no claim above that of being an useful compila-

tion.* In it much interesting and valuable information in every department of Anatomical Science has been selected, and, we hope, judiciously arranged. Not only many of the numerous anatomical and physiological observations of Haller, Albinus, Monro, Winslow, Hunter, Soemmerring, Scarpa, Cruikshank, Masgagni, Murray, Walter, Sabatier, Meckel, Zinn, Cottunnius, Wrisberg, &c. are here introduced, but also the Angiological Tables of Murray, the Myologic Descriptions of Innes corrected by those of Albinus, and the Osteological Accounts of the first Monro, freed from obsolete physiology, and improved by modern observation—each of them works altogether unequalled in their respective departments.

This selection will probably therefore be found at once more complete, and, in proportion, far less expensive, than any other English Anatomical System.

A new and probably more rational arrangement has also been adopted in this work.

* A compilation, replete with excellent information, was published at Edinburgh several years ago, but its usefulness has been greatly limited by containing much repetition, and obsolete physiology, and above all by being totally destitute of arrangement.

The Bones are first described as forming the Basis of the human structure, next the Cartilages and the Ligaments which Connect them, and then the Muscles which Move them, with the Bursæ Mucosæ, which Lubricate these. This FIRST PART of our system therefore, Considers the Loco-motive Organs of Man ; and thus far also the generality of other systems are well arranged. But in the arrangement of the subsequent parts, they almost uniformly err.

In the present work, the SECOND PART embraces the Description of those Organs on which animal Existence Depends : first, the intestinal canal with the other abdominal viscera, as constituting one of the principal Absorbing Surfaces of the human body ; next, the lacteal or lymphatic Vessels which Absorb from that surface, then the Heart and lungs, to which, by these vessels, the Absorbed Chyle, mixed with former blood, is Carried for oxigenation and Circulation ; next, the Arteries through which the Blood is Propelled by the heart, then the Veins by which it is Returned ; and lastly, the Organs of Secretion, by which certain parts are separated from it.

The THIRD PART of this system Considers those Organs which are more immediately Connected with the Mental Operations of Man : first, the Organs of

Sense, which receive Impressions from External Objects; next, the Brain, where they are Matured into Ideas; and lastly, the Nerves through which the impulses of Volition are Effected, and by which we are Excited to Loco motion.—And thus in a natural circle, we return to the Loco-motive Organs of man—the point from which we set out.

ERRATA.

Vol. 1, p. 177, for Synchronology and Syndesmology, read
Chondrology and *Syndesmology*.

Vol. 1, p. 208, for Relicis Minor, read *Helicis Minor*.

In a Work of this magnitude, the candid will readily excuse
a few other trivial typographical errors.

NOTE.

As in the foregoing Advertisement we have not mentioned the Elementary Anatomical Work of Mr. Fyfe, we here think it necessary merely to remark, that unfortunately for the Student, among other defects, it contains no Physiology, without which Anatomy is almost useless; it omits several Muscles, viz. the Laxator Tympani Minor, the Anomalous Maxillæ Superioris, the Transversus Perinei Alter in the Female, the Depressor Urethræ Muliebris, the Musculus Glandulæ Thyroidæ, the Thyreo-Epiglottideus Minor, the Thyreo-Arytenoideus Minor, the Compressor Prostatae, the Curvator Coccygis, &c. it errs also in asserting, that the Bursæ Mucosæ are peculiar to the extremities; it falsely ascribes, as is usually done, a lamellated structure to Bones, &c. &c. Errors of this nature show the Author not thoroughly acquainted with the improvements of Soemmerring, Scarpa, and some of the most celebrated modern Anatomists.

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A
SYSTEM
OF
ANATOMY and PHYSIOLOGY.

PART FIRST.

SECTION I.

OF ANATOMY IN GENERAL.

ANATOMY is that science which teaches the structure of the human body by dissection of its parts.

These parts are either *solid* or *fluid*.

The *solids*, composed of fibres or small filaments, of different substance, size, and direction, which appear to be the most simple parts of the body, and which compose all the other parts, are divided into certain general classes: viz.

1st. *Bones*, which are the hardest, most solid, and most inflexible parts of the human body.

2nd. *Cartilages*, which are whitish or pearl coloured substances, softer than a bone, but harder than any other part, smooth, polished, pliable and elastic.

3rd. *Ligaments*, which are white, fibrous, compact substances, more pliable still than cartilages, difficult to be broken or to be torn, and yielding but very little when drawn out with force.

4th. *Muscles*, which are bundles of fibres, of a redish colour, and of different lengths.—The middle portion of the moving fibres is the principal, and differs from the extremities in being red, thick, soft, and capable of contraction; whereas the extremities are white, small, compact, and capable of yielding.—

This middle portion of each moving fibre is said to be fleshy, and forms what is properly called *flesh*. The extremities are called tendinous, and the substances formed by them, *tendons*.

5th. *Membranes*, which are pliable textures of fibres disposed or interwoven together in the same plane. They differ in thickness according to the smallness of their fibres and number of their planes. The particular planes are termed *laminæ*, and are occasionally distinguished by the names of external, internal, middle, &c.—The difference of membranes in general depends on that of the fibres, of which they are composed. Small portions of membranes, especially when they are very thin, are called *pelliculæ*; and some membranous laminæ are united together by the intervention of a particular substance, composed of this sort of pellicles, and called the *cellular* or *spongy substance*.

6th. *Viscera*, which are parts contained in a great cavity without being connected to it through their whole extent or circumference. Such are the stomach, intestines, &c. in the abdomen and the lungs in the thorax.

7th. *Vessels*, which are tubes, ducts, or canals, more or less flexible, composed of different membranes, the strata of which are generally termed *tunicæ* or *coats*. Some of them are divided into *branches*, and these again into *rami* and *ramifications*, which gradually diminish, but still remain hollow.—The general design of the vessels is to contain fluids, from the diversity of which, they are distinguished into *vasa lactea*, *lymphatica*, *sanguinea*, &c. The last and smallest extremities of all sorts of vessels are generally termed *capillary*.

8th. *Glands*, which are clusters or *moleculæ*, distinguishable from all the other parts of the body by their consistence, form, texture and connexion.—They are in general made up of arteries, veins, nerves, and other particular vessels, and of a substance which unites all these together in its different folds, and intertextures; the whole invested by a membranous covering.—The office of glands is to separate from the mass of blood, by means of certain secretory vessels, fluids, which they discharge either immediately or by other vessels termed *excretory*; and these

fluids are either accumulated in particular reservoirs, collected in the common cavities, or forced out of the body.

10th. *Fat* and *marrow*, which are equivocal terms. By the first is understood an oily, soft, white, or yellowish substance, of different consistences, collected between the skin and the muscles, in the interstices of the muscles, about the viscera, &c. and composed partly of a cellular or spongy substance, and partly of an oily matter, called *corpus adiposum* or *fat*, especially when separated from the cellular substance.—Marrow is a kind of fat, and differs from it only in the fineness of the membranous texture which involves it, and of the oily matter, and in its situation within the bones.

11th. *Nerves*, which are the white ropes proceeding from the cerebrum, cerebellum, and spinal marrow, and spread over all the parts of the body by filaments and ramifications.—Each nervous chord may be looked upon as a membranous vessel, the cavity of which is filled by a great number of membranous longitudinal septa, and by medullary filaments which lie between these septa.

These and the other solid parts of the human body, an innumeration of which would be unnecessary here, shall be described at length in those sections of the work to which they respectively belong: as

The growth of Bones	in	Osteogeny.
The Adult Bones	in	Osteology.
The Muscles	in	Myology.
The Viscera	in	Splanchnology.
The Vessels	in	Angiology.
The Glands	in	Adenology.
The Nerves	in	Neurology,
&c. &c. &c.		

The *fluids* of the human body are the blood and the various liquors separated from it by peculiar glands, &c. viz.

1st. *Earwax*, in the ears.

2nd. *Tears*, in the lachrymal gland.

3rd. *Spittle*, in the salival glands of the mouth.

4th. *Mucus*, in the mucous glands of the nose, mouth, &c.

- 5th. *Gastric liquor*, in the stomach.
- 6th. *Bile*, in the liver.
- 7th. *Pancreatic liquor*, in the pancreas.
- 8th. *Urine*, in the kidneys.
- 9th. *Seed*, in the testicles.
- 10th. *Fat*, in the adipose membrane.
- 11th. *Synovia*, in the joints.
- 12th. *Milk*, in the breasts.
- 13th. *Perspirable matter*, in the skin.—When this is more sensible, or in greater plenty, it is called *sweat*.

That part of anatomical science which considers the nature and uses of these fluids is called *Physiology*.

SECTION II.

OF THE BONES, CARTILAGES AND LIGAMENTS IN GENERAL.

THE PERIOSTEUM.

BONES are covered by a membrane, named on that account *Periosteum*, which is so necessary to them, that we must examine its texture and uses before we can understand their structure.

The *periosteum*, as well as most other membranes, can be divided into *layers* of fibres. The *exterior* ones, composed of the fibres of the muscles connected to the bones, vary in their number, size, and direction, and consequently occasion a very great difference in the thickness and strength of the periosteum of different bones, and even of the different parts of the same bone. The *internal* layer is every where nearly of a similar structure, and has its fibres in the same direction with those of the bone to which they are contiguous. The name *periosteum* ought therefore to be applied, strictly speaking, only to this internal layer, to which the others are joined in an uncertain manner and number.

Except where muscles, cartilages, or ligaments, are inserted into the periosteum, its external surface is connected to the surrounding parts by thin cellular membranes, which can easily be stretched considerably, but shorten themselves whenever the stretching force is removed. When these membranes are cut off or broken, they collapse into such a small space, that the surface of the periosteum seems smooth and equal.

When we attempt to tear off the periosteum from bones, we see a great number of white threads produced from the membrane into them; and, after a successful injection of the arteries, numerous vessels are not only seen on the periosteum, but most of these fibres sent from the membranes to the bone, show themselves to be vessels entering it, with the injected liquor in them.

The veins corresponding to these arteries are sometimes to be seen in subjects that die with their vessels full of blood; though such numerous ramifications of them, as of the arteries, can seldom be demonstrated, because few of them in the dead subject, contain blood, and coloured liquors can difficultly be injected into them. This, however, is sometimes done.

The great sensibility of the periosteum, whenever this membrane is in an inflamed state, is a sufficient proof that it is well provided with nerves, though they are perhaps too small to be traced upon it.

Vessels also pass through the periosteum to the marrow; of which more hereafter. And frequently muscles, ligaments, or cartilages, pierce through the periosteum, to be inserted into the bones.

The chief uses of the periosteum are: 1st. To strengthen the conjunction of the bones with their epiphyses, ligaments, and cartilages, which are easily separated in young creatures, when this membrane is taken away. 2nd. To afford convenient origin and insertion to several muscles which are fixed to this membrane. 3rd. To allow the muscles, when they contract or are stretched, to move and slide easily upon the bones. And 4th. To keep in due order and to support the vessels in their passage to the bones.

OF THE COMPOSITION OF BONES.

The bones like all other parts where large vessels do not enter, are generally of a white colour; only in a living creature they are bluish, which is owing to the blood in the small vessels under their surface. The less therefore and fewer the vessels are, and the thicker and firmer the bony surface covering the vessels is, the bones are whiter. Hence the bones of adults are whiter than those of children; and, in either young or old, the white colour of different bones, or of the several parts of the same bone, is always in proportion to their vascularity and solidity; circumstances which ought to be regarded by surgeons, when they are to judge of the condition of bones laid bare.

The following doctrine of osseous structure is given in conformity to that taught in the London schools ; but it is equally necessary the student should understand that professor SCARPA has lately endeavoured to prove that those appearances which in bones have hitherto been considered as fibrous are merely caused by the distribution of vessels ; that bones are totally destitute of laminæ or plates ; and that they, in reality, possess throughout a reticulated and more or less cellular texture. SOMMERRING is also of the same opinion, allowing however to the bones of the cranium alone a fibrous and laminated structure.

Bones are composed of a great many plates, each of which is made up of fibres.

But though their exterior part is always composed of firm compact plates, yet they are all more or less cavernous internally. In some (e.g. middle thin part of the *scapula* and *os ilium*) the solid sides are brought so near, that little cavity can be seen ; and in others (middle of *os humeri*, *femoris*, &c. the cavities are so large, that such bones are generally esteemed to be hollow or fistular. The internal spongy texture is most evident in young animals ; and some of it may be seen to remain in those of the greatest age, when bones are cautiously opened, after they have been kept so long as to be free from the oil they contain, or after being burnt.

This spongy cavernous internal part of bones is generally called their *cancelli* or *lattice-work*, and is formed in the following manner. The plates are firmly joined about the middle of the bone ; but as they are extended toward its ends, the more internal parts separate from the exterior, and stretch out their fibres toward the axis of the bone, where they are interwoven with the fibres of other plates that have been sent off in the same way. Seeing the plates are thus constantly going off, the solid sides of the bones must become thinner, and the lattice-work must be thicker and stronger toward their ends. This is evident in many of them, where the solid sides of their middle are very thick, and the cancelli are scarce observable ; whereas, at the ends, where their diameter is greatest, the solid walls or sides are not thicker than paper, and the cancelli are numerous and large enough to fill up the whole space left between the sides.

The cancelli sustain the membranous bags of the marrow which are stretched upon them, and thereby hinder these parts from being torn or removed out of their proper places in the motions in which the bones are employed. This support which the cancelli afford the marrow, also saves its membranes and vessels, in the lower parts of the bones, from being compressed by the weight of the marrow above.

The depressions between the fibres of the external plates of bones appear like so many furrows on their surface, into each of which the periosteum enters; by which the surface of contact, consequently the cohesion, between it and the bone, is considerably increased, and a greater number of vessels is sent from it into the bone than if it was a plain surface.

Both on the ridges and furrows, numerous little pits or orifices of canals are to be seen, by which the vessels pass to and from the bones.

After a successful injection, the arteries can be traced in their course from the pits to the plates and fibres; and, in sawing, cutting, or rasping the bones of living creatures, these vessels discover themselves by the small drops of blood which then ooze out from the most solid part of the bones. But the clearest demonstration of the intimate distribution of these small arteries is, to observe the effect of such a tinging substance as can retain its colour, when swallowed, digested, and mixed with the blood of any living animal, and at the same time has particles small enough to be conveyed into the vessels of the bones; such is *rubia tinctorum*, madder-root: for we see the gradual advances which this tincture makes from the periosteum into the more internal parts of the bones, and how universally the distribution of the liquors is made, the whole bony substance being tinged.—The arteries are larger near each end than at the middle of the large bones that are much moved; and they not only serve the bony plates near the ends, but pass through them to the marrow.—As animals advance in age, the arteries of the bones become less capacious; as is evident, 1. From the bones of adults having less blood in them than those of children have. 2. From many of them becoming incapable in old age of admitting the coloured powders used in injections, which easily pass

in youth. And, 3. From the bones of old creatures being more difficultly tinged with madder than those of young ones.

We may conclude, from arteries being accompanied with veins, so far as we can trace them in every other part of the body, that there are also veins in the bones; and the disappearing of the tincture of madder, after bones of living animals are coloured with it, could not take place without such veins to carry it away; nay, the veins of bones can sometimes be injected, and then seen.

The bones of a living animal are so insensible, that they can be cut, rasped, or burnt, without putting the creature to pain, and the nerves distributed in their substance cannot be shown by dissection; from which it might be inferred that they have no nerves distributed to them: but the general tenor of nature, which bestows nerves to all other parts, should prevent our drawing such a conclusion. And if sensibility is a sure proof of nerves entering into the composition of any part, as it is generally allowed to be, the exquisite sensibility of bones in some of their diseases proves that they are amply supplied.

From what has been said of the vessels of bones, it is evident, that there is a constant circulation of fluids in every part of them; and that there is a perpetual waste and renewal of the particles which compose the solid fibres of bones, as well as of other parts of the body; the addition from the fluids exceeding the waste during the growth of the bones; the renewal and waste keeping pretty near par in adult middle age; and the waste exceeding the supply from the liquors in old age; as is demonstrable from their weight: for each bone increases in weight as a person approaches to maturity; continues of nearly the same weight till old age begins, and then becomes lighter.—The specific gravity of the solid sides, on the contrary, increases by age; for then they become more hard, compact, and dense. In consequence of this, the bones of old people are thinner and firmer in their sides, and have larger cavities than those of young persons.

PERIOSTEUM INTERNUM.

Bones are lined within, as well as covered externally, with a membrane; which is therefore commonly called *Periosteum Internum*.

But the adhesion of this fine membrane to the bone is so small, that it separates commonly more easily from the bone than from the marrow which it contains: wherefore one might call it the common membrane of the marrow, rather than by the name it now has.

From the internal surface of the *internal periosteum*, a great number of thin membranes are produced; which, passing across the cavity, unite with others of the same kind, and form so many distinct bags, which communicate with each other; and these again are subdivided into communicating vesicular cells, in which the marrow is contained: Hence it is that the marrow, when hardened, and viewed with a microscope, appears like a cluster of small pearl; and that the hardened marrow of bones, buried long under ground, or laid some time in water and then dried, is granulous.—This texture is much the same with what obtains in other cellular parts of the body, where fat is collected; only that the cells containing the marrow are smaller than those of the *tunica adiposa* or *cellulosa* elsewhere; which probably is owing to their being enclosed in the bones, where they are not so much stretched or extended as in other parts.

OF THE MARROW.

The *marrow* is separated from the blood by small arteries, and deposited in these cells. Its vessels, wrapt up in one common coat from the periosteum, pass through the bones by very oblique canals, the most considerable of which are about the middle of each bone.

After these arteries have pierced the solid side of a bone, they are divided into several branches; which soon are distributed every where on the internal periosteum, and afterwards spread

their branches inward on the medullary cells, and outward through the tables of the bone.

In Soemmerring's opinion, the use of the marrow is, to render the bones comparatively lighter.

The blood which remains after the secretion of the marrow is returned by proper veins, which are collected from the membranes into one or two large trunks, to pass out at the same holes or passages at which the artery or arteries enter.

The general rule of the small vessels decreasing in their capacities as animals advance in age, to which many phenomena in the animal-œconomy are owing, obtains here: for though the trunks of the medullary vessels enlarge as animals turn older, yet the small branches become smaller, as is evident from injections, which cannot be made to pass near so far in these vessels of adults as of children. Hence the marrow is bloody in children, oily and balmy in middle age, and thin and watery in old people.

By experiments made on the marrow when bones of living animals are opened or cut through, and from the racking pain with which suppurations within bones are frequently attended, we have sufficient proof that the membranes here are sensible, and consequently have nerves distributed to them.

THE DIFFERENT CLASSES, &c. OF BONES.

I shall only mention one striking difference which takes place among bones—a difference which comprehends very near the whole bones of the body, and at the same time leads us to examine the most considerable variety that is to be found in the disposition of their constituent parts, and in their uses. It is this, that some bones are *broad* and *flat*, while others are *long* and *round*.

The *broad* bones have thin sides, by the plates being soon and equally sent off to form the lattice-work; which therefore is closer, and nearly of an equal form all through. By this structure they are well adapted to their uses, of affording a large enough surface for the muscles to rise from and move upon, and of defending sufficiently the parts which they enclose.

The *round* bones have thick strong walls in the middle, and become very thin toward their ends, which is owing to very few plates separating at their middle; where, on that account, the cancelli are so fine and small, that they are not taken notice of. Toward their ends the lattice-work becomes very thick, and rather more complete than in the other sort of bones.—These round bones having strong forces naturally applied to them, and being otherwise exposed to violent injuries, have need of a cylindrical figure to resist external pressure. Besides which, they are advantageously provided with thick sides toward their middle, where the greatest forces are applied to injure them; while, considering them as a given quantity of matter, hollowness increases their diameter, and consequently their strength to resist forces applied to break them transversely. Thus, for instance, in estimating the proportional resistance of two cylindrical bones of unequal diameters, but consisting of an equal number of similar fibres uniformly disposed round each, it is plain,

1. That the absolute* forces of these two bones are equal, because they consist of equal numbers of similar fibres.
2. That the absolute forces of all the fibres in each bone have an effect in resisting any power applied to break them, as if the sum of all their forces was united in a line passing through the respective centres of the transverse sections where the fractures are to be made. For, by hypothesis, the fibres being uniformly disposed in each, there is not any fibre in either bone that has not a corresponding fibre; the sum of both whose distances from the axis of revolution (the above-mentioned central line) about which all the parts of the bone must revolve in breaking, is equal to two semidiameters of the bone: consequently each fibre, and all the fibres, may be regarded as resisting at the distance of one semidiameter or radius from this axis.

3. Since the united force of all the fibres is to be regarded as resisting at a distance from the centre of motion equal to the semidiameter, it follows, that the total resistance of all these fibres,

* That is its strength considered merely with regard to the nature and number of its fibres independent of any specific arrangement, or any diameter resulting from that arrangement.

or the strength of the bone, is proportional to its semidiameter, and consequently to its diameter.

I have here taken for an example one of the most simple cases for calculating the proportional forces of bones. But, were it not too foreign to the present design, it might be universally demonstrated, that of whatever figure bones are, and in whatever manner their fibres are disposed, their strength must always be in a ratio, compounded of the area of their transverse sections, or of their quantity of bony matter, and of the distance of the centre of gravity of these sections from the centre of motion or fulcrum, on which the bone is supposed to be broken.

Since, therefore, the strength of bones depends on their number of fibres, or quantity of matter, and the largeness of their diameters, one may conclude, that the part of a bone formerly fractured, and reunited by a *callus*, must be stronger than it was before the fracture happened; which is a wise provision, since bones are never set in such a good direction as they were naturally of.

Many bones have protuberances or *processes* rising out from them. If a process stands out in a roundish ball, it is called *caput* or *head*.—If the head is flatted, it obtains the appellation of *condyle*.—A rough unequal protuberance is called *tuberosity*.—When a process rises narrow, and then becomes large, the narrow or small part is named *cervix* or *neck*.—Long ridges of bones are called *spines*.—Such processes as terminate in a sharp point have the general name of *coronæ* or *coronoid* bestowed on them; though most of them receive particular names from the resemblance they have, or are imagined to have, to other substances, *e. g. mastoid, styloid, anchonoid, coracoid, spinal, &c.*—Such processes as form brims of cavities, are called *supercilia*.

Processes serve for the advantageous origin and insertion of muscles, and render the articulations firm and stable.

On the surfaces of a great many of the bones there are cavities or depressions. If these are deep, with large brims, authors name them *cotylloid*.—If they are superficial, they obtain the designation of *glenoid*. These general classes are again divided into several species:—of which, *pits* are small roundish channels

sunk perpendicularly into the bone ;—*furrows*, long narrow canals formed in the surface ;—*notches* or *notches*, small breaches in the bone ;—*sinuosities*, broad, but superficial depressions without brims ;—*fossæ*, large deep cavities, which are not equally surrounded by high brims ;—*sinuses*, large cavities within the substance of the bones, with small apertures ;—*foramina*, or holes, canals that pierce quite through the substance of the bones.—When this last sort of cavity is extended any long way within a bone, the middle part retains the name of *canal*, and its ends are called *holes*.

The cavities allow the heads of bones to play in them ; they lodge and defend other parts ; they afford safe passage to vessels, muscles, &c.

To far the greater number of bones, whose ends are not joined to other bones by an immoveable articulation, there are smaller ones annexed, which afterward become scarce distinguishable from the substance of the bone itself. These are called *epiphyses* or *appendices*. Some bones have one, others have two, three, or four of those appendices annexed by the means of cartilages, which are of a considerable thickness in children, but by age become thinner ; the ossification proceeding from the end of the bone on one side, and from the epiphyses on the other, till at last, in adults, the place of their conjunction can scarcely be seen on the external surface ; and it is only sometimes that we can then see any mark of distinction in the cancelli. Many of the processes in adult bones are in the foetus mere epiphyses.

Several processes (*e. g.* *trochanters* of the thigh, *spine* of the scapula, &c.) have *epiphyses* ; and epiphyses likewise frequently have *processes* ; for example, at the lower end of the femur, tibia, &c.

The epiphyses are united chiefly to such bones as are destined for much motion ; and for this purpose they are wisely framed of a larger diameter than the bone they belong to : for, by this means, the surface of contact between the two bones of any articulation being increased, their conjunction becomes firmer, and the muscles inserted into them act with greater force, by reason of their axes being further removed from the centre of motion. These advantages might indeed have been obtained by the expan-

sion of the end of the bone itself to a thickness equal to that of the epiphyses ; but then the constant separation of new plates to form so wide a cellular structure, must have left the solid sides of the bones so thin as to yield easily, either to the action of the muscles fixed to them and passing over them, to the weight several of them are obliged to support, or to the application of any other external force.

As at the conjunction of the epiphyses and bone, the latter remains longer soft than any where else, and the adhesion of the periosteum and of ligaments to bones is always stronger in proportion to the bones being nearest to the consistence of those parts, which is, being softest, the connection of the ligaments where the bones and epiphyses join, is the stronger.

The softness of the ends of bones may be of advantage in the womb and at birth ; after which the ossification begins at different points to form epiphyses, before it can extend from the middle to the ends of the bones.

OF THE CONNECTION OF BONES.

Having thus considered the bones when single, we ought next to show the different manner of their conjunctions. To express these, anatomists have contrived a great number of technical terms ; about the meaning, propriety, and classing of which, there has unluckily been variety of opinions. Some of these terms it is necessary to retain, since they serve to express the various circumstances of the articulations, and to understand the writers on this subject.

The ARTICULATIONS are most commonly divided into three classes, viz. Symphysis, Synarthrosis, and Diarthrosis.

I. SYMPHYSIS, which properly signifies the conception or growing together of parts, when used to express the articulations of bones, does not seem to comprehend, under the meaning generally given to it, any thing relating to the form or motion of the conjoined bones ; but by it most authors only denote the bones to be connected by some other substance ; and as there are different substances which serve this purpose, therefore they divide it into the three following species.

1. *Synchondrosis* when a cartilage is the connecting substance : thus the ribs are joined to the sternum ; thus the bodies of the vertebræ are connected to each other ; as are likewise the ossa pubis.

2. *Synneurosis* or *syndesmosis*, when ligaments are the connecting bodies, as they are in all the moveable articulations.

3. *Syssarcosis*, when muscles are stretched from one bone to another, as they must be where there are moveable joints.

II. The second class of articulations, the *SYNARTHROSIS*, which is said to be the general term by which the immoveable conjunction of bones is expressed, is divided into three kinds.

1. The *suture* is that articulation where two bones are mutually indented into each other, or as if they were sewed together ; and is formed by the fibres of two bones meeting while they are yet flexible and yielding, and have not come to their full extent of growth ; so that they mutually force into the interstices of each other, till, meeting with such resistance as they are not able to overcome, they are stopped from sprouting out further, or are reflected ; and therefore these indentations are very different both in figure and magnitude : thus the bones of the head are joined ; thus epiphyses are joined to the bones, before their full connection and union with them.

Under this title of *suture*, the *harmonia* of the ancients may be comprehended ; scarce any unmoved bones being joined by plain surfaces.

2. *Gomphosis* is the fixing one bone into another, as a nail is fixed in a board : thus the teeth are secured in their sockets.

3. *Schindylesis*, when a thin lamella of one bone is received into a long narrow furrow of another : thus the processus azygos of the sphenoid, and the nasal process of the ethmoid bone, are received by the vomer.

III. The third class, or *DIARTHROSIS*, is that conjunction of bones whereby they are fitted for motion, being each covered with a smooth cartilage, connected by one or more common ligaments, and lubricated with liquor at the conjoined parts : in which definition I have no regard to the quantity of motion which they really do perform ; the motion being often confined or enlarged by some other cause not immediately depending on

the frame of the two surfaces of the bones forming the particular joint which then is considered.—This is subdivided into three kinds.

1. *Enarthrosis*, or ball and socket, that articulation where a round head of one bone is received into a cavity of another; and consequently, without some foreign impediment, is capable of motion to all sides. Examples of this kind are to be seen in the articulation of the thigh-bone and ossa innominata; arm-bone and scapula; astragalus and os naviculare; magnum of the wrist with the scaphoides and lunare; first bone of the thumb with the second, &c.

2. The *Arthrodia*, differing from the enarthrosis, only in the cavity's being more superficial, ought to be called with Vesalius, that articulation of two bones adapted for motion, where it is not at first sight obvious which of the two has the head or cavity, or whether they are joined by plain surfaces, or nearly so; such is the conjunction of the clavicle with the scapula, ossa cuneiformia with the os naviculare, metatarsal bones with the ossa cuneiformia, &c. From the nature of this sort of joint, it is plain, that very great motion cannot be allowed, without the bones going further out of their natural situation than is convenient or safe.

3. *Ginglimus*, I would reckon that articulation by the form of which the motion of the joined bones must be chiefly confined to two directions, as hinges of doors are.

a. The first species of this is the *trochoides*, when one bone turns on another, as a wheel does on its axis. Thus the first vertebra of the neck moves on the toothlike process of the second.

b. The second species, or *ginglimus simplex*, should be esteemed that articulation where several prominent and hollow surfaces of two bones move on each other within the same common ligament; as in the knee, elbow, &c.

c. The third sort of *ginglimus* is the *ginglimus compositus*, when two bones are articulated to each other at different parts, with a distinct apparatus of the motory machines at each: such is the articulation of the os occipitis with the first vertebra of the neck; of any two contiguous vertebræ by their oblique processes; of the ribs with the bodies and transverse processes of the verte-

bræ; of the radius with the ulna, tibia with the fibula, astragalus with the calcaneum, &c.

If the moveable bones were not connected and kept firm by some strong substance, they would be luxated at every motion of the joints; and if their hard, rough unequal surfaces were to play on each other, their motion would not only be difficult, but the loss of substance from attrition would be great. Therefore ligaments are made to obviate the first, and cartilages to prevent the other inconveniency. But because ligaments and cartilages turn rigid, inflexible, and rough, unless they are kept moist, a sufficient quantity of proper liquors is supplied for the lubrication, and to preserve them in a flexible state. Seeing, then, these parts are so necessary to the articulations, we shall next consider their structure, situation, and uses, so far as they are subservient to the bones and their motions.

OF THE LIGAMENTS.

Ligaments serve to connect one part to another, or to prevent the parts to which they are fixed from being removed out of that situation which is useful and safe.

After maceration in water, the ligaments can easily be divided; and each ligamentous layer appears composed of fibres, the largest of which are disposed in a longitudinal direction.

The arteries of ligaments are very conspicuous after a tolerable injection, and the largest trunks of their veins are sometimes to be seen full of blood.

Such ligaments as form the sides of cavities, have numerous orifices of their arteries opening upon their internal surface, which keep it always moist. If we rub off that moisture, and then press the ligament, we can see the liquor oozing out from small pores; and we can force thin liquors injected by the arteries into the cavities of the joint.

These arteries must have corresponding absorbents, otherwise the cavities would soon be too full of liquor.

Authors generally say that ligaments are insensible; and consequently it may be inferred, that they have no nerves bestowed

on them. But the violent pain felt in several diseases persuade us that they are abundantly supplied with nerves.

The ligaments which connect the moveable bones commonly rise from the conjunction of the epiphyses of the one bone, and are inserted into the same place of the other; or, where epiphyses are not, they come out from the cervix, and beyond the supercilia of the articulated bones; and after such a manner, in both cases, as to include the articulation in a purse or bag; with this difference, depending on their different motions, that where the motion is only to be in two directions, the ligaments are strongest on those sides toward which the bones are not moved; and when a great variety of motions is designed to be allowed, the ligaments are weaker than in the former sort of articulations, and are nearly of the same strength all round.

Part of the capsular ligaments is composed of the periosteum, continued from one bone to another, and their internal layer is continued on the parts of the bone or cartilage which the ligament includes.

Besides these common capsular ligaments of the joints, there are particular ones in several places, either for the firmer connection of the articulated bones, or for restraining and confining the motion to some one side; such are the *cross* and *lateral* ligaments of the knee, the *round* one of the thigh, &c.

From this general account of the ligaments, we may conclude, that, *cæteris paribus*, in whatever articulation the ligaments are few, long, and weak, the motion is more free and quick; but luxations happen frequently: and, on the contrary, where the ligaments are numerous, short, and strong, the motion is more confined; but such a joint is less exposed to luxation.

Ligaments also supply the place of bones in several cases to advantage. Thus the parts in the pelvis are more safely supported below by ligaments than they could have been by bone.—The ligaments placed in the great holes of the ossa innominata and between the bones of the fore-arm and leg, afford convenient origin to muscles.—Immoveable bones are firmly connected by them; of which the conjunction of the os sacrum and innominatum is an example.—They afford a socket for moveable bones.

to play in, as we see part of the astragalus does on the ligament stretched from the heel bone to the scaphoid.

OF THE CARTILAGES.

Cartilages are covered with a membrane named *perichondrium*; which is of the same structure and use to them as the periosteum is to the bones.

They are composed of plates, which are formed of fibres, disposed much in the same way as those of bones are. This may be confirmed by the exfoliation which cartilages are subject to as well as bones.

The perichondrium of several cartilages, for example those of the ribs and larynx, has arteries, which can be equally well injected with those of the periosteum; but the vessels of that membrane in other parts, *e. g.* the articular cartilages, are smaller, and in none of them does injection enter deep into the substance of the cartilages; nay, madder, mixed with the food of animals, does not change the colour of cartilages as it does that of bones.

The granulated flesh which rises from the ends of metacarpal or metatarsal bones, when the cartilage exfoliates, after a finger or toe has been taken off at the first joint, is very sensible; from which the existence of nerves in cartilages may be inferred.

While cartilages are in a natural state, it is to be remarked, first, That they have no cavity in their middle. Secondly, That their outer surface is softest, which renders them more flexible. And, lastly, That as the specific gravity of cartilages is near a third less than that of bones; so the cohesion of their several plates is not so strong as in bones: whence cartilages laid bare in wounds or ulcers, are not only more liable to corrupt, but exfoliate much sooner than bones do.

Cartilages seem to be principally kept from ossifying, either by being subjected to alternate motions of flexion and extension, the effects of which are very different from any kind of simple pressure; or by being constantly moistened. Thus the cartilages on the articulated ends of the great bones of the limbs, and the moveable ones placed between the moving bones in some articulations, which are to suffer many and different flexions, and are

plentifully moistened, scarce ever change into bone ; while those of the ribs and larynx are often ossified.—The middle angular part of the cartilages of the ribs, which is constantly in an alternate state of flexion and extension, by being moved in respiration, is always the last of becoming bony.—In the larynx, the epiglottis, which is oftener bended and more moistened than the other four cartilages, seldom is ossified, while the others as seldom escape it in adults.

Cartilages are sometimes found on the ends of bones which are joined to no other ; but are never wanting on the ends and in the cavities of such bones as are designed for motion. Cartilages also are interposed between such other cartilages as cover the heads and cavities of articulated bones ; nay, they are also placed between immoveable bones.

The *uses* of cartilages, so far as they regard bones, are, to allow, by their smoothness, such bones as are designed for motion, to slide easily without detrition, while, by their flexibility, they accommodate themselves to the several figures necessary in different motions, and, by their elasticity, they recover their natural position and shape as soon as the pressure is removed.—This springy force may also assist the motion of the joint to be more expeditious, and may render shocks in running, jumping, &c. less.—To these cartilages we chiefly owe the security of the moveable articulations : for, without them, the bony fibres would sprout out, and intimately coalesce with the adjoining bone ; whence an anchylosis must necessarily follow ; which never fails to happen when the cartilages are eroded by acrid matter, or ossified from want of motion or defect of synovial fluid. The moveable cartilages interposed in joints serve to make the motions both freer and more safe than they would otherwise be. Cartilages sometimes serve as ligaments, either to fasten together bones that are immoveably joined, such are the cartilages between the os sacrum and ossa ilium, the ossa pubis, &c. or to connect bones that enjoy manifest motion, as those do which are placed between the bodies of the true vertebræ, &c.—Cartilages very often do the office of bones to greater advantage than these last could ; as in the cartilages of the ribs, those which supply brims to cavities, &c.

OF THE SYNOVIA.

The liquor which principally serves to moisten the ligaments and cartilages of the articulations is supplied by glands, which are commonly situated in the joint, after such a manner as to be gently pressed, but not destroyed by its motion. By this means, when there is the greatest necessity for this liquor, that is, when the most frequent motions are performed, the greatest quantity of it must be separated. These glands are soft and pappy, but not friable: in some of the large joints they are of the conglomerate kind, or a great number of small glandules are wrapt up in one common membrane. Their excretory ducts are long, and hang loose, like so many fringes, within the articulation; which, by its motion and pressure, prevents obstructions in the body of the gland or its excretories, and promotes the return of this liquor, when fit to be taken up by the absorbent vessels; and, at the same time, the pressure on the excretory ducts hinders a superfluous secretion, while the fimbriated disposition of these excretories does not allow any of the secreted liquor to be pushed back again by these canals towards the glands.

Very often these fountains of slimy liquor appear only as a net-work of vessels.---Frequently they are almost concealed by cellular membranes containing the fat---and sometimes small simple mucous folliculi may be seen.

The different joints have these organs in different numbers and sizes: the conglomerate ones do not vary much, especially as to situation, in the similar joints of different bodies; but the others are more uncertain.

Upon pressing any of these glands with the finger, one can squeeze out of their excretories a mucilaginous liquor, which somewhat resembles the white of an egg, or serum of the blood; but it is manifestly salt to the taste.

The quantity of this mucilage, constantly supplied, must be very considerable, since we see what a troublesome discharge of glairy matter follows a wound or ulcer of any joint: of which liquor the mucilage is a considerable part.

The vessels which supply liquors for making the secretion of

this mucilage, and the veins which bring back the blood remaining after the secretion, are to be seen without any preparation ; and, after a tolerable injection of the arteries, the glands are covered with them.

In a sound state we are not conscious of any sensibility in those glands : but, in some cases which I have seen, when they inflame and suppurate, the most racking pain is felt in them : a sure proof that they have nerves.

The synovia, as this liquor of the joints is called, while in a sound state, effectually preserves all the parts concerned in the articulations soft and flexible, and makes them slide easily on each other, by which their mutual detrition and overheating is prevented. After the liquor of the articulations becomes too thin and unserviceable, by being constantly rubbed between the moving bones, it is reassumed into the mass of blood by the absorbents.

SECTION III.

OSTEOGENY.

BONES consist of membranes and cretaceous particles, which are peculiar to the bony parts alone in healthy animals, and will appear to be what really form these substances, the membranes being only either what surround and keep the bony particles and fibres together, or vesicular coats.

The bony particles in *fætuses* begin to be deposited or to shoot either between membranes or within cartilages.

Those which shoot between membranes are what form most of the hardest and most solid of foetal bones, and appear much sooner than the others, which compose all the *epiphyses*, and such bones only as are supplied for some time by cartilages of nearly the same shape which those parts possess when they become bony.

The texture of that species of ossification, which is produced between the membranes, by a careful and proper examination, may be seen to be of small particles, so joined together, as to form fine bony threads or fibres, which are disposed differently according to the different formation of each bone, and of its several parts. This is most visible in thin and broad bones, especially in some of those which form the *cranium*, as you see in the parietal bone of a *fætus* about ten or twelve weeks after conception, in which the beginning of an ossification appears, not as has been generally described to be only in the centre, and from thence to shoot as *radii* to a circumference ; but, like an *exceeding fine irregular piece of net-work*, the middle of which is much closer and finer than the circumference, and is so thin that without the greatest care it cannot be taken from between the membrane which covers it.

In preparations of subjects a little older, you may observe the bony particles to be gradually multiplied, and so conjoined as to produce the appearance of small fine bony threads or fibres, which then appear a little like *radii* shooting from a centre.

All the small furrows or vacancies between these fibres, which cause them to appear distinct, and thus to resemble *radii*, have by injections been demonstrated to be only passages for blood-vessels. And as the *fœtus* grows bigger, you may perceive that the bony fibres by degrees increase in number, until they permit no new matter to be deposited between them. Thus a single *lamina* or plate of this sort of bone is produced.

As the bone continues to grow and increase in size every way, many *strata* of similar plates are, by the bony fibres shooting on one another, in the manner just described, gradually generated, by which the more solid part of a bone is formed.

It is observable, that the inner *laminæ* are less solid and more porous than the exterior ; and none of them acquire the solidity they usually are found to have in adults, until the part has entirely done growing in bulk.

After much the same manner those *laminæ* are formed, of which the more solid part of the cylindrical bones consist. Their ossifications begin, while the circumference of the part is not larger than a small pin, in the form of a broad flat ring, which surrounds the internal *periosteum*, and is surrounded by the external.

In these bones the interior *laminæ* are never so long as the exterior, or at least do not run so far in straight lines, because on the number of plates depends the extraordinary solidity of the bone about its middle, which gradually decreases towards its extremes, probably by the recession of these *laminæ*.

In like manner the more solid part of the palate, maxillary, and all other irregular shaped bones, which are generated between membranes, are composed of bony fibres, that shoot differently, according to their various figures and forms.

What seems in perfect bony *laminæ* to be pores, are passages for blood-vessels : and the cellular or cavernous parts of bones are receptacles for the *folliculi* of marrow, to the intervention of which the cells or cavities owe their formation. For as the marrow increases, the bony particles assume a form proper for containing the medullary bags.

If the clavicle, which is a cylindrical bone, be accurately examined, when it is so small, as not to weigh the fourth part of

a grain, which is not more than the two thousandth part of the weight of a full grown one, it will be always found to be nearly of the same shape as adult ones usually are, and perfect bone, with its *periosteum* covering it ; but it has no more cartilage, or the least resemblance of one in or over any part of it, than, in proportion to its size, such bones are found to have, when they have done growing.

In like manner the same appearance of ossification without cartilage, you may always find in those of the palate, upper jaw, and nose, when some of them are so small, as scarcely to be distinguished without the help of a glass, and as thin as an exceeding fine membrane.

The teeth likewise are always found to be generated and accreted without having any cartilage or cartilaginous substance in or near them, from their first appearance to the time of their maturity.

The other species of ossification, which first appears within a cartilage, begins late, and at very distant times in different parts. Its soonest appearance, which is either in the *ossa ilii*, or some of the *vertebræ*, is not before the *fœtus* is more than two months old, and it latest is not until many years after birth. This species of ossification either begins in a point, and round that gradually accretes until the part arrives at maturity : or the bony particles are deposited in various parts of the cartilage in distinct clusters irregularly situated ; all which afterwards perfectly unite.

Those cartilages of almost full grown *fœtuses*, in which are to be found either tendencies to ossify, or ossifications just beginning, plainly shew that not one bony particle is to be perceived, or felt, before there is a visible influx into the cartilages of a fluid different from what used to flow through them. In sections of ossifying *epiphyses*, you may see both in that which has no visible bony particles, and in others which have a few, many of those vessels, which while the part continued totally cartilaginous without a tendency to ossify, were too fine to be distinguished or perceived by the greatest magnifying microscopes, and consequently too small too admit the red globules of blood to flow freely through them, appear to be, by a more

than usual afflux of fluid into them, so much dilated, as to receive a quantity of red globules, sufficient to make some part of them distinctly visible to the naked eye, and to cause in, near, and round the place, where the ossification is to begin, always when just begun to be apparent, and frequently after it is considerably increased, the appearance of an inflammation.

The first small particles of bone, which become visible, are always in that part of the cartilage, which has the greatest quantity of red fluid appearing in it: they are not always placed close together, but often at small distances from each other.

In some of the vessels, which are much dilated and appear full of blood, or a fluid very similar to it, there may often be felt, with the point of a knife, hard gritty particles, which are bony.

In some *epiphyses*, there are often three or more very considerable vessels going to and penetrating the ossifications, within which vessels, at their ends, near the ossification, you will rarely miss feeling, by a fine instrument, bony particles. And if the cartilage be slit into thin pieces, and dried flat between two plane glasses, there are often to be distinguished by the naked eye, though oftener by the help of a microscope, in these dilated vessels, what seem to have the appearance of bony particles. In the little red specks, which sometimes appear with one or more small vessels ending in them, on sections of *fœtal epiphyses*, bony particles are generally to be felt, and sometimes even seen.

Thus much is evident, from *fœtal* preparations, of the manner in which these sort of bones begin, and continue until birth to be generated; but on examination of the same parts in children, three or four years after birth, the like *phænomena* will be much more apparent, because the vessels, which enter the ossifying parts, are considerably larger, and consequently their contents more easily discovered. Moreover, you will seldom, if ever, fail of finding in the large *epiphyses*, particularly those at the bottom of the thigh bones of children between three and six years of age, considerable vessels, containing bony particles and a red fluid. And at the same time you may observe the progress of these ossifications to be after birth less uniform, and

not so close together as they are always found to be in *fætuses*, but irregularly deposited round, and joined to that part, which first began to ossify. In various parts also of the cartilage, which you find between the ossifications, there are frequently to be seen dilated vessels partly filled with bony matter.

Most of this sort of bones are very spongy and cellular; and have the size and figure of their cells, which are generally small, regulated by the medullary and vesicular substances contained within them: and their external and more solid parts are composed of bony threads, which are disposed according to the shape of the part, in the same manner as has been observed of the other species of ossification.

Very soon after the *vertebræ*, and such parts as do not remain very long after conception wholly cartilaginous, begin to ossify, their increase is so manifestly more from the accretion of the bones, than the cartilages, that long before those bones arrive at half the size of adult ones, the cartilaginous substances decrease, and gradually, as the bones grow, become so thin, as to seem to be entirely destroyed, except next the joints, where cartilages remain for the benefit of the articulations, and continue in healthy subjects to grow, and receive nutrition, as long as any other part of the body.

How little *fætal* bones are dependent on the cartilages, in which they are generated, may be made apparent, if any of them, while the cartilages entirely or almost surround the bone, be kept a sufficient time in water; for then, on only slitting the cartilage, the bone will, as soon as the large vessels that enter its substance are divided, slip as easily, if not easier, from it, than an acorn from its cup. And by the smoothness and polish of the parts of both cartilage and bone, which were in contact, it is very manifest, there could be no intermixture of their particles, or continuation of the fibres of one substance to those of the other.

Even in the recent subject, the cartilage, which joins at birth part of the *os occipitis* to the hinder part of the *petrosum*, just beyond the place where the mammillary *apophysis* is afterwards formed, demonstrates, that there is no conjunction or union of the fibres of these two substances. For as soon as the *pericra-*

anium and *dura mater* are removed, the cartilage, by gently pulling, will separate or come from the bone without the least laceration of its fibres.

As the solidity of bones increases, their *periosteum* more easily separates from them. When bones are membranous, the *periosteum* and they cannot be distinguished; they appear to be the same substance. When they are cartilages, their membrane adheres so firmly to them, that it is difficult to separate it from them. Where the rigid bony fibres exist, the *periosteum* is easily taken off.

The ossification of bones therefore depends principally on their vessels being so disposed, and of such diameters, as to secrete the osseous particles; but it is also greatly assisted by their being exposed, more than any other parts, to the strong pressure of the great weights they support, to the violent contraction of the muscles fixed to them, and to the force of the parts they contain, which endeavour to make way for their own further growth. By all this pressing force, the solid fibres and vessels of bones are thrust closer; and such particles of the fluids conveyed in these vessels as are fit to be united to the fibres, are sooner and more firmly incorporated with them, while the remaining fluids are forcibly driven out by the veins, to be mixed with the mass of blood. In consequence of this, the vessels gradually diminish as the bones harden. This is one reason, why the bones of young animals sooner reunite after a fracture than those of old, and why cattle that are put too soon to hard labour, seldom are of such large size as others of the same brood who are longer kept from labour.

That the ossifying of bones greatly depends on pressure, seems to be evinced from the frequent examples we meet with of other parts turning bony, when long exposed to the pressing force of the surrounding parts, or when they are subjected to the like circumstances by their own frequent and violent contraction. Witness, the bones found frequently near the base of the heart in some old men, and in several other creatures. Nay, the muscular substance of the heart has been ossified in such, and the arteries of old men often become bony.—The cartilages of the *larynx* are generally ossified in adults.—In beasts of burden,

the cartilages between the *vertebræ* of the back very often change into complete bones; and, being intimately united with the *vertebræ*, the whole appears one continued bone.---Nor is the *periosteum* exempted from such an induration.

To confirm this argument still further, we may again observe, that bones begin their ossification at the places where they are most exposed to these causes, viz. in the cylindrical bones from a middle ring, and in the broad ones, at or near their centre, from one or more distinct points. The reason of which is, that these parts are contiguous to the bellies of the muscles annexed to the bones, where the swelling of these moving powers is greatest. What the effects of this may be, let any judge, who view some of the bones, as the *scapula*, and *ossa ilium*, which are covered with muscles on each side; how compact and thin they are in adults, where the bellies of the muscles were lodged; whereas, in children, whose muscles have not been much exercised, they are thicker.

From the effects of pressure only it is, that we can account for the bones of old people having their sides much thinner, yet more dense and solid, while the cavities are much larger than in those of young people; and for the prints of muscles, vessels, &c. being so much more strongly marked on the surfaces of the former than of the latter, if they belong to people of near the same condition in life.---Pressure must likewise be the cause, which, in people of equal ages, makes these prints stronger in the bones of those who have had much labour and exercise, than they are in people who have led an indolent unactive life.

Perhaps both the causes of ossification above-mentioned, may be assisted by the nature of the climate people live in, and the food they use.

These are the most important phenomena of the two species of ossification; but the particular state of the ossific process in each bone, at any given period, cannot be described until the adult bones themselves have been minutely explained, and therefore to the description of each of these shall be subjoined its condition in children born at the ordinary time. The following rules however must be attended to.

1. Wherever we mention any parts being cartilaginous, or still separable from the other parts of the bone to which they belong, it must be understood, that, about seven or eight years of age, such parts are ossified and united to their proper bones, unless when it is said, that they are afterwards formed into *epiphyses*.

2. Such as become *epiphyses*, are generally ossified at seven or eight years of age; though not, even then, united to their bones.

3. At eighteen or twenty years of age the *epiphyses* are entirely ossified, and have blended their fibres so with the body of the bone, as to make them inseparable without violence.

SECTION IV.

OSTEOLOGY.

OF THE SKELETON.

THOUGH any dry substance may be called *skeleton*, yet, among anatomists, this word is universally understood to signify the bones of animals connected together, after the teguments, muscles, bowels, vessels, glands, and nerves, are taken away.

A skeleton is said to be a *natural* one when the bones are kept together by their own ligaments; and it is called *artificial* when the bones are joined with wire, or any other substance which is not part of the creature to which they belonged.

Before we proceed to the division and particular description of the skeleton, it is worth while to remark, that, when the bones are put into their natural situation, scarce any one of them is placed in a perpendicular bearing to another; though the fabric composed of them is so contrived, that, in an erect posture, a perpendicular line, from their common centre of gravity, falls in the middle of their common base. On this account we can support ourselves as firmly as if the axis of all the bones had been a straight line perpendicular to the horizon; and we have much greater quickness, ease, and strength, in several of the most necessary motions we perform. It is true, indeed, that wherever the bones, on which any part of our body is sustained, decline from a straight line, the force required in the muscles to counteract the gravity of that part is greater than otherwise it needed to have been, an uneasy sensation is produced, and we become *weary of one posture*: an inconvenience that we should not have had in standing erect, if the bearing of all the bones to each other had been perpendicular; but which is more than compensated by the advantages above-mentioned.

The human skeleton is generally divided into the HEAD, the TRUNK, the SUPERIOR and the INFERIOR EXTREMITIES.

OF THE HEAD.

BY the HEAD is meant all that spheroidal part which is placed above the first bone of the neck. It therefore comprehends the cranium and bones of the face.

THE CRANIUM.

The cranium, or brain-case, consists of several pieces, which form a vaulted cavity, for lodging and defending the brain and cerebellum, with their membranes, vessels, and nerves.

The cavity of the cranium is proportioned to its contents. Hence such a variety of its size is observed in different subjects; and hence it is neither so broad or so deep at its fore-part, in which the anterior lobes of the brain are lodged, as it is behind, where the large posterior lobes of the brain, and the whole cerebellum, are contained.

The roundish figure of the skull, which makes it more capacious, and better able to defend its contents from external injuries, is chiefly owing to the equal pressure of these contained parts as they grow and increase before it is entirely ossified.—It is to be observed, however, that the sides of the cranium are depressed below a spherical surface by the strong temporal muscles, whose action, probably, hinders here the uniform protrusion of the bones, which is more equally performed in other parts where no such large muscles are. In children, whose muscles have not acted much, and consequently have not had great effects on the bones, this depression is not so remarkable; and, therefore, their heads are much rounder than in adults. These natural causes, differently disposed in different people, produce a great variety in the shapes of skulls, which is still increased by the different management of the heads of children when very young: so that one may know a Turk's skull by its globular figure, a German's by its breadth and flatness of the occiput, Dutch and English by their oblong shapes, and an African's by its narrowness. Two advantages are reaped from this flatness of

the sides of the cranium, viz. the enlargement of our sphere of vision, and more advantageous situation of our ears for receiving a greater quantity of sound, while they are less exposed to injuries.

The external surface of the upper part of the cranium is very smooth and equal, being only covered with the periosteum (common to all the bones, but in the skull distinguished by the name of *pericranium*), the thin frontal and occipital muscles, their tendinous aponeurosis, and with the common teguments of the body; while the external surface of its lower part has numerous risings, depressions, and holes, which afford convenient origin and insertion to the muscles that are connected to it, and allow safe passage for the vessels and nerves that run through and near it.

The internal surface of the upper part of the skull is commonly smooth, except where the vessels of the dura mater have made furrows in it, while the bones were soft. In the upper part of the internal surface of several skulls, there are likewise pits of different magnitudes and figures, which seem to be formed by some parts of the brain being more luxuriant and prominent than others. Where these pits are, the skull is so much thinner than any where else, that it is often rendered diaphanous, the two tables being closely compacted without a diploe; the want of which is supplied by vessels going from the dura mater into a great many small holes observable in these pits. These vessels are larger, and much more conspicuous than any others that are sent from the dura mater to the skull; as evidently appears from the drops of blood they pour out, when the skull is raised from the dura mater in a recent subject. The internal base of the skull is extremely unequal, for lodging the several parts and appendices of the brain and cerebellum, and allowing passage and defence to the vessels and nerves that go into or come out from these parts.

The bones of the cranium are composed of two tables, and intermediate cancelli, commonly called their *diploe*. The external table is thickest; the inner, from its thinness and consequent brittleness, has got the name of *vitrea*. The diploe has

much the same texture and uses in the skull as the cancelli have in other bones. In several old subjects it is so obliterated, that scarce any vestige of it can be seen; neither is it observable in some of the hard bones at the base of the skull. In other people, the diploe becomes of a monstrous thickness, while the tables of the skull are thinner than paper.

The cranium consists of eight bones, six of which are said to be proper, and the other two are reckoned common to it and to the face.---The six proper are the *os frontis*, two *ossa parietalia*, two *ossa temporum*, and the *os occipitis*.---The common are the *os ethmoides* and *sphenoides*.

The *os frontis* forms the whole fore-part of the vault; the two *ossa parietalia* form the upper and middle part of it; the *ossa temporum* compose the lower part of the sides; the *os occipitis* makes the whole hinder part, and some of the base; the *os ethmoides* is placed in the fore-part of the base, and the *os sphenoides* is in the middle of it.

THE SUTURES.

The above bones are joined to each other by five sutures; the names of which are the *coronal*, *lambdoidal*, *sagital*, and two *squamous*.

The *coronal* suture is extended over the head, from within an inch or so of the external canthus of one eye, to the like distance from the other; which being near the place where the ancients wore their coronæ, or garlands, this suture has hence got its name.---Though the indentations of this suture are conspicuous in its upper part, yet an inch or more of its end on each side has none of them; for it is squamous and smooth there.

The *lambdoidal* suture begins some way below, and farther back than the vertex or crown of the head, whence its two legs are stretched obliquely downward, and to each side in form of the Greek letter Λ , and are now generally said to extend themselves to the base of the skull: but formerly anatomists very

properly reckoned the proper lambdoidal suture to terminate at the additamentum suturæ squamosæ; and what is extended at an angle down from that on each side, where the indentations are less conspicuous than in the upper part of the suture, they called *additamentum suturæ lambdoidis*.

This suture is sometimes very irregular, being made up of a great many small sutures, which surround so many little bones that are generally larger and more conspicuous on the external surface of the skull than internally. These bones are generally called *triquetra* or *Wormiana*: but some other name ought to be given them, for they are not always of a triangular figure, and older anatomists than Olaus Wormius have described them. Anatomists generally agree, that their formation is owing to the ordinary bones of the cranium not extending their ossification far enough or soon enough, and to the formation of new ones. Such bones are sometimes seen in other sutures, as well as in the lambdoidal; and they are sometimes in one table of the skull, and not in the other.

The *sagittal* suture is placed longitudinally in the middle of the upper part of the skull, and commonly terminates at the middle of the coronal and of the lambdoidal sutures; between which it is said to be placed, as an arrow is between the string and bow. However, this suture is frequently continued through the middle of the os frontis down to the root of the nose. Among the skulls which we have seen thus divided, the female are the most numerous.

In some old skulls, there is scarce a vestige of any of the three sutures which we have now described. In other heads, one or two of the sutures only disappear.

The *squamous agglutinations*, or *false sutures*, are one on each side, a little above the ear, of a semicircular figure, formed by the overlapping (like one scale upon another) of the upper part of the temporal bones on the lower part of the parietal, where, in both bones, there are a great many small risings and furrows, which are indented into each other; though these inequalities do not generally appear much till the bones are separated. That which is commonly called the posterior part of this

squamous suture, always has the evident serrated form; and therefore is reckoned a distinct suture, under the name of *additamentum suturæ squamosæ*.

We ought here to remark, that the true squamous sort of suture is not confined to the conjunction of the temporal and parietal bones, but is made use of to join all the edges of the bones on which each temporal muscle is placed: for the two parts of the sphenoidal suture which are continued from the anterior end of the common squamous suture just now described, of which one runs perpendicularly downwards, and the other horizontally forwards, and also the lower part of the coronal suture already taken notice of, may all be justly said to pertain to the squamous suture.—The manner how this sort of suture is formed at these places is, that, by the action of the strong temporal muscles on one side, and by the pressure of the brain on the other, the bones are made so thin, that they have not large enough surfaces opposed to each other to stop the extension of their fibres in length, and thus to cause the common serrated appearance of sutures, but the narrow edge of the one bone slides over the other.

The bones of the skull are joined to those of the face, by schyndeleses and sutures.—The schyndeleses is in the partition of the nose.—The sutures said to be common to the cranium and face are five, viz. the ethmoidal, sphenoidal, transverse, and two zygomatic.—Parts, however, of these sutures are at the junction of the bones of the skull alone.

The *ethmoidal* and *sphenoidal* sutures surround the bones of these names; and in some places help to make up other sutures, particularly the *squamous* and *transverse*; and in other parts there is but one suture common to these two bones.

The *transverse* suture is extended quite across the face, from the external canthus of one orbit to the same place of the other, by sinking from the canthus down the outside of the orbit to its bottom; then mounting upon its inside, it is continued by the root of the nose down the internal part of the other orbit, and rises up again on its outside to the other canthus. It may be here remarked, that there are some interruptions of this suture

in the course I have described ; for the bones are not contiguous every where, but are separated, to leave holes and apertures, to be mentioned hereafter.

The *zygomatic* sutures are one on each side, being short and slanting from above obliquely downward and backward, to join a process of the cheekbone to one of the temporal bones, which advances toward the face ; so that the two processes thus united, form a sort of bridge or jugum, under which the temporal muscle passes ; on which account the processes, and suture joining them, have been called *zygomatic*.

It must be observed, that the indentations of the sutures do not appear on the inside of the cranium by much so strong as on the outside ; but the bones seem almost joined in a straight line : Nay, in some skulls, the internal surface is found entire, while the sutures are manifest without ; which may possibly be owing to the less extent of the concave than of the convex surface of the cranium, whereby the fibres of the internal side would be stretched further out at the edges of the bones, if they were not resisted. The objects resisting are, the fibres of the opposite bone, the parts within the skull, and the diploe : of which the last being the weakest, the most advanced fibres or *serræ* run into it, and leave the contiguous edges equal, and more ready to unite ; whereas the *serræ* of the external table have space enough for their admission between the fibres of the opposite bone, and therefore remain of the indented form, and are less liable to that concretion whereby the sutures are obliterated.—By this mechanism, there is no risk of the sharp points of the bones growing inwards, since the external *serræ* of each of the conjoined bones rest upon the internal smooth-edged table of the other ; and external forces applied to these parts are strongly resisted, because the sutures cannot yield, unless the serrated edges of the one bone, and the plain internal plate of the other, are broken.

The advantages of the sutures of the cranium are these : 1. That this capsula is more easily formed and extended into a spherical figure, than if it had been one continued bone. 2. That the bones which are at some distance from each other at

birth, might then yield, and allow to the head a change of shape, accommodated to the passage it is engaged in. 3. That the dura mater may be more firmly suspended by its processes, which insinuate themselves into this conjunction of the bones: and in order to do this equally, and where the greatest necessity of adhesion is, the sutures are disposed at nearly equal distances; and the large reservoirs of blood, the sinuses, are under or near them. 4. That fractures might be prevented from reaching so far as they would in a continued bony substance.

Having gone through the general structure of the cranium, I now proceed to examine each bone of which that brain-case consists, in the order in which I first named them.

OS FRONTIS.

The os frontis has its name from its being the only bone of that part of the face we call the *forehead*, though it reaches a good deal farther. It has some resemblance in shape to the shell of the concha bivalvis, or *cockle*: for the greatest part of it is convex externally, and concave internally, with a serrated circular edge; while the smaller part has processes and depressions, which make it of an irregular figure.

The external surface of the os frontis is smooth at its upper convex part; but several processes and cavities are observable below: for at each angle of each orbit, the bone juts out to form four processes, two internal, and as many external; which, from this situation, may well enough be named *angular*. Between the internal and external angular processes on each side, an arched ridge is extended, on which the eyebrows are placed.--Very little above the internal end of each of these superciliary ridges a protuberance may be remarked, in most skulls, where there are large cavities, called *sinuses*, within the bone; of which hereafter.—Betwixt the internal angular processes a small process rises, which forms some share of the nose, and thence is named *nasal*.—Some observe a protuberant parts on the edge of the bone behind each external angular process, which they

call *temporal* processes; and extending obliquely upward and backward from these, are, what may be called the temporal ridges of this bone, and below these are the temporal depressions.—From the under part of the superciliary ridges, the frontal bone runs a great way backward: which parts may justly enough be called *orbital* processes. These, contrary to the rest of this bone, are concave externally, for receiving the globes of the eyes, with their muscles, fat, &c.

In each of the orbital processes, about one third from the outer end of the superciliary ridges, a considerable depression is observed, where the glandula lachrymalis is lodged.—Behind each internal angular process, a small pit may be remarked, where the cartilaginous pulley of the musculus obliquus major of the eye is fixed.—Betwixt the two orbital processes, there is a large discontinuation of the bone, into which the cribriform part of the os ethmoides is incased.—The frontal bone frequently has little caverns formed in it here where it is joined to the ethmoid bone.

The *foramina*, or holes, observable on the external surface of the frontal bone, are three in each side.—One in each superciliary ridge, a little removed from its middle towards the nose; through which a twig of the ophthalmic branch of the fifth pair of nerves passes out of the orbit, with a small artery of the same name from the internal carotid, to be distributed to the teguments and muscles of the forehead.—These vessels, in some skulls, make furrows in the os frontis, especially in the bones of children. Often instead of a hole, a notch only is to be seen, or it is varied in numerous other ways.—Near the middle of the inside of each orbit, hard by or in the transverse suture, there is a small hole for the passage of the nasal twig of the first branch of the fifth pair of nerves, and of a branch of the ophthalmic artery. This hole is sometimes entirely formed in the os frontis; in other skulls, the sides of it are composed of this last bone and of the os planum. It is commonly known by the name of *orbitarium internum anterius*.—That which is called *orbitarium internum posterius*, is smaller than the former, and about three fourths of an inch deeper in the orbit: through it a small branch of the

ocular artery passes to the nose.---Besides these six, there are a great number of small holes observable on the outer surface of this bone, particularly in the two protuberances above the eyebrows. Most of these penetrate no further than the sinuses, or than the diploe if the sinuses are wanting: they generally serve for the transmission of small arteries or nerves.

The internal surface of the *os frontis* is concave, except at the orbital processes, which are convex, to support the anterior lobes of the brain. This surface is not so smooth as the external; for the larger branches of the arteries of the *dura mater* make some furrows in its sides and back parts. The sinuosities from the luxuriant risings of the brain, mentioned when describing the general structure of the cranium, are often very observable on its upper part; and its lower and foreparts are marked with the contortions of the anterior lobes of the brain.---Through the middle of this internal surface, where always in children, and sometimes in old people, the bone is divided, either a ridge stands out, to which the upper edge of the *falx* is fastened, or a furrow runs, in which the upper side of the superior longitudinal sinus is lodged. Perhaps this variety may be owing to the different times of complete ossification of those parts in different subjects: for if the two sides of this bone meet before they arrive at their utmost extent of growth, they unite very firmly, and all their fibres endeavour to stretch themselves out where the least resistance is, that is, between the hemispheres of the brain. To support this reasoning, we may remark, that those adults whose frontal bone is divided by the sagittal suture, seldom have a ridge in this place.

Immediately at the root of this ridge or furrow, there is a small hole, which sometimes pierces through the first table, and, in other skulls, opens into the superior sinus of the ethmoid bone within the nose. In it a little process of the *falx* is lodged, a small artery, and sometimes a vein, runs, and the superior longitudinal sinus begins.---This hole, however, is often not entirely proper to the *os frontis*: for in several skulls, the lower part is formed in the upper part of the base of the *crista galli*, which is a process of the ethmoid bone,

The os frontis is composed of two tables, and an intermediate diploe, as the other bones of the cranium are, and in a middle degree of thickness between the os occipitis and the parietal bones; and is pretty equally dense all through, except at the orbital processes, where, by the action of the eye on one side, and pressure of the lobes of the brain on the other, it is made extremely thin and diaphanous, and the medullium is entirely obliterated.

The diploe is also exhausted in that part above the eyebrows, where the two tables of the bone separate, by the external being protruded outwards, to form two large cavities, called *sinus frontales*.—These are divided by a middle perpendicular bony partition. Their capacities in the same subject are seldom equal; in some the right, in others the left, is largest. And in different bones their size is as inconstant: nay, I have examined some where they were entirely wanting; which oftener happens in such as have a flat forehead, and whose sagittal suture is continued down to the nose, than in others. In some skulls, besides the large perpendicular *septum*, there are several bony pillars, or short partitions, found in each sinus: in others these are wanting. Sometimes it is discontinued, and the two *sinuses* communicate. When the sinuses are seen in such skulls as have the frontal bone divided by the sagittal suture, the partition dividing these cavities is evidently composed of two plates, which easily separate.—Each sinus commonly opens by a roundish small hole at the inner and lower part of the internal angular processes, into a sinus formed in the ethmoid bone, at the upper and back part of the os unguis; near to which there are also some other small sinuses of this bone, the greater part of which open separately near the septum narium, and often they terminate in the same common canal with the large ones.

These, and the other cavities which open into the nose, increase the sound of our voice, and render it more melodious, by serving as so many vaults to resound the notes. Hence people labouring under a coryza, or stoppage of the nose from any other cause, when they are by the vulgar, though falsely, said to speak through their nose, have such a disagreeable harsh voice.

Articulation.

The upper circular part of the os frontis is joined to the ossa parietalia, from one temple to the other, by the coronal suture. From the termination of the coronal suture to the external angular processes, this bone is connected to the sphenoid by the sphenoidal suture. At the external canthi of the eyes, its angular processes are joined by the transverse suture to the ossa malarum, to which it adheres one-third down the outside of the orbits; whence to the bottom of these cavities, and a little upon their internal sides, these orbital processes are connected to the sphenoidal bone by that same suture. In some few skulls, however, a discontinuation of these two bones appears at the upper part of the long slit, near the bottom of the orbit.---On the inside of each orbit, the orbital process is connected to the ethmoid bone and the os unguis. The transverse suture afterwards joins the frontal bone to the superior nasal processes of the ossa maxillaria superiora, and to the nasal bones. And, lastly, its nasal process is connected to the nasal lamella of the ethmoid bone.

The frontal bone serves to defend and support the anterior lobes of the brain. It forms a considerable part of the cavities that contain the globes of the eyes, helps to make up the septum narium, organ of smelling, &c.

In a ripe child, the frontal bone is divided through the middle; the superciliary holes are not formed; often a small round piece of each orbital process, behind the superciliary ridge, is not ossified; and there is no sinus to be seen within its substance.

OSSA PARIETALIA.

Each of the two Ossa Parietalia, or bones serving as walls to the encephalon, is an irregular square; its upper and fore sides being longer than the one behind or below. The inferior side is a concave arch; the middle part receiving the upper round part of the temporal bone.---The angle formed by this under side and the fore one, is so extended, as to have the appearance of a process.

The external surface of each os parietale is convex. Upon it,

somewhat below the middle height of the bone, there is a transverse arched ridge, of a whiter colour generally than any other part of the bone ; from which in bones that have strong prints of muscles, we see a great many converging furrows, like so many radii drawn from a circumference toward a centre. From this ridge of each bone the temporal muscle rises : and, by the pressure of its fibres, occasions the furrows just now mentioned.---Below these we observe, near the semicircular edges, a great many risings and depressions, which join like inequalities on the inside of the temporal bone, to form the squamous suture. The temporal bone may therefore serve here as a buttress, to prevent the lower side of the parietal from starting outwards when its upper part is pressed or struck.

Near the upper sides of these bones, towards the hind part, is a small hole in each, through which a vein passes from the teguments of the head to the longitudinal sinus. Sometimes a branch of the temporal artery passes through this hole, to be distributed to the dura mater, where it anastomoses with the branches of the proper menengral arteries.—In several skulls, one of the ossa parietalia has not this hole : in others, there are two in one bone ; and in some, not one in either. Most frequently this hole is through both tables ; at other times the external table only is perforated.

On the inner concave surface of the parietal bones, we see a great many deep furrows, for the branches of the arteria meningea media : the furrows are largest and deepest at the lower edge of each os parietale, especially near its anterior angle, where sometimes a full canal is formed. They afterwards divide into small furrows, in their progress upwards.---In some skulls a large furrow begins at the hole near the upper edge, and divides into branches, which join with those which come upward ; showing the communications of the upper and lower vessels of the dura mater.---In these furrows we frequently see passages into the diploe. On the inside of the upper edge of the ossa parietalia, there is a large sinuosity, frequently larger in the bone of one side than of the other, where the upper part of the falx is fastened, and the superior longitudinal sinus is lodged. Generally part of the late-

tal sinus makes a depression near the angle, formed by the lower and posterior sides of these bones ; and the pits made by the prominent parts of the brain are to be seen in no part of the skull more frequent or more considerable, than in the internal surface of the parietal bones.

The ossa parietalia are amongst the thinnest bones of the cranium ; but enjoy the general structure of two tables and diploe the completest, and are the most equal and smooth.

Articulation.

These bones are *joined* at their fore-side to the os frontis by the coronal suture ; at their long inferior angles, to the sphenoid bone, by the part of the suture of this name ; at their lower edge, to the ossa temporum, by the squamous suture, and its additamentum ; behind, to the os occipitis, or ossa triquetra, by the lambdoid suture ; and above, to one another, by the sagittal suture.

In a child born at the full time, none of the sides of this bone are completed ; and there never is a hole in the ossified part of it near to the sagittal suture.

The large unossified ligamentous part of the cranium observable between the parietal bones and the middle of the divided os frontis of new-born children is called the bregma. It is generally ossified before seven years of age.

OSSA TEMPORUM.

Ossa Temporum, so named, say authors, from the hair first becoming grey on the temples, and thus discovering peoples ages, are each of them equal and smooth above, with a very thin semicircular edge ; which, from the manner of its connection with the neighbouring bones, is distinguished by the name of *os squamosum*.—Behind this, the upper part of the temporal bone is thicker, and more unequal ; and is sometimes described as a distinct part, under the name of *pars mamillaris*.—Towards the base of the skull, the temporal bone appears very irregular and unequal ; and this part, instead of being broad, and placed per-

pendicularly, as the others are, is contracted into an oblong very hard substance, extended horizontally forward and inward, which in its progress becomes smaller, and is commonly called *os petrosum*.

Three external processes of each temporal bone are generally described.—The first, placed at the lower and hind part of the bone, from its resemblance to a nipple, is called *mastoides* or *mamillaris*. It is not solid; but within is composed of cancelli, which have a communication with the large cavity of the ear, called the drum. Into the mastoid process the sterno cleido-mastoideus muscle is inserted; and to its back part, where the surface is rough, the trachelomastoideus and part of the splenius are fixed. About an inch farther forward, the second process begins to rise out from the bone; and having its origin continued obliquely downward and forward for some way, it becomes smaller, and is stretched forward to join the *os malæ*; they together forming the bony jugum, under which the temporal muscle passes. Hence this process has been named *zygomatic*. Its upper edge has the strong aponeurosis of the temporal muscle fixed into it; and its lower part gives rise to a share of the masseter.—The fore-part of the base of this process is an oblong tubercle, which, in a recent subject, is covered with a smooth polished cartilage, continued from that which lines the cavity immediately behind.—From under the craggy part of the *os temporum*, the third process stands out obliquely forward. The shape of it is generally said to resemble the ancient *stylus scriptorius*; and therefore it is called the *styloid process*. Several muscles have their origin from this process, and borrow one half of their name from it; as *stylo-glossus*, *stylo-hyoideus*, *stylo-pharyngeus*: to it a ligament of the *os hyoideus* is sometimes fixed; and another is extended from it to the inside of the angle of the lower jaw. This process is often, even in adults, not entirely ossified, but is ligamentous at its root, or elsewhere.—Round the root of it, especially at the fore-part, there is a remarkable rising of the *os petrosum*, which some have esteemed a process; and, from the appearance it makes with the styloid, have named it *vaginalis*.—Others again have, under the name

of *auditory* process, reckoned among the external processes that semicircular ridge, which, running between the root of the mastoid and zygomatic processes, forms the under part of the external *meatus auditorius*.

The *sinuosities* or depressions on the external surface of each os temporis are these:—A long fossa at the inner and back part of the root of the mammary process, where the posterior head of the digastric muscle has its origin; and a very little internal to this, there is another, in which the occipital artery runs.—Immediately before the root of the zygomatic process, a considerable hollow is left for lodging the temporal muscle.—Between the zygomatic, auditory, and vaginal processes, a large cavity is formed; through the middle of which, from top to bottom, a fissure is observable, into which part of the ligament that secures the articulation of the lower jaw with this bone is fixed. The fore-part of the cavity being lined with the same cartilage which covers the tubercle before it, receives the condyle of the jaw; and in the back-part a small share of the parotid gland, and a cellular fatty substance, are lodged.—At the inside of the root of the styloid apophyse, there is a thimble-like cavity forming part of the jugular foramen, where the beginning of the internal jugular vein, or end of the lateral sinus, is lodged, and where the par vagum, gloss-pharyngeal nerve and nervus accessorius pass out—the vein is at the posterior, the nerves at the anterior part of the depression, where also may be seen, about the fourth of an inch below the internal meatus, the small opening of the aqueductus cochleæ.—As the sinuses of the two sides are frequently of unequal size, so one of these cavities is as often larger than the other.—Round the external meatus auditorius, several sinuosities are formed for receiving the cartilages and ligaments of the ear, and for their firm adhesion.

The *holes* that commonly appear on the outside of each of these bones, and are proper to each of them, are five.—The first, situated between the zygomatic and mastoid processes, is the orifice of a large funnel-like canal, which leads to the organ of hearing; therefore is called *meatus auditorius externus*..—The second gives passage to the portia dura of the seventh pair of nerves; and from its situation between the mastoid and styloid

processes, is called *foramen stylo-mastoideum*.—Some way before, and to the inside of the styloid process, is the third hole ; the canal from which runs first upward, then forward, and receives into it the internal carotid artery, and the beginning of the intercostal nerve ; where this canal is about to make the turn forward, one, or sometimes two, very small holes go off towards the cavity of the ear, called *tympanum* : through these Valsalva affirms the proper artery or arteries of that cavity are sent.---On the anterior edge of this bone, near the former, a fourth hole is observable, being the orifice of a canal which runs outward and backward, in a horizonral direction, till it terminates in the tympanum. This, in the recent subject, is continued forward and inward, from the parts which were mentioned just now as its orifice in the skeleton, to the side of the nostrils ; being partly cartilaginous, and partly ligamentous. The whole canal is named *Iter a palato ad aurem*, or *Eustachian tube*, immediately above which is situated the small canal in which lies the tensor tympani.---On the external side of the bony part of this canal, and a-top of the chink, in the cavity that receives the condyle of the lower jaw, is the course of the little nerve said commonly to be reflected from the lingual branch of the fifth pair, till it enters the tympanum, to run across this cavity, and to have the name of *chorda tympani*.---The fifth hole is very uncertain, appearing sometimes behind the mastoid process ; sometimes it is common to the temporal and occipital bones ; and in several skulls it does not exist. The use of it, when found, is for the transmission of a vein from the external teguments to the lateral sinus ; and a branch of the occipital artery passes through it to serve the back part of the dura mater ; in others I have seen two or three such holes : but they are oftener wanting than found. And we may, once for all, in general remark, that the largeness, number, situation, and existence of all such holes as for the most part allow only a passage for veins from without to the internal receptacles, are very uncertain.

The internal surface of the ossa temporum is unequal ; the upper circular edge of the squamous part having numerous small ridges and furrows for its conjunction with the parietal bones ; and the rest of it is irregularly marked with the convo-

lutions of the middle part of the brain, and with furrows made by the branches of the arteries of the dura mater.

From the under part of this internal surface, a large transverse hard craggy protuberance runs horizontally inward and forward, with a sharp edge above, and two flat sides, one facing obliquely forward and outward, and the other as much backward and inward. To the ridge between these two sides, the large lateral process of the dura mater is fixed.

Toward the back part of the inside of the os temporis, a large deep fossa is conspicuous, where the lateral sinus lies; and frequently on the top of the petrous ridge, a furrow may be observed, where a small sinus the superior petrosal is situated.

The internal proper *foramina* of each of these bones are, first, the internal meatus auditorius in the posterior plain side of the petrous process. This hole soon divides into two; the superior one of which is the beginning of of the aqueduct of Fallopius; the other ends in several very small canals that allow a passage to the branches of the portio mollis of the seventh pair of nerves, into the vestibule and cochlea. Through it also an artery is sent, to be distributed to the organ of hearing.—About half of an inch external to this, on the same side of the bone, may be seen the small opening of the aqueductus vestibuli.—The third hole, which is on the anterior plain side of the craggy process, gives passage to a reflected branch of the second branch of the fifth pair of nerves, the Vidian nerve, which joins the portio dura of the auditory nerve, while it is in the aqueduct, small branches of blood-vessels accompanying the nerve, or passing through smaller holes near this one. The passage of the cutaneous vein into the lateral sinus, and of a branch of the occipital artery, is seen about the middle of the large fossa for that sinus; and the orifice of the canal of the carotid artery is evident at the under part of the point of the petrous process.

Besides these proper holes of the temporal bones which appear on their external and internal surfaces, there are two others on each side that are common to this bone, and to the occipital and sphenoidal bones; which shall be mentioned afterwards in the description of these bones.

The upper round part of the squamous bones is thin, but

equal ; while the low petrous part is thick and strong, but irregular and unequal, having the distinction of tables and diploe confounded, with several cavities, processes, and bones within its substance, which are parts of the organ of hearing. That a clear idea may be had of this beautiful, but intricate organ, anatomists generally choose to demonstrate all its parts together. I think the method good ; and therefore, since it would be improper to insert a complete treatise on the ear here, shall omit the description of the parts contained within the os petrosum of the skeleton.

Articulation.

The temporal bones are *joined* above to the parietal bones by the squamous sutures and their additamenta : before, to the sphenoid bone, by the suture of that name ; to the cheek bones by the zygomatic sutures : behind, to the occipital bone, by the lambdoid suture and its additamenta ; and they are articulated with the lower jaw in the manner which shall be described when this bone is examined.

In an infant, a small fissure is to be observed between the thin upper part and the lower craggy part of each of these bones ; which points out the recent union of these parts. Neither mastoid nor styloid processes are yet to be seen. Instead of a bony funnel-like external meatus auditorius, there is only a smooth bony ring, within which the membrane of the drum is fastened. At the entry of the Eustachian tube, the side of the tympanum is not completed.——A little more outward than the internal auditory canal there is a deep pit, over the upper part of whose orifice the interior semicircular canal of the ear is stretched ; and some way below this, the posterior semicircular canal also manifestly appears.

OS OCCIPITIS.

Os occipitis, so called from its situation, is convex on the outside, and concave internally. Its figure is an irregular rhomboid ; of which the angle above is generally a little rounded ; the two lateral angles are obtuse ; and the lower one is stretched forward in form of a wedge, thence called the *cuneiform* process.

Five or seven sides, and as many angles of this bone, might however be described.

The external surface is convex, except at the cuneiform apophyse, where it is flattened. At the base of this triangular process, on each side of the great hole, but more advanced forward than the middle of it, the large oblong protuberances, named the *condyles*, appear, to serve for the articulation of this bone with the first vertebra of the neck. The smooth surface of each of these condyloid processes is longest from behind forward, where, by their oblique situation, they come much nearer to each other than they are at their back part. Their inner sides are lower than the external, by which they are prevented from sliding to either side out of the cavities of the first vertebra. In some subjects, each of these plain smooth surfaces seems to be divided by a small rising in its middle; and the lower edge of each condyle, next the great foramen, is discontinued about the middle, by an intervening notch: each of these apophyses is made up of two protuberances. Round their root a small depression and spongy roughness is observable, where the ligaments for surrounding and securing their articulations adhere. Though the motion of the head is performed on the condyles, yet the centre of gravity of that globe does not fall between them, but is a good way further forward; from which mechanism it is evident, that the muscles which pull the head back must be in a constant state of contraction; their power of effecting which is, from their greater size much stronger than that of the proper flexors, else the head would always fall forwards, as it does when a man is asleep, or labours under a palsy, as well as in infants, where the weight of the head far exceeds the proportional strength of these muscles. This seeming disadvantageous situation of the condyles is, however, of good use to us, by allowing sufficient space for the cavities of the mouth and fauces, and for lodging a sufficient number of muscles, which commonly serve for other uses; but may at pleasure be directed to act on the head.

Somewhat more externally than the condyles, there is a small rising and semilunated hollow in each side, which make part of the holes common to the occipital and petrous bones.—Immedi-

ately behind this, on each side, a scabrous ridge is extended from the middle of the condyle towards the root of the mastoid process. Into this ridge the rectus lateralis is inserted.—About the middle of the external convex surface, a large arch runs across the bone; from which the occipital muscles have their rise; to its middle the trapezii are attached; and halfway between this and the great hole, a lesser arch is extended.—In the hollows between the middle of these arches the complexi are inserted; and in the depressions more external and further forward than these, the splenii are inserted. Between the middle of the lesser arch and the great hole, the little hollow marks of the recti postici minores appear; and on each side of these the fleshy insertions of the obliqui superiores and recti postici majores make depressions.—Through the middle of the two arches a small sharp spine is placed. All round the great foramen, the edges are unequal, for the firmer adhesion of the strong circular ligament which goes thence to the first vertebra. One end of each lateral or moderator ligament of the head, is fixed to a rough surface at the forepart of each condyle, and the perpendicular one is connected to a rough part of the edge of the great hole between the two condyles. Immediately before the condyles, two little depressions are made in the external surface of the cuneiform process, for the insertion of the recti antici minores. And still further forward, near the sphenoid bone, are two other such depressions for the reception of the recti antici majores.

On the inner surface of the os occipitis we see two *ridges*; one standing perpendicular, the other running horizontally across the first. The upper part of the perpendicular limb of the cross, to which the falx is fixed, is hollowed in the middle, or often on one side, for the reception of the superior longitudinal sinus; and the lower part of it has the small or third process of the dura mater fastened to it, and is sometimes hollowed by the occipital sinus. Each side of the horizontal limb is made hollow by the lateral sinuses enclosed in the tranverse process of the dura mater; the fossa in one of the sides being generally a continuation of the one made by the longitudinal sinus in the perpendicular limb, and therefore larger than the other.—Round the middle of

the cross there are four large depressions, separated by its limbs ; the two upper ones being formed by the back part of the brain, and the two lower ones by the cerebellum.---Further forward than the last mentioned depressions, is the lower part of the fossa for the lateral sinus on each side.---The inner surface of the cuneiform apophyse is made concave for the reception of the medulla oblongata, and of the basilar artery.---A furrow is made on each side, near the edges of this process, by the inferior petrosal sinus, which empties itself into the lateral one.

The *holes* of this bone are commonly five proper, and two common to it and to the temporal bones.---The first of the proper holes, called *foramen magnum* from its size, is immediately behind the wedge-like process ; and allows a passage to the medulla oblongata, nervi accessorii, to the vertebral arteries, and sometimes to the vertebral veins.---At each side of this great hole, near its forepart, and immediately above the condyles, we always find a hole, sometimes two, which soon unite again into one that opens externally ; through these the ninth pair of nerves go out of the skull.---The fourth and fifth holes pierce from behind the condyle of each side into the fossæ of the lateral sinuses ; they serve for the passage of the cervical veins to these sinuses. Often one of these holes is wanting, sometimes both, when the veins pass through the great foramen.---Besides these five, we frequently meet with other holes near the edges of this bone, for the transmission of veins ; but their number and diameter are very uncertain. The two common foramina are the large irregular holes formerly mentioned, one on each side, between the sides of the cuneiform process and the edges of the petrous bones. In a recent subject, a strong membrane runs across from one side to the other of each of these holes : in some heads a bony partition divides each hole : but in the greater number of adult skulls, there is a small sharp pointed process stands out from the os petrosum, and a more obtuse rising in the occipital bone, between which the membrane is stretched. Behind this partition, where the largest space is left, the lateral sinus has its passage ; and before it the par vagum, glosso-pharyngeal and accessorius make their exit out of the skull ; an artery also passes through this hole to be bestowed on the dura mater.

The *occipital* bone is among the thickest of the cranium, though unequally so; for it is stronger above, where it has no other defence than the common teguments, than it is below; where, being pressed by the lobes of the brain and cerebellum on one side, and by the action of the muscles on the other, it is so very thin as to be diaphanous in many skulls: but then these muscles ward off injuries, and the ridges and spines, which are frequent here, make it sufficiently strong to resist ordinary forces.

The tables and diploe are tolerably distinct in this bone, except where it is so thin as to become diaphanous.

Articulation.

The occipital bone is *joined* above to the ossa parietalia and triquetra; when present, by the lambdoid suture;—laterally to the temporal bones, by the additamenta of the lambdoid suture—below to the sphenoid bone, by the end of its cuneiform process, in the same way that epiphyses and their bones are joined: for in children a ligamentous cartilage is interposed between the occipital and sphenoid bones, which gradually turns thinner as each of the bones advances, till their fibres at last run into each other; and about sixteen or eighteen years of age, the union of these two bones becomes so intimate, that a separation cannot be made without violence.—The os occipitis is joined by a double articulation to the first vertebra of the neck, each condyle being received into a superior oblique process of that vertebra. What motion is allowed here we shall consider afterwards, where the vertebræ are described.

An infant born at the full time has this bone divided by cartilages, into four parts.—The first of these is larger than the other three, is of a triangular shape, and constitutes all the part of the bone above the great foramen. Generally fissures appear in the upper part and sides of this triangular bone, when all the cartilage is separated by maceration; and sometimes little distinct bones are seen towards the edges of it.—The second and third pieces of this bone are exactly alike, and situated on each side of the great foramen, from them very near the whole condyles are produced; and they are extended forward almost to the forepart of the hole for the ninth part of nerves.—The fourth

piece is the cuneiform process, which forms a small share of the great hole, of those for the ninth pair of nerves and of the condyles; betwixt it and the sphenoid bone, a cartilage is interposed.

Of the eight bones which belong to the cranium, there are only two which are not yet described, viz. the *ethmoid* and *sphenoid*. These we already mentioned, in complaisance to the generality of writers on this subject, as bones common to the cranium and face, because they enter into the composition of both; but the same reason might equally be used for calling the frontal bone a common one too.

OS ETHMOIDES.

Os ethmoides, or the *sieve-like* bone, has got its name from the great number of small holes with which that part of it first taken notice of is pierced. When this bone is entire, the figure of it is not easily described; but by a detail of its several parts, some idea may be afforded of the whole; and therefore I shall distinguish it into the *cribriform lamella* with its process, the *nasal lamella*, *cellulæ*, with the *ossa plana*, and *ossa spongiosa*.

The thin horizontal lamella is all (except its back part) pierced obliquely by a great number of small holes, through which the filaments of the olfactory nerves are transmitted. In a recent subject, these holes are so closely lined by the dura mater, that they are much less conspicuous than in the skeleton. From the middle of the internal or superior side of this plate, a thick process rises upward; and being highest at the forepart, gradually becomes lower as it is extended backwards. From some resemblance which this process was imagined to have to a cock's comb, it has been called *crista galli*. The falx is connected to its ridge, and to the unperforated part of the cribriform plate. When the crista is broken, its base is sometimes found to be hollow, with its cavity opening into the nose. Immediately before the highest part of this process is the blind hole of the frontal bone, which, as was formerly remarked, is often in a good

measure formed by a notch in the forepart of the root of the crista.

From the middle of the outer or inferior surface of the cribriform lamella, a thin solid plate is extended downwards and forwards, having the same common base with the crista galli. Generally it is not exactly perpendicular, but is inclined to one side or other, and therefore divides the cavity of the nose unequally. It is thin at its rise, and rather still thinner in its middle; yet towards its lower edge, it becomes thicker, that its conjunction with the bones and middle cartilage of the nose might be firmer.

At a little distance from each side of this external process, a cellular and spongy bony substance depends from the cribriform plate. The number and figure of the cells in this irregular process of each side, are very uncertain, and not to be represented in words; only the cells open into each other, and into the cavity of the nose. The outer surface of these cells is smooth and plain, where this bone assists in composing the orbit; at which place, on each side, it has got the name of *os planum*; on the upper edge of which a small notch or two may sometimes be observed, which go to the formation of the internal orbital holes; as was remarked in the description of the frontal bone.

Between these cells and the nasal lamella, a thin plate is extended inward; and then bending down, it becomes thick and of a spongy texture. This spongy part is somewhat triangular, with a straight upper edge placed horizontally, an anterior one slanting from above, downward and forward, and with a pendulous convex one below. The upper and lower edges terminate in a sharp point behind. The side of this pendulous spongy part next to the septum narium is convex, and its external side is concave. These two processes of the ethmoid bone have got the name of *ossa spongiosa*, or *turbinata superiora*, from their substance, figure, and situation, on them the olfactory nerves are expanded.

Articulation.

All the prominences, cavities, and meanders of this ethmoid bone, are covered with a continuation of the membrane of the nostrils in a recent subject. Its horizontal cribriform plate is

lodged between the orbital processes of the frontal bone, in its ethmoidal fissure, to which it is joined by the ethmoid suture, except at the back part, where it is connected with the cuneiform bone by a suture common to both these bones, though it is generally esteemed part of the sphenoidal.—Where the ossa plana are contiguous to the frontal bone within the orbit, their conjunction is reckoned part of the transverse suture.—Further forward than the ossa plana, the cells are covered by the ossa unguis: which are not only contiguous to these cells, but cannot be separated from them without breaking the bony substance.—Below the ossa unguis and plana, these cells and ossa spongiosa are overlapped by the maxillary bones. The cellular part of each palate bone is contiguous to each os planum and cells backward. The lower edge of the nasal perpendicular plate is received into the furrow of the vomer.—Its posterior edge is joined to the forepart of the processus azygos of the sphenoid bone. Its upper edge joins the nasal process of the frontal and nasal bones; and its anterior one is connected to the middle cartilage of the nose.

From all which, the *uses* of this bone are evident, viz. to sustain partly the anterior lobes of the brain; to give passage to the olfactory nerves, and attachment to the falx; to straiten the passage of the air through the nose, by leaving only a narrow winding canal, on the sensible membranous sides of which the substances conveyed along with the air must strike; to form part of the orbit of the eyes and septum narium; while all its parts are so light as not to be in hazard of separating by their weight; and so thin as to form a large surface without occupying much space. This brittle substance, however, is sufficiently protected from external injuries by the firm bones which cover it.

The ethmoid bone of ripe children is divided into two by a perpendicular cartilage, which, when ossified, is the crista galli and nasal plate; but its other parts are ossified and complete.

OS SPHENOIDES.

Os sphenoides, or *wedge-like* bone, so called because of its situation in the middle of the bones of the cranium and face.

When we view its external surface, two or three remarkable processes from each side of it may be observed, which are all of them again subdivided.—The first pair is the two large lateral processes or wings; the upper external part of each of which is called the *temporal process*, because they join with the temporal bones in forming the temples, and the seat for some share of the temporal muscles. That part of the wings which juts forward and inward, somewhat lower than the temporal apophyses, and is smooth and hollowed, where it makes up part of the orbit, is thence named the *orbital process*. Behind the edge, separating these two processes, there is often a small groove, made by a branch of the superior maxillary nerve, in its passage to the temporal muscle. The lowest and back part of each wing, which runs out sharp to meet the ossa petrosa, has been styled the *spinous process*: from near the point of which a sharp process is frequently produced downward, which some call *styliform*, that affords origin to the levator palati. From this styloid process a very small groove is extended along the edge of the bone to the hollow at the root of the internal plate of the following processes, which forms part of the Eustachian tube. The second pair of external processes of the cuneiform bone, is the two which stand out almost perpendicular to the base of the skull. Each of them has two plates, and a middle fossa facing backward; they are named *pterygoid processes*. The external plates are broadest, and the internal longest. From each side of the external plates the pterygoid muscles take their rise. At the root of each internal plate, a small hollow may be remarked, where the circumflexus palati partly rises, and some share of the cartilaginous end of the Eustachian tube rests; and at the lower end of the same plate is a hook-like process, round which the tendon of the last-named muscle plays, as on a pulley. From the edge of the external plates some small sharp spikes stand out; but their number and bulk are uncertain.—To these another pair may be

added, to wit, the little triangular thin process, which comes from each side of the body of the sphenoid bone, where the pterygoid processes are rising from it, and are extended over the lower part of the aperture of the sinus as far as to join the ethmoid bone, while their body hangs down into the nares. Besides these pairs of processes, there is a sharp ridge which stands out from the middle of its base: it is called *processus azygos*. The lower part of this process, where it is received into the vomer, is thick, and often not quite perpendicular, but inclining more to one side than the other. The fore-part of this process, where it joins the nasal plate of the os ethmoides, is thin and straight. These two parts have been described as two distinct processes by some.

The depressions, sinuosities, and fossæ, on the external surface of this sphenoid bone, may be reckoned up to a great number, viz. two on the temporal apophyses, where the temporal muscles lodge. Two on the orbital processes, for the globes of the eyes. Two between the temporal and spinous processes receiving the temporal bones. Two between the plates of the pterygoid processes, where the muscoli pterygoidei interni and circumflexi palati are placed. Two between the pterygoid and orbital processes, for forming the holes common to this, and to the cheek and maxillary bones. Two on the lower ends of the aliform processes, which the palate bones enter into. Two at the roots of the temporal and pterygoid processes, where the largest share of the external pterygoid muscles have their rise. Two at the sides of the processus azygos, for forming part of the nose, &c.

What I described under the name of *temporal* and *spinous processes* on the outside of the skull, are likewise seen on its inside, where they are concave, for receiving part of the brain. On the internal surface of the sphenoid bone commonly three apophyses are mentioned.—Two rising broad from the fore-part of its body, become smaller as they are extended obliquely backward.—The third standing on a long transverse base, near the back-part of the body of this bone, rises nearly erect, and of an equal breadth, terminating often in a little knob on each side. The three are called *clinoid*, from some resemblance which they were thought to have to the supporters of a bed. Sometimes one

or both the anterior clinoid processes are joined to the sides of the posterior one, or to the body of the bone itself. From the roots of the anterior clinoid processes the bone is extended on each side outward and forward, till it ends in a sharp point, which may have the name of the *transverse* spinous processes.—Between, but a little farther back than the two anterior clinoid processes, we see a protuberance considerably smaller than the posterior clinoid process, but of its shape: this may be denominated the middle clinoid process. Another process from between the transverse processes, often forces itself forward into the os ethmoides, and may be called the ethmoidal.

Within the skull, there are two *sinuosities* in the internal part of each wing of the sphenoid bone, for receiving the middle part of the brain.—One between the transverse spinous processes, for lodging the part of the brain where the crura medullæ oblongatæ are.—Immediately before the third or middle clinoid process, a single pit generally may be remarked, from which a fossa goes out on each side to the holes through which the optic nerves pass. The pit is formed by the conjoined optic nerves; and in the fossa these nerves are lodged, as they run divided within the skull. Between that third protuberance and the posterior clinoid process, the larger pit for the glandula pituitaria may be remarked. This cavity, because of its resemblance to a Turkish saddle, is always described under the name of *sella turcica*, or *ephippium*. On the sides of the posterior clinoid process a fossa may be observed, that stretches upward, then is continued forward along the sides of the sella turcica, near to the anterior clinoid processes, where a pit on each side is made. These fossæ point out the course of the two internal carotid arteries, after they have entered the skull; and the pits one of the last flexures of these arteries. Besides all these, several other fossæ may be observed, leading to the several holes, and imprinted by the nerves and blood-vessels.

The *holes* on each side of the os sphenoides are six proper, and three common.—The first is the round one immediately below the anterior clinoid processes, for the passage of the optic nerve, and of the branch of the internal carotid artery that is sent to the eye, the ophthalmic artery. The second is the foramen lacerum, or large slit between the transverse spinous and orbital processes:

the interior end of which slit is large; and as it is extended outward, it becomes narrower. The outer end of it is partly formed in the os frontis; and therefore this might be reckoned among the common foramina. Through it the third, fourth, the first branch of the fifth, and the greater share of the sixth pair of nerves, and an artery from the internal carotid, go into the orbit. Sometimes a small branch of the external carotid enters near its end, to be distributed to the dura mater and the ophthalmic vein, always returns through it to the cavernous sinus. The third hole, situated a little below the one just now described, is called *rotundum*, from its shape. It allows passage to the second branch of the fifth pair of nerves, or superior maxillary nerve, into the bottom of the orbit. The fourth is the *foramen ovale*, about half an inch behind the round hole. Through it the third branch of the fifth pair, or inferior maxillary nerve, goes out; and sometimes a vein from the dura mater passes out here also. Very near the point of the spinous process is the fifth hole of this bone: it is small and round, for a passage to the largest artery of the dura mater, which often is accompanied with a vein. The sixth proper hole cannot be well seen, till the cuneiform bone is separated from all the other bones of the cranium; for one end of it is hid by a small protuberance of the internal plate of the pterygoid process, and by the point of the processus petrosus of the temporal bone. Its canal is extended above the inner plate of the pterygoid process; and where it opens into the cavity of the nose, it is concealed by the thin laminous part of the palate-bone. Through it a considerable branch of the second branch of the fifth pair of nerves, the Vidian nerve, is reflected into the cranium. Often, in the middle of the sella turcica, a small hole or two pierce as far as the cellular substance of the bone; and sometimes at the sides of this sella, one or more small holes penetrate into the sphenoidal sinuses.

The first of the *common holes* is that unequal fissure at the side of the sella turcica, between the extreme point of the os petrosum and the spinous process of the cuneiform bone. This hole only appears after the bones are macerated; for in a recent subject its back-part is covered by a thin bony plate that lies over the internal carotid artery, and further forward it is filled with a

cartilaginous ligament, under which the cartilaginous part of the Eustachian tube is placed. The second common hole is the large discontinuation of the external side of the orbit, left between the orbital processes of the cuneiform bone, the os maxillare, malæ, and palati. In this large hole, bedded in fat, branches of the superior maxillary nerve, with small arteries from the carotid and veins, pass. The third hole, the sphenopalatine, is formed between the base of this bone and the root of the orbital process of the palate-bone of each side. Through this a branch of the external carotid artery, and of the second branch of the fifth pair of nerves, are allowed a passage to the nostrils, and a returning vein accompanies them. Sometimes, however, this hole is proper to the palate-bone, being entirely formed out of its substance.

Under the sella turcica, and some way farther forward, but within the substance of the sphenoid bone, are two *sinuses*, separated by a bony plate. Each of them is lined with a membrane, and opens into the upper and back part of each nostril by a round hole, which is at their upper fore-part. This hole is not formed only by the os sphenoides, which has an aperture near as large as any transverse section of the sinus, but also by the palate-bones, which are applied to the fore-part of these sinuses, and close them up, that hole only excepted which was already mentioned. Frequently the two sinuses are of unequal dimensions, and sometimes there is only one large cavity, with an opening into one nostril. These cavities are likewise said to be extended sometimes as far back as the great foramen of the occipital bone. In other subjects they are not to be found, when the bone is composed of large cells. Some mention a cavity within the partition of the sinuses; but it is small. The sphenoidal sinuses serve the same uses as the frontal do.

As this bone is extremely ragged and unequal, so its substance is of very different thickness, being in some places diaphanous; in others it is of a middle thickness, and its middle back part surpasses the greatest share of the cranium in thickness.

Articulation.

The os sphenoides is joined by its wings to the parietal bones above, to the os frontis and ossa malarum before, to the tem-

poral bones behind ; by the forepart of its body and spinous processes, to the frontal and ethmoid bones ; by its back-part, behind the two sinuses, to the occipital, where it looks like a bone with the epiphyses taken off ; to the palate-bones, by the ends of the pterygoid processes, and still more by the fore-part of the internal plates of the pterygoid processes, and of the sinuses ; to the maxillary bones, by the fore-part of the external pterygoid plates ; to the vomer and nasal plate of the os ethmoides, by the processus azygos. All these conjunctions, except the last, which is a schindylesis, are said to be by the suture proper to this bone ; though it is at first sight evident, that several other sutures, as the transverse, ethmoidal, &c. are confounded with it.

We see now how this bone is joined to all the bones of the cranium, and to most of the upper jaw ; and therefore obtained the name of the *wedge-like bone*.

The sphenoidal bone is almost complete in the fœtus of nine months ; only the great alæ separate after maceration from the body of the bone. The processus azygos is very large and hollow ; the thin triangular processes are not ossified ; the internal surface of the body is unequal and porous ; the sinuses do not appear.

Whoever is acquainted with each bone of the cranium, can, without difficulty, examine them as they stand united, so as to know the shapes, sizes, distances, &c. of their several parts, and the forms, capacities, &c. of the cavities formed by them ; which is of great use to understanding the anatomy of the soft parts contiguous to, or contained within them. Such a review is necessary, after considering each class of bones. Thus the orbits, nostrils, mouth, face, head, spine, thorax, pelvis, trunk, extremities, and skeleton, ought likewise to be examined.

BONES OF THE FACE.

The face is the irregular pile of bones composing the fore and under part of the head, which is divided by authors into the *upper and lower maxilla* or jaws.

The *superior maxilla* is the common designation given to the

upper immoveable share of the face ; though, with Celsus, we should probably apply the word *maxilla* to the lower jaw only, and the name *mala* to this upper jaw. However, to use the terms now commonly employed, the shape of the superior jaw cannot easily be expressed ; nor is it necessary, provided the shape and situation of all the bones which compose it are described. It is bounded above by the transverse suture, behind by the forepart of the sphenoid bone, and below by the mouth.

The upper jaw consists of six bones on each side ; of a thirteenth bone, placed in the middle ; and of sixteen teeth. The thirteen bones are, two *ossa nasi*, *ossa unguis*, *ossa malarum*, *ossa maxillari*, *ossa palati*, *ossa spongiosa inferiora*, and *vomer*.

The *ossa nasi* are placed at the upper part of the nose ; *ossa unguis* are at the internal canthi of the orbits ; *ossa malarum* form the prominence of the cheeks ; *ossa maxillaria* form the side of the nose, with the whole lower and forepart of the upper jaw, and the greatest share of the roof of the mouth ; *ossa palati* are situated at the back part of the palate, nostrils, and orbit ; *ossa spongiosa* are seen in the lower part of the nares ; and the *vomer* helps to separate these two cavities.

The bones of the upper jaw are joined to the bones of the skull by the *schindylesis* and sutures already described as common to the cranium and face, and they are connected to each other by *gomphosis*, *schindylesis*, and fifteen sutures.

The first suture is the longitudinal nasal, placed longitudinally in the middle forepart of the nose.

The second and third are the oblique nasal at each side of the nose, and almost parallel to the first suture.

The two *transverse nasal* sutures are on the middle of the sides of the nares.

Each of the two lacrymal is almost semicircular, and surrounds the lacrymal groove.

The sixth and seventh are the internal orbital : extended obliquely from the middle of the lower side of an orbit to the edge of its base.

The two external orbitals are continued, each from the end of the internal orbital to the under and forepart of the cheek.

The tenth is the mystachial, which reaches only from the

lower part of the septum narium to between the two middle dentes incisores.

The longitudinal palatine suture stretches from the middle of the foremost teeth through the middle of all the palate.

The transverse palatine runs across the palate, nearer the back than the fore part of it.

Each of the two palato-maxillary is at the back part of the side of each nostril.

The fifteenth or spinous, is in the middle of the lower part of the nostrils.

Schindelesis connects the edges of the septum of the nares ; and gomphosis fixes the teeth.

The sutures of the face (formerly called *harmonia*) have not such conspicuous indentations as those of the skull have ; the bones here not having substance enough for forming large indentations, and there being besides less necessity for security against external injuries.—These sutures often disappear in old people, by the bones running into each other ; which can do little prejudice, because the principal use of the bones being so numerous here, is to allow them to be extended into a proper form.

It is evident, from the manner of the conjunction of these bones, that they can have no motion, except in common with the cranium.

The purposes which this pile of bones serves, will be shewn in the description which we are to give of each of them.

OSSA NASI.

Ossa nasi, so named from their situation at the root of the nose, are each of an irregular oblong square figure, being broadest at their lower end, narrowest a little higher than their middle, and becoming somewhat larger at the top, where they are ragged and thickest, and have a curvature forwards, that their connection with the frontal bone might be stronger.—These bones are convex externally, and thereby better resist any violence from without ; and they are concave internally, for enlarging the cavity of the nose.

The lower edge of these bones is unequal, and is stretched outward and forward, to join the cartilages of the nostrils.--- Their anterior side is thick, especially above, and unequal, that their conjunction to each other might be stronger ; and a small rising may be remarked on their inner edge, where they are sustained by the septum narium. Their posterior side, at its upper half, has externally a depression, where it is overlapped some way by the maxillary bones, while its lower half is internally depressed by covering these bones : by which contrivance, they do not yield easily to pressure applied to their fore-part or sides.

A small hole is frequently to be observed on their external surface, into which two, three, or four holes, which appear internally, terminate for the transmission of small veins ; sometimes the holes go no farther than the cancelli of the bones.

The nasal bones are firm and solid, with very few cells in them.

Articulation.

They are *joined* above to the frontal bone, by the middle of the transverse suture ;---behind, to the maxillary bones, by the oblique nasal sutures ;---below, to the cartilages of the nose ;---before, to one another, by the longitudinal nasal suture ;---internally, to the septum narium.

The *use* of these bones is to cover and defend the root of the nose.

In an infant the nasal bones are proportionally shorter, and less thick at their upper part, than in an adult ; but are otherwise complete.

OSSA UNGUIS, OR LACRYMALIA.

Ossa unguis, or lacrymalia, are so named, because their figure and magnitude are something near to those of a nail of one's finger, and because the tears pass upon them into the nose.

Their external surface is composed of two smooth concavities and a middle ridge.---The *depression* behind forms a small share of the orbit for the eye ball to move on ; and the one before is a deep perpendicular canal, or *fossa*, larger above than

below, containing part of the lacrymal sac and duct. This fossa of the bone is cribriform, or has a great number of small holes through it, that the filaments from the membrane which lines it, insinuating themselves into them, might prevent a separation of the membrane, and secure the bone in its natural situation. The ridge between these two cavities of the os unguis is the proper boundry of the orbit at its internal canthus.---The internal or posterior surface of this bone consists of a furrow in the middle of two convexities.

The *substance* of the os unguis is as thin as paper, and very brittle; which is the reason that those bones are often wanting in skeletons, and need little force to pierce them in living subjects.

Articulation.

Each of those bones is *joined*, above, to the frontal bone, by part of the transverse suture;—behind, to the os planum of the ethmoid bone, by the same suture;—before, and below, to the maxillary bone, by the lacrymal suture.—Internally, the ossa unguis cover some of the sinus ethmoidales; nay, are really continuous with the bony lamellæ which make up the sides of these cells; so that they are almost as much part of the ethmoid bone as the ossa plana.

These unguiform bones compose the anterior internal parts of the orbits, lodge a share of the lacrymal sac and duct, and cover the ethmoid cells.

OSSA MALARUM.

Ossa malarum was the name given by Celsus, as was already remarked, to all the upper jaw; but is now appropriated to the prominent square bones which form the cheek on each side.—Before, their surface is convex and smooth; backward, it is unequal and concave, for lodging part of the temporal muscles.

The four *angles* of each of these bones have been reckoned processes by some.—The one at the external canthus of the orbit, called the *superior orbital* process, is the longest and thickest.—The second terminates near the middle of the lower

edge of the orbit in a sharp point, and is named the *inferior orbital* process.—The third, placed near the lower part of the cheek, and thence called *maxillary*, is the shortest, and nearest to a right angle.—The fourth, which is called *zygomatic*, because it is extended backward to the *zygoma* of the temporal bone, ends in a point, and has one side straight and the other sloping. Between the two orbital angles there is a concave arch, which makes about a third of the external circumference of the orbit, from which a fifth process is extended backward within the orbit, to form near one third of that cavity; and hence it is called the *internal orbital* process. From the lower edge of each of the ossa malarum, which is between the maxillary and zygomatic processes, the masseter muscle takes its origin; and from the exterior part of the zygomatic process, the zygomatici rise; in both which places the surface of the bone is rough.

On the external surface of each cheek-bone, one *hole* is commonly found, for the transmission of a nerve to the cheek, and several smaller ones for small nerves and blood-vessels from, and sometimes into, the orbit. On the internal surface are the holes for the passage of the nutritious vessels of these bones. A notch behind the internal orbital process of each of these bones assists to form the great slit common to this bone and to the sphenoid, maxillary, and palate bones.

The *substance* of these bones is, in proportion to their bulk, thick, hard, and solid, with some cancelli.

Articulation.

Each of the ossa malarum is *joined*, at its superior and internal orbital processes to the os frontis, and to the orbital process of the sphenoid bone, by the transverse suture. By the edge between the internal and inferior orbital processes, to the maxillary bone, by the internal orbital suture. By the side between the maxillary and inferior orbital process, again to the maxillary bone, by the external orbital suture. By the zygomatic process, to the os temporis, by the zygomatic suture.

The cheek-bones are entire, and fully ossified in infants.

OSSA MAXILLARIA SUPERIORA.

Ossa maxillaria superiora, are the largest bones, and constitute the far greater part, of the upper jaw, which has appropriated the name of *maxillaria* to them. The figure of one of them, or of the two when joined, is so irregular, that words can scarce give an idea of it.

The *processes* of each os maxillare may be reckoned seven. The first is the long nasal one at its upper and fore-part, which is broad below, and turns smaller as it rises upward, to make the side of the nose. At the root of this, a transverse ridge may be observed within the nostrils, which supports the fore-part of the upper edge of the os spongiosum inferius. The second is produced backward and outward, from the root of the nasal process, to form the lower side of the orbit; and therefore may be called *orbital*. The edge of this orbital process, and the ridge of the nasal one, which is continued from it, make a considerable portion of the external circumference of the orbit. From the proper orbital process, a very rough triangular surface is extended downward and outward, to be connected to the cheek-bone; and therefore may be called the malar process, from the lowest protuberant part of which some share of the masseter muscle takes its rise. Behind the orbital process, a large bulbous process of the bone appears, which is esteemed the fourth process. On the internal part of this we often meet with a ridge almost of the same height with that in the nasal process, which runs transversely, and is covered by a similar ridge of the palate-bone, on which the back part of the upper edge of the os spongiosum inferius rests. The convex back part of this tuberosity is rough for the origin of part of the external pterygoid muscle, and more internally is scabrous, where the palate and sphenoid bones are joined to it. That spongy protuberance at the lower circumference of this bone, where the sockets for the teeth are formed, is reckoned the fifth, or *alveolar*. The sixth is the horizontal plate, which forms the greater part of the base of the nostrils, and roof of the mouth: its upper surface which belongs to the nostrils, is very smooth; but the other below is arched

and rough, for the stronger adhesion of the membrane of the mouth, which is stretched upon it; and in chewing, speaking, &c. might otherwise be liable to be separated. The seventh rises like a spine from the inner edge of the last, and forms a small part of the partition of the nostrils.

The *depressions* in each maxillary bone are, 1. A sinuosity behind the orbital process; made by the temporal muscle. 2. A pit immediately before the same process, where the origin of the elevator labiorum communis, and elevator labii superioris, with a branch of the fifth pair of nerves, are lodged securely. 3. The hollow arch of the palate. 4. The semicircular great notch, or entry to the lower part of the nostrils, betwixt the root of the nasal process and spine of the palate plate. Below this, the fore-part of the bone is flattened, or sometimes hollowed, by the depressor labii superioris. 5. The sockets for the teeth: the number of these is uncertain; for the same number of teeth is not in all people, and the four backmost teeth of each side of each jaw vary greatly in their number of roots. 6. The lacrymal fossa in the nasal process, which assists the os unguis to form a passage for the lacrymal duct. Immediately on the outside of this, there is a small depression, from which the inferior or lesser oblique muscle of the eye has its origin. 7. The canal on the upper part of the great tuberosity within the orbit, which is almost a complete hole; in this a branch of the superior maxillary nerve passes. Besides these, the superior surface of the great bulge is concave, to receive the under part of the eye. Immediately above the transverse ridge in the nasal process, a small hollow is formed by the os spongiosum. In some subjects, the nasal process has a small round pit above the lacrymal duct, where the little tendon or ligament of the orbicular muscle of the eyelids is inserted.

The *holes* of this bone are two proper and two common, which are always to be found; besides several others, whose magnitude, number, &c. are uncertain. The first of the proper is the external orbital, immediately below the orbit, by which the infra-orbital branch of the second branch of the fifth pair of nerves, and a small artery, come out, after having passed in the

canal, at the bottom of the orbit. This hole is often double, and that when the nerve has happened to split before it has escaped from the bone. The second is the foramen incisivum, just behind the fore-teeth ; which, at its under part, is one irregular hole common to both the maxillary bones when they are joined ; but, as it ascends, soon divides into two, three, or sometimes more holes ; some of which open into each nostril. Through them small arteries and veins, and a twig of the second branch of the fifth pair of nerves, pass, and make a communication between, or join the membranes of the nose and mouth. In some subjects, Steno's duct may be traced some way on the side of these passages next to the nose, and small orifices may be observed opening into the mouth.

The first common hole is that which appears at the inner side of the back part of the bulbous process, and of the sockets of the teeth ; and is formed by a fossa in this bone, and a corresponding one in the os palati : through it the palatine nerve, which is a branch of the second branch of the fifth pair, runs to the palate. The other common hole is the great slit in the outside of the orbit, described already as the second common hole of the sphenoid bone, the sphenomaxillary fissure.

On the nasal process often holes may be observed for the passage of vessels to the substance of the bones ; and at the back part of each tuberosity, several foramina are placed, for the transmission of nerves to the cavity within : but these are uncertain.

All the *body* of the maxillary bone is hollow, and leaves a large *sinus* akin to the frontal and sphenoid, which is commonly, but unjustly, called *antrum Highmorianum*. When the os maxillare is single, or separated from all the other bones of a skeleton, its antrum appears to have a large aperture into the nostrils ; but, in a recent subject, it is so covered at its back part by the palate bone, in the middle by the os spongiosum inferius, and before by a strong membrane, that one or sometimes two holes, scarce larger than a crow quill, are only left at the upper part ; which, after a short winding progress, open into the nostrils between the two ossa spongiosa.—At the bottom of this cavity, we may often observe some protuberances

in which the small points of the roots of the teeth are contained. This cavern and the sockets of the teeth are often divided by the interposition only of a very thin bony plate.

Though the membranes which line the frontal, sphenoidal, and maxillary sinuses, are continuations of the one which covers the bones within the nose ; yet they are much thinner than it is, and have so much smaller vessels, that the injection which makes the membrane of the nose red all over, fills only some few vessels of the maxillary sinuses, and scarce is observed in the frontal and sphenoidal.

The *substance* of the ossa maxillaria is compact and firm, except at the inferior processes, in which the teeth are lodged, where it is very spongy.

Articulation.

The maxillary bones are *joined* above, by the upper ends of their nasal processes to the os frontis, by the transverse suture ; at the sides of these processes, to the ossa unguis, by the lacrymal sutures ;—to the nasal bones, by the lateral nasal sutures ; by their malar processes, to the cheek bones, by the external orbital sutures ; by their orbital processes, to the cheek bones, by the internal orbital suture ; by the internal sides of the internal orbital processes, to the ossa plana, by part of the ethmoidal suture ; by the back part of the tuberosities, to the palate bones, by the suturæ palato-maxillares ; by the posterior edges of their palatine lamellæ, to the ossa palati, by the transverse palatine suture ; by their nasal spines, to the vomer, by the spinous suture ; by their sockets, to the teeth, by gomphosis ; by the internal edge of the palate-plate, to one another, by the longitudinal palatine suture ; between the forepart of the nostrils and mouth, to each other, by the mystachial suture : sometimes they are connected to the ossa spongiosa inferiora, by a plain concretion or union of substance, at other times by the transverse nasal suture.

These bones form the greater part of the nose and of the roof of the mouth, and a considerable share of the orbit. They contain sixteen teeth, give rise to muscles, transmission to nerves, &c. as mentioned in the description of their several parts.

In each of the maxillary bones of a new-born child, the orbital process is hollow, with remarkable holes in it;—there are five sockets for the teeth, of which the two posterior are very large; and, when divided by a second cross partition, make the number of sockets six. The palate-plate is cribriform about the middle. The great tuberosity is not formed;—instead of the antrum, there is only an oblong depression at the side of the nares.

OSSA PALATI.

Ossa palati are commonly described as two small square bones, at the back part of the palate or roof of the mouth, though they are of much greater extent, being continued up the side of the back part of the nares to the orbit. Each palate-bone may therefore be divided into four parts, the palatine square-bone, the pterygoid process, nasal lamella, and orbital process.

The palatine lamella is unequally concave, for enlarging both the mouth and cavity of the nose. The upper part of its internal edge rises in a spine, after the same manner as the palate-plate of the maxillary bone does, to be joined with the vomer. Its anterior edge is unequally serrated, for its firmer connection with the palatine process of the os maxillare. The internal edge is thicker than the rest, and of an equal surface, for its conjunction with its fellow of the other side. Behind, this bone is somewhat in form of a crescent, and thick, for the firm connection of the velum pendulum palati; the internal point being produced backward, to afford origin to the azygos uvulæ. This square bone is well distinguished from the pterygoid process by a perpendicular fossa, which, applied to such another in the maxillary bone, forms a passage for the palatine branch of the fifth pair of nerves; and by another small hole behind this, through which a twig of the same nerve passes.

The *pterygoid process* is somewhat triangular, having a broad base, and ending smaller above. The back part of this process has three fossæ formed in it; the two lateral receive the ends of the two pterygoid plates of the sphenoid bone; the middle fossa

makes up a part of what is commonly called the *fossa pterygoidea*; the fore-side of this palatine pterygoid process is an irregular concave, where it receives the back part of the great tuberosity of the maxillary bone. Frequently several small holes may be observed in this triangular process, particularly one near the middle of its base, which a little above communicates with the common and proper holes of this bone already taken notice of.

The *nasal lamella* of this bone is extremely thin and brittle, and rises from the upper side of the external edge of the square bone, and from the narrow extremity of the pterygoid process; where it is so weak, and at the same time so firmly fixed to the maxillary bone, as to be very liable to be broken in separating the bones. From the part where the plate rises, it runs up broad on the inside of the tuberosity of the maxillary bone, to form a considerable share of the sides of the maxillary sinus, and to close up the space between the sphenoid and the great bulge of the maxillary bone, where there would otherwise be a large slit opening into the nostrils. Upon the middle internal side of this thin plate, a cross ridge, placed on such another of the maxillary bone, is extended; on it the back part of the *os spongiosum inferius* rests. Along the outside of this plate, the perpendicular fossa made by the palatine-nerve is observable.

At the upper part of this nasal plate, the palate-bone divides into *two processes*, which we already named *orbital*;—between which and the body of the sphenoid bone, that hole is formed which was mentioned as the last of the holes common to the sphenoid bone. Sometimes this hole is wholly formed in the *os palati*, by a cross plate going from the one orbital process to the other. A nerve, artery, and vein, belonging to the nostrils, pass here. The anterior of the two orbital processes is the largest, and has its forepart contiguous to the back part of the maxillary sinus, and its upper surface appears in the bottom of the orbit, behind the back part of the *os maxillare*, and below that of the *os planum*. It has cells behind, resembling those of the ethmoid bone, to which it is contiguous; it is placed on the aperture of the sinus sphenoidalis, so as to leave only a round hole at its upper forepart. The other part of the orbital process is ex-

tended along the internal side of the upper back part of the maxillary bulb, to the base of the sphenoid bone, between the root of the processus azygos and the pterygoid process.

The palatine lamella of the palate-bone, and its pterygoid process, are firm and strong, with some cancelli; but the nasal-plate and orbital processes are very thin and brittle.

Articulation.

The palate-bones are *joined* to the maxillary, by the fore-edge of the palatine lamella, by the transverse palatine suture:—By their thin nasal plates, and part of their orbital processes, to the same bones, by the palato-maxillary sutures:—By their pterygoid processes, and the back part of their nasal plates, to the pterygoid processes of the sphenoid bone, by the sphenoid suture:—By the transverse ridges of the nasal palates, to the ossa spongiosa inferiora, by contact—By the orbital processes, to the ossa plana and cellulæ ethmoideæ, by the ethmoid suture:—To the body of the sphenoid bone, by the sphenoid suture: By the internal edge of the square bones, to each other by the longitudinal palatine suture; and by their nasal spines, to the vomer, by the spinous suture.

The palate bones form part of the palate, nostrils, orbits, and fossæ pterygoideæ; and they cover part of the sinus maxillares, sphenoidales, and ethmoidei.

These bones are very complete in a new-born infant, the nasal plates being then thicker and stronger than in adults; but the orbital processes have not the cells which appear in the adult bones.

OSSA TURBINATA.

Ossa turbinata, or *spongiosa inferiora*, resemble the superior ossa spongiosa in shape and substance, but have the anterior and posterior ends of their upper edges contiguous to the transverse ridges of the nasal processes of the maxillary and palate bones.

—From their upper straight edge, two small processes stand out: The posterior, which is the broadest, descends to cover some of the antrum Highmorianum; the anterior rises up

to join the *os unguis*, and to make part of the lacrymal duct.

Below the spongy bones already mentioned, there are sometimes two others, one in each nostril, which seem to be a production of the sides of the maxillary sinus turned downward. When this third sort of spongy bones is found, the middle one of the three in each nostril is the largest, and the lowest is the smallest.

The names of these bones sufficiently declare their spongy substance, which has no firm external plate covering it.

Articulation.

They are *joined* to the *ossa maxillaria*, *palati*, and *unguis*, in all subjects, by a firm union of substance.

Their *use* is, to straiten the nostrils, and probably to afford a large surface for extending the organ of smelling, although the olfactory nerves have not yet been traced upon them; to cover part of the *antra maxillaria*, and to assist in forming the under part of the lacrymal ducts, the orifices of which into the nose are concealed by these bones.

The *ossa turbinata* are nearly complete in a new-born infant.

VOMER.

Vomer, or bone resembling a ploughshare, is the thirteenth of the upper jaw, without a fellow, forming the lower and back parts of the partition of the nose.

The figure of this bone is an irregular rhomboid. Its sides are flat and smooth. Its posterior edge appears in an oblique direction at the back part of the nostrils. The upper one is firmly united to the base of the sphenoid bone, and to the nasal plate of the ethmoid; and, when it can be got separated, is hollow for receiving the *processus azygos* of the former. The anterior edge has a long furrow in it, where the middle cartilage of the nose enters. The lower edge is firmly united to the nasal spines of the maxillary and palate-bones. These edges of this bone are much thicker than its middle, which is as thin as the thinnest paper; by which, and the firm union or connection this bone has above and below, it can very seldom be separated entire in

adults ; but in a child this is much more easily effected, and its structure more distinctly seen.

Its situation is not always perpendicular, but often inclined to one side, as well as the nasal plate of the ethmoid bone.

The vomer is convex at its upper part ; and then is straight, as it is extended downward and forward, where it is composed of two plates ; the edges of which have a great number of small processes, disposed somewhat like the teeth of a saw, but more irregularly, and several of them are reflected back. Between these plates a deep fossa is left, which, so far as the top of the curvature, is wide, and has strong sides, for receiving the process azygos of the sphenoid bone. Beyond the arch forward, the fossa is narrower and shallower gradually to the point of the bone, receiving for some way the nasal lamella of the ethmoid ; which, after the ossification is complete, is so closely united to the vomer by the little processes piercing into its substance, as to prevent any separation : on which account this bone has been esteemed by some a part of the ethmoid bone. The middle cartilage of the nose fills up what remains of the fossa at its forepart. The posterior edge of the vomer, which appears above the back part of the palate bones, is broader above ; but as it descends forward, becomes thinner, though it is still solid and firm. The lower edge of this bone, which rests on the nasal spine of the palate and maxillary bones, has a little furrow on each side of a small middle ridge, answering to the spines of the bones of different sides, and the interstices between them. This edge and the upper one meet in the pointed fore end of this bone.

The body of the vomer has a smooth surface, and solid, but thin *substance* ; and towards its sides, where it is thickest, some cancelli may be observed when the bone is broken.

Articulation.

It is *joined* above to the sphenoid and ethmoid bones, and to the middle cartilage of the nose by schindylesis ; below, to the maxillary and palate bones by the spinous suture.

The vomer divides the nostrils ; and sustains the palate-plates of the maxillary and palate bones, which otherwise might be in hazard of being pressed inward ; while it is secured from shuf-

fling to one side or other by the double schindylesis, by which it is joined to the bones above and below.

These are all the bones of the upper jaw, except the teeth.

MAXILLA INFERIOR.

Maxilla inferior, the lower jaw, consists only of one moveable bone, and sixteen teeth incased into it.

This bone is situated at the lower part of the face, so as its convex middle part is forward, and its legs are stretched back. It is commonly divided into the chin, sides, and rami.—The *chin* is the middle forepart; the extent of which to each side is marked on the external surface by the holes observable there, and internally by the beginning of an oblique ridge. Beyond these the *sides* appear; and are continued till the bone, by bending upward, begins to form the *rami*.

On the forepart of the *chin*, a transverse ridge appears in the middle; on each side of which the depressores labii inferioris, and the levatores labii inferioris, depress the bone: And below these prints a small rising may be observed, where the depressores commence. On the back part of the chin, sometimes three, always two, small protuberances appear in the middle. To the uppermost, when it is seen, the frænum of the tongue is connected. From the middle one, the musculi genioglossi rise; and from the lowest, the geniohyoidei have their origin. Below the last, we see two rough sinuosities formed by the digastric muscles.

At the lower and forepart of the external surface of each *side* of the lower jaw, a small eminence may be observed, where the depressor labiorum communis rises. Above the middle of the side a ridge runs lengthwise, to which the under part of the musculus buccinator is connected.—Internally, toward the upper edge of each side, another ridge appears, from which the mylohyoidei have their origin, and to which the internal membrane of the gum adheres.

In the upper edge of both *chin* and *sides*, are a great many deep pits or sockets, for receiving the roots of the teeth. The number and magnitude of these sockets are various, because of

the different number, as well of the teeth themselves as of their roots, in different people. These sockets in this lower jaw, as well as in the upper one, are less deep as old age comes on: when freed from the teeth by any means, they are some time after filled up with an osseous net-work, which at last becomes entirely solid, and as smooth as any other part of the bone; so that in a great many old jaws one cannot observe a vestige of the sockets: but then the jaw becomes less, and much narrower. Hence we may know why the chin and nose of edentulous people are much nearer than before the teeth were lost; while their lips either fall in toward the mouth, or stand prominent forward.—When new teeth are protruded new sockets are formed. The lower edge of the chin and sides is smooth and equal, and is commonly called the base of the lower jaw. The ends of the base where the jaw turns upward, are called its angles; the external surface of each of which has several inequalities upon it, where the masseter muscle is inserted; as the internal surface also has, where the pterygoideus internus is inserted, and a ligament extended from the styloid process of the temporal bone is fixed.

The rami are one on each side, and each ramus is surmounted by two processes.—The anterior sharp thin *coronoid* ones have the temporal muscles inserted into them. The posterior processes or *condyles* terminate in an oblong smooth head, supported by a cervix. The heads, whose greatest strength is transverse, and whose convexity is turned forwards are tipped with a cartilage, as the articulated parts of all other moveable bones are. The forepart of the root and neck of these condyloid processes are a little hollow and rough where the external pterygoid muscles are inserted.

The *holes* of the lower jaw are two on each side; one at the root of the processes internally, where a large branch of the third branch of the fifth pair of nerves enters with an artery, and a vein returns. A small sharp process frequently juts out backward from the edge at the forepart of this hole, to which a ligament extended from the temporal bone is fixed, which saves the nerve and vessels from being too much pressed by the pterygoid muscles.—From the lower side of this hole, either a small su-

perforial canal or a furrow descends, where a branch of the nerve is lodged, in its way to the mylo-hyoideus muscle and sublingual gland. The other hole is external, at the confines of the chin, where branches of the nerve and vessels come out. The canal betwixt these two holes is formed in the middle of the substance of the bone, and is pierced by a great number of small holes, by which the nerves and blood-vessels of the cancelli and teeth pass. This canal is continued a little further than the external hole at the chin.

The *surface* of the lower jaw is hard and firm, except at the spongy sockets, where, however, it is stronger than the upper jaw. Its internal *substance* is cellular, without any solid partition between the cancelli in its middle. At the base, especially of the chin, where this bone is most exposed to injury, the solid sides of it are thick, compact, and hard.

Articulation.

The lower jaw generally receives the roots of sixteen teeth into its sockets, by *gomphosis*; and its condyloid processes, covered with cartilage, are articulated with the temporal bones, in a peculiar manner: for, as was already mentioned in the description of the temporal bones, not only the forepart of the cavity between the zygomatic auditory and vaginal processes, but also the adjoining tubercle at the root of the zygomatic process of each os temporis, is covered with a smooth cartilage for this articulation. Here also an intermediate moveable cartilage is placed; which being thin in the middle, and thick at the edges, is concave on both sides; and is connected so firmly by ligaments to each condyle, as to follow the motions of the condyle; and so loosely to the temporal bone as readily to change its situation from the cavity to the tubercle, and to return again; while the common ligament of the articulation affords space enough for such a change of place backward and forward; but like other ligaments of the joints by *ginglimus*, is strong and short at the sides, to confine the lateral motions.

When therefore the teeth of both jaws coincide, the condyles are lodged securely in the temporal cavities; but their motions to either side must be confined both by the firmness of the ligaments, and the rising brims which are on each side of the cavi-

ties.—When the jaw is brought directly forward, the condyle and intermediate cartilages descend and advance forward upon the tubercles. In this situation the lateral motions are a little more free than in the former one, from the want of rising brims to stop the condyles. When the fore-teeth of the lower jaw are moved forward and to a side, the condyle of the opposite side is either advanced from the cavity to the tubercle, while the condyle of the same side remains in the cavity; or if both condyles are on the tubercles, the condyle of the side to which the motion is made slides back from the tubercle to the cavity. When the mouth is opened by the descent of the lower jaw, the forepart of it, where the depressing muscles are fixed, is drawn backward, as well as downward, while resistance is made to the angles moving backward by the masseter and internal pterygoid muscles, and at the same time the external pterygoid draw the condyles and their moveable cartilages forward; and therefore when the mouth is opened the condyles are carried forward upon the tubercles, and the axis of motion of the bone is a little above its angles. But in this situation there is less resistance than in any other, to the condyles luxating forward: an accident which seldom happens, except when people are gaping too wide. In chewing there is a succession of the motions above described.

Here a general remark may be made, That wherever moveable cartilages are found in joints, either the articulated bones are of such a figure, or so joined and fixed by their ligaments, that little motion would be allowed without such cartilages; or else additional motions are necessary, which the form of the articulation would not otherwise admit of. This will more fully appear after the other joints with such cartilages are described.

In a child born to the full time, the lower jaw is composed of two bones, connected by a thin cartilage in the middle of the chin, which gradually ossifies, and the two bones intimately unite. In each of these bones there are five or six sockets for teeth, as in the upper jaw.

After we have thus described the incasement of the teeth; the insertion of so many muscles of the tongue, and of the os hyoides; the connection of the membrane of the tongue to the

maxillary bone, and the motions of this bone ; it is easy to see, that the lower jaw must be a principal instrument in manducation, deglutition, and speech.

THE TEETH.

The teeth are the hard white bodies placed in the sockets of both jaws. Their number is generally sixteen above, and as many below ; though some people have more, and others fewer.

The broad thick part of each tooth which appears without the socket, is the *head* or *corona*. The smaller processes sunk into the maxillæ, are the *roots* or *fangs* ; which become gradually smaller toward the end farthest from the base, or are nearly conical ; by which the surface of their sides divides the pressure made on the bases, to prevent the soft parts, which are at the small points of the sockets, from being hurt by such pressure. At the place where the base ends and the roots begin, there is generally a small circular depression, which some call the *neck*.

Without the gums the teeth are covered with no membrane, but have a periosteum within the sockets, which after a good injection may be evidently seen in a young subject ; and it may be discovered in any tooth recently pulled, by macerating it in water. The adhesion of this membrane to these roots is strengthened by the small furrows observable on them.

Each tooth is composed of its *cortex* or enamel, and an internal *bony* substance. The *cortex* has no cavity or place for marrow ; and is so solid and hard, that saws or files can with difficulty make impression on it. It is thickest upon the base, and gradually becomes thinner towards the cervix. The fibres of this enamel are all perpendicular to the internal substance ; and are straight on the base, but at the sides are arched with a convex part toward the roots, which makes the teeth resist the compression of any hard body between the jaws, with less danger of breaking these fibres than if they had been situated transversely.

The ingenious SOEEMMERRING thinks himself the author of the discovery that the teeth consist of curved as well as radiated fibres ; but it illustrates the great talents of the first MONRO that he observed this fact half a century ago.

The spongy sockets in which the teeth are placed, likewise serve better to prevent such an injury than a more solid base would have done.—Notwithstanding the great hardness of this cortex, it is wasted by manducation. Hence the sharp edges of some teeth are blunted and made broad, while the rough surfaces of others are made smooth and flat, as people advance in life. The *bony part* of the teeth has its fibres generally running straight, according to the length of the teeth.

The teeth have *canals* formed in their middle, wherein their nerves and blood-vessels are lodged: which they certainly need to preserve, in so unfavourable a situation as the mouth, the existence of so much animal matter as enters into their composition.

The vessels are easily traced so long as they are in the large canal, but cannot be observed in their distribution from that to the substance of the teeth of adults. Ruysch however affirms, that after injection he could trace the arteries into the hardest part of the teeth.

Every root of each tooth has a distinct canal, with vessels and nerves in it. These canals in those teeth which have more than one root, come nearer each other as they approach the base of the tooth; and at last are only separated by very thin plates, which being generally incomplete, allow a communication of all the canals; and frequently one common cavity only appears within the base, in which a pulpy substance composed of nerves and vessels is lodged. The condition therefore of the nerves here bears a strong analogy to that of the cutaneous nerves which serve for the sensation of touching.

The entry of the canals for these vessels is a small hole placed a little to a side of the extreme point of each root; sometimes, especially in old people, this hole is entirely closed up, and consequently the nerves and blood-vessels are destroyed.

The teeth are *joined* to the sockets by *gomphosis*, and the gums contribute to fix them there.

The *uses* of the teeth are to masticate our aliment, and to assist us in the pronunciation of several letters.

Though thus the teeth so far agree in their structure, yet because of some things wherein they differ, they are generally

divided into three classes, viz. *incisores*, *canini*, and *molaes*. By Mr. Hunter, the *canini* are called *cuspidati*, and the first and second *molaes* are called *bicuspides*.

The *incisores* are the four front teeth in each jaw, receiving their name from their office of cutting our aliment; for which they are excellently adapted, being each formed into a sharp-cutting edge by their foreside turning inward, while they are sloped down and hollowed behind; so that they have the form of wedges, and therefore their power of acting must be considerably increased.—Seeing, in the action of the *incisores*, a perpendicular compression is only necessary, without any lateral motion, they are not so firmly fixed in their sockets as the other teeth are, each having only one short root; but that is broader from before backward, than to either side, to have the greatest strength where it is exposed to the strongest force.

The two middle *incisores* of the upper jaw are broader and longer generally than the lateral ones, or than any of those of the under jaw, while the lateral ones of the under jaw are larger than the middle ones. The *incisores* of the upper jaw protrude further outward, and in part cover those of the under jaw.

The *incisores* have on their sides little or no enamel.

The *canini*, from the resemblance to dogs' tusks, are one on each side of the *incisores* in each jaw.—The two in the upper jaw are called *eye-teeth*, from the communication which is said to be betwixt them and the eyes.—The two in the lower jaw are named *angular* or *wike-teeth*, because they support the angles of the mouth.

These teeth are broader, longer, and stronger than the *incisores*. Their heads are formed into a sharp edge, as the *incisores* are, only that the edge rises into a point at the middle. Each of them has generally but one long root, though sometimes they have two. The roots are crooked toward the end. The *canini* of the upper jaw are larger, longer, and with more crooked roots, than those of the under jaw. The form of their head is fit both for piercing and cutting, and the long crooked root of each makes it secure in the socket.

The *canini* or *cuspidati*, are not exactly in the arch of the jaw, they project somewhat from it. Hence the four *incisores* and two *cuspidati* are almost in a right line. This is more remarkable

in the lower jaw, The cuspidati differ from the incisores, in having their sides and edges covered with enamel.

The dentes molares, or grinders, which have got their name from their office, are generally five in each side of each jaw; in all twenty. Their bases are broader, more scabrous, and with a thinner cortical substance than the other teeth. They have also more roots; and as these roots generally divaricate from each other, the partitions of the sockets between them bear a large share of the great pressure they suffer, and hinder it from acting on their points.

The base of the first grinder has an edge pointed in the middle, on its outside, resembling the canini, from which it slopes inward till it rises again into a point. It has generally but one root, which sometimes is long and crooked at its point.

The second dens molaris has two points on its base, rising near equally on its out and inside. It has two roots, either separate or together, but shorter than the root of the first. These two anterior grinders or bicuspidæ, are much smaller than the three that are placed farther back in the mouth.

Both bicuspidæ have less enamel laterally than the cuspidati, but more than the incisores. Mr. Hunter says, that the bicuspidæ, and especially the second of both jaws, are oftener naturally wanting than any of the teeth, except the dentes sapientiæ. He thinks they are less useful, considering them of a middle nature between incisores and molares.

The third and fourth are very broad in their bases, with four or five points standing out; and those of the under jaw have two, those of the upper three roots, the terminations of which are generally curved somewhat backward.

The fifth called commonly *dens sapientiæ*, from its coming through the gums later than the other grinders, has four points on its base, which is not so large as the base of the third and fourth, and its roots are less numerous.

The incisores of the upper jaw being broader than those of the lower jaw, make the superior grinders to be placed so much further back than the lower ones, that when they are brought together, by shutting the mouth, the points of the grinders of the one jaw enter into the depressions of the opposite grinders, and

they are all equally applied to each other, notwithstanding the inequality of the surface of each.

The numerous roots of the *dentes molares* prevent their loosening by the lateral pressure they suffer in grinding ; and as the sockets in the upper jaw are more spongy, and the teeth are more liable, by their situation, to fall out, the grinders there have more numerous and more separated roots than in the lower jaw. The number, however, of the roots of the teeth of both jaws is very uncertain ; sometimes they are more, sometimes fewer ; frequently several roots are joined together ; at other times they are all distinct. The disposition of such as are distinct is also various ; for in some the roots stand out straight, in others they separate, and in others again they are crooked inward. When the roots are united, we can still distinguish them, by remarking the number of small holes at their points, which determine the number of roots each tooth ought to be reckoned to have.

In a *fœtus* of three or four months old, there are no bony partitions between the anterior and posterior surfaces of the alveolar process ; but instead of them, there are ridges across the bottom of the longitudinal groove, with intermediate depressions, marking the beginnings, of future *alveoli*.

There is no distinct canal yet, for the blood-vessels and nerves of the lower jaw ; but a mere groove at the bottom of the alveolar cavity.

The ridges which are to form the partitions of the *alveoli* extend upward on the internal surfaces of the anterior and posterior plates of the alveolar process, and shoot across from the sides, forming arches : and as the intercepted cells become deeper, their apertures contract, and are at length almost closed. This contraction seems to answer a good end ; it supports the gum till the teeth are come through. The *alveoli* of the three last grinders are formed after a different manner. They are formed in the root of the coronoid process of the lower jaw, and in the tubercles of the upper jaw ; so that they come forward in proportion as the body of the lower jaw comes forward, from under that process.

So much for the *alveoli* : we are next to speak of the *Teeth* ; the rudiments of which, in a foetus of three or four months, are four or five little pulpy substances, contained in the beginnings of the *alveoli*. Each pulp is of a firm texture, transparent and very vascular. It is attached only at the bottom of the cavity which forms the *alveoli*, and there the vessels enter. The pulp having become almost as large as the body of the tooth, ossification commences, but the pulp does not immediately cease growing.

The pulpy substances are loosely invested with a thin *capsula* ; which if sought for, in a recently born child, is found easily separable into two membranes ; the external of which is soft, spongy, but not vascular ; it adheres to the gum where it covers the *alveoli* ; the internal membrane is firmer and very full of vessels ; which it receives from those that go to the pulp and body of the tooth. Between this pulp and membranous capsule, there is a liquor like *synovia*.

The *capsula* is necessarily perforated when the tooth has come through the gum ; and as its lower part encompasses the neck of the tooth, it is gradually removed as the tooth is completed.

Now the points of ossification appear in one, or in many parts, on the surface of the pulp. If there be only one point of ossification, it enlarges till the tooth is formed. If there be many, they all increase, till they meet and unite ; when they become as one point of ossification, extending and covering the whole pulp. In the progress of ossification, that part of the pulp is always the more vascular, which is covered with bone ; though the bony part cohere so slightly to the pulp as to be easily separated from it, without any seeming laceration.

The pulp, which bears a resemblance to the body of the tooth, being covered with bone, contracts, and thus forms the neck ; after which the fang begins to be formed, and raises the body of the tooth against the top of the socket, which is consequently rendered thin ; and at length, both it and the gum which covered the socket, are removed. There is no part of the pulp which corresponds with the fang of a tooth ; but we can readily conceive how that defect is compensated : for as the cavity in

the body of the tooth is gradually lessened, a part of the pulp is gradually forced out, elongated and formed into a fang. As this fang passes deeper into the socket, the tooth is proportionally protruded. But the socket also accommodates itself to the beginning of the fang, or neck of the tooth : it contracts around the incipient fang, and passes along with it ; whilst the *alveolus*, which contained the body of the tooth, is contracted in its whole length, over the fang ; or is absorbed, to make room for another.

There is only one cavity in the body of any tooth ; and if it have more fangs than one, the ossification shoots from opposite sides ; both or all meeting and dividing the opening of the cavity in the middle of the tooth, from each of which divisions the fangs grow.

If there be three fangs, ossification proceeds from three points of the circumference, which converge to a centre, so as to make three apertures to the cavity in the body of the tooth ; and from the edges of these apertures the fangs are formed.

The *Enamel* is not formed before the bony part of a tooth. But there is another pulpy substance opposite to that which we have described ; it adheres to the inside of the *capsula*, where the gum is joined to it, and its opposite surface lies in contact with the basis of the above described pulp, and afterward with the new formed basis of the tooth ; whatever eminences or cavities the one has, the other has the same, but reversed, so that they are moulded exactly to each other. The best time for examining it is in a foetus of seven or eight months old. It is thinner than the other pulp, decreases as the teeth advance, but does not seem to be possessed of many vessels. As soon then as the bony part of a tooth is formed, it is covered with a thin coat of enamel, which encreases in thickness, till some time before the tooth begins to cut the gum. Now the enamel is perhaps secreted from this pulp, and the *capsula* of the body of the tooth ; after it is secreted it crystallizes ; hence we see the cause why it appears striated when broken. Where the enamel is first formed there it is always thickest ; and it is thinnest at the neck ; for there is no enamel on the fang.

The *cavity of teeth*, which is like that of the body superiorly,

but gradually contracted inferiorly toward the opening at the extremity of the fang, is not cellular, nor does it contain marrow, but is smooth, and filled with blood-vessels, and nerves, connected together by cellular substance.

The ossification of the incisores begins at three points; the middlemost being the highest and the first that begins. The cuspidati have only one point of ossification; the bicuspidates have two; and the molares have four or five: the external being always first formed.

After the stamina of the two sets of teeth are formed, each of the incisores has its own socket, those nearest to the edge of the gums being placed more forward, and the others lodged farther back within the jaw-bone. The canini of a child are in much the same condition as the incisores are.—And at the time of birth, only two dentes molares have begun to ossify, and that at little more than the head, which has several sharp points standing out from it. The temporaneous grindees are placed more directly upon the internal set than the other two classes are; sometimes there is a piece of the bone of the jaw between the two sets; in other children, the two sets have no bone interposed between them.

Thus, in the young jaw the bicuspidates are omitted, and the teeth are twenty in number: eight incisores, four cuspidati, and eight molares. All these are apparent at two years of age, and their number does not increase till they are about seven years old, when the teeth that first made their way through the gums are shed, and more begin to discover themselves farther back in the mouth. About fourteen years of age, the rest of the first set are shed, and the number is increased.

The second set of teeth however, do not push out the first, for the second set is formed in distinct sockets, and the fangs of the first set gradually decay, as the succeeding teeth grow. That this doth not depend on the constant pressure from below, is evident from this, that the decay of the fangs of the first set is always in proportion to the decay of the first sockets, and the new teeth arise in new, distinct sockets. Nay, the secondary teeth are enclosed in their *alveoli* after the primary ones have fallen, and consequently are not injured by pressure.

According to the division made of the skeleton, we should now proceed to the description of the *trunk* of the body. But we must first consider a bone which cannot well be said to belong to either the head or the trunk; nor is it immediately joined to any other, and therefore is very seldom preserved with skeletons. However, it is generally described by authors after the bones of the face. In obedience, therefore, to the prevailing method, we shall next examine the structure of the

OS HYOIDES.

This bone is situated horizontally between the root of the tongue and the larynx. It is properly enough named *hyoides*, from the resemblance it bears to the Greek letter υ ; and may, for a clearer demonstration of its structure, be distinguished into its *body*, *cornua*, and *appendices*.

The *body* is the middle broad part, convex before and hollow behind.—The convex forepart is divided into two by a ridge, into the middle of which the mylo-hyoidei, and into the sides the stylo-hyoidei, are inserted.—Above the ridge, the bone is horizontal; but pitted in the middle by the insertion of the two genio-hyoidei, and a little hollowed more laterally by the basioglossi.—Below the ridge, it is convex; but a little flattened in the middle by the sterno-hyoidei, and pitted more externally by the coraco-hyoidei.—The concavity behind faces backward and downward to receive the thyroid cartilage, when the larynx and the os hyoides are pulled toward each other by the action of the sterno-hyoidei and hyothyroidei muscles; and to its upper edge, the ligamentous membranes of the epiglottis, tongue, and thyroid cartilage, are fixed.

The *cornua* of the os hyoides are stretched backward from each side of its body, where often a small furrow points out the former separation; for in young subjects, the body and cornua are not one continued substance, as they come afterward to be in adults. These cornua are not always straight, nor of an equal length; their two plain surfaces stand obliquely sloping from above outward and downward.—Into the external, the cerato glossus is inserted above, and the thyro-hyoideus below; and to the

one behind, the ligamentous membrane of the tongue and larynx adheres. Each of the cornua becomes gradually smaller as it is extended from the base; but ends in a round tubercle, from which a moveable cartilage stands out, which is connected to the upper process of the cartilago thyroidea.

Where the body of the os hyoides joins on each side with its cornua, a small styliform process, called *appendix*, rises upward and backward, into which the stylo-hyoidei alteri, and part of the hyo-glossi are fixed. From each of them a ligament is sometimes extended to the styloid processes of the temporal bones, to keep the os hyoides from being drawn too much forward or downward. The part of this ligament next to these processes sometimes forms into several cartilages, which afterwards ossify in old people. Ruysch says, that he has seen this ossification continued as far up as the styloid processes, which were therefore joined to the os hyoides by ankylosis.

The *substance* of the os hyoides is cellular; but covered with a firm external plate, which is of sufficient strength to bear the actions of so many muscles as are inserted into it.

It is not *articulated* with any bone of the body, except by means of the muscles and ligaments mentioned.

The *use* of the os hyoides, is to serve as a solid lever for the muscles to act with, in raising or depressing the tongue and larynx, or in enlarging and diminishing the capacity of the fauces.

At birth, this bone is in a cartilaginous state; excepting a small point of bone in the middle of its body, and in each of the cornua.-- The appendices frequently remain cartilaginous many years.

OF THE TRUNK.

The trunk consists of the *spine*, *pelvis*, and *thorax*.

THE SPINE.

The spine is the long pile of bones extended from the condyles of the occiput to the end of the rump. It somewhat resembles

two unequal pyramids joined in a common base. It is not, however, straight; for its upper part being drawn backward by strong muscles, it gradually advances forward, to support the œsophagus, vessels of the head, &c. Then it turns backward, to make place enough for the heart and lungs. It is next bended forward to support the viscera of the abdomen. It afterward turns back, for the enlargement of the pelvis. And, lastly, it is reflected forward, for sustaining the lowest part of the great gut.

The spine is commonly divided into *true* and *false vertebræ*; the former constituting the long upper pyramid, which has its base below; while the false vertebræ make the shorter lower pyramid, whose base is upward.

TRUE VERTEBRÆ.

The true vertebræ are the twenty-four upper bones of the spine, on which the several motions the trunk of our bodies are performed; from which use they have justly got their name.

Each of these vertebræ is composed of its body and processes.

The *body* is the thick spongy forepart, which is convex before, concave backward, horizontal and plain in most of them above and below. Numerous small holes, especially on the fore and back part of their surface, give passage to their vessels, and allow the ligaments to enter their substance. The edges of the body of each vertebra are covered, especially at the forepart, with a ring of bone firmer and more solid than the substance of the body any where else. These rings seem to be joined to the vertebræ in the form of epiphyses, but are alleged by some to be the ligaments ossified. They are of great use in preventing the spongy bodies from being broken in the motions of the trunk.

Between the bodies of each two adjoining vertebræ, a substance between the nature of ligament and cartilage is interposed; which seems to consist of concentric curved fibres, when it is cut horizontally; but when it is divided perpendicularly, the fibres appear oblique and decussating each other. The outer part of the intervertebral ligaments is the most solid and hard, and they gradually become softer till they are almost in the form of a glairy liquor in the centre. The external fibrous part of each

is capable of being greatly extended, and of being compressed into a very small space, while the middle fluid part is incompressible, or nearly so; and the parts of this ligament between the circumference and centre approach in their properties to either, in proportion to their more solid or more fluid texture. The middle point is therefore a fulcrum or pivot, on which the motion of a ball and socket may be made, with such a gradual yielding of the substance of the ligament, in whichever direction our spines are moved, as saves the body from violent shocks, and their dangerous consequences. This ligamento-cartilaginous substance is firmly fixed to the horizontal surfaces of the bodies of the vertebræ, to connect them; in which it is assisted by a strong membranous ligament, which lines all their concave surface, and by still a stronger ligament that covers all their anterior convex surface.

We may lay it down as a general rule, notwithstanding some exceptions, That the bodies of the vertebræ are smaller, and more solid above; but, as they descend, they appear larger and more spongy; and that the cartilages between them are thick, and the surrounding ligaments strong, in proportion to the largeness of the vertebræ, and to the quantity of motion they perform: by which disposition, the greater weight is supported on the broadest best-secured base, and the middle of our body is allowed a large and secure motion.

From each side of the body of each vertebræ, a bony bridge is produced backward, and to a side: from the posterior end of which one slanting *process* rises, and another descends; the flattest side of each of these four processes, which are called the *oblique*, is covered with a smooth cartilage; and the two lower ones of each vertebra are articulated with the two upper or ascending oblique processes of the vertebra below, having their articular ligaments fixed into the rough line round their edges.

From between the oblique processes of each side, the vertebra is stretched out laterally into a process that is named *transverse*.

From the back part of the roots of the two oblique and of the transverse process of each side, a broad oblique bony plate is extended backward; where these meet, the seventh process of the vertebræ takes its rise, and stands out backward: this being ge-

nerally sharp-pointed and narrow-edged, has therefore been called *spinal process* ; from which this whole chain of bones has got its name.

Besides the common ligament which lines all the internal surface of the spinal processes, as well as of the bodies, there are particular ligaments that connect the bony bridges and processes of the contiguous vertebræ together.

The substance of the processes is considerably stronger and firmer, and has a thicker external plate, than the bodies of the vertebræ have.

These seven *processes* form a concavity at their forepart, which, joined to the one at the back part of the bodies, makes a great hole ; and the holes of all the vertebræ form a long large conduit for containing the spinal marrow. In the upper and lower edge of each lateral bridge, there is a notch. These are so adapted to each other in the contiguous vertebræ, as to form a round hole in each side between each two vertebræ, through which the nerves that proceed from the spinal marrow and its blood-vessels pass.

Articulation.

The *articulations*, then, of these true vertebræ are plainly double : for their bodies are joined by the intervening cartilage above described ; and their oblique processes, being tipped with cartilage, are so connected by their ligaments as to allow a small degree of motion to all sides. Hence it is evident, that their centre of motion is altered in different positions of the trunk : for, when we bow forward, the upper moved part bears entirely on the bodies of the vertebræ ; if we bend back, the oblique processes support the weight ; if we recline on one side, we rest upon the oblique processes of that side and part of the bodies ; if we stand erect, all the bodies and oblique processes have their share in our support.

Hence it follows, 1. That as the joints of which the spine is composed are so numerous, the spinal marrow, nerves, blood-vessels, &c. are not liable to such compression and over-stretching in the motion of the trunk as they would be if fewer and longer vertebræ were employed ; but several vertebræ are concerned in every motion of the spine ; and therefore a very small curva-

ture is made at the conjunction of any two. 2. That an erect posture is the surest and firmest, because the surface of contact of the fulcra is largest, and the weight is most perpendicular to them. 3. That the muscles which move the spine act with greater force in bringing the trunk to an erect posture than in drawing it to any other: for in bending forward, backward, or to a side, the muscles which perform any of these actions are nearer the centre of motion; consequently the lever with which they act is shorter than when the centre of motion is on the part of the vertebra, opposite to that where these muscles are inserted; which is the case in raising the trunk. This is extremely necessary; since, in the deflections of the spine from a perpendicular bearing, the weight of the body soon inclines it which way we design; whereas, in raising us erect, this great weight must be more than counteracted. 4. In calculating the force exerted by the muscles which move the spine, we should always make allowance for the action of the cartilages between the vertebræ, which, in every motion from an erect posture, must be stretched on one side, and compressed on the other, to both which they resist; whereas, in raising the trunk, these cartilages assist by their springy force. 5. We hence understand the reason of our height of stature increasing in the morning, and diminishing at night: for the intermediate cartilages of the vertebræ being pressed all day long by the weight of our body, become more compact and thin in the evening; but, when they are relieved from this pressure in the night, they again expand themselves to their former thickness: and seeing the bulk of any part must vary according to the different distension or repletion of the vessels composing it, we may understand how we become taller, after a plentiful meal, and decrease after fasting or evacuations. 6. From the different articulations of the bodies and oblique processes of the vertebræ, and the different strength of the ligaments, it is plain, that they are formed so as to allow much larger motion forward than backward; this last being of much less use, and might be dangerous, by overstretching the large blood-vessels that are contiguous to the bodies of the vertebræ. 7. The intervertebral cartilages shrivelling as they become more

solid by age, is the cause why old people generally bow forward, and cannot raise their bodies to such an erect posture as they had in their youth.

The *uses* of the true vertebræ are, to give us an erect posture ; to allow sufficient and secure motion to the head, neck, and trunk of the body ; and to support and defend the bowels and other soft parts.

At the ordinary time of birth, each vertebra consists of three bony pieces, connected by cartilages ; to wit, the body, which is not fully ossified ; and a long crooked bone on each side, on which we see a small share of the bony bridge, the oblique processes complete, the beginning transverse processes, and the oblique plate, but no spinal processes : so that the teguments are in no danger of being hurt by the sharp ends of these spinal processes, while a child is in its bended posture in the womb, or while it is squeezed in the birth.

Though the true vertebræ agree in the general structure which I have hitherto described ; yet, because of several specialities proper to a particular number, they are commonly divided into three classes, viz. *cervical*, *dorsal*, and *lumbar*.

The *cervical* are the seven uppermost vertebræ ; which are distinguished from the rest by these marks.—Their bodies are smaller and more solid than any others ; and flatted on the forepart by the pressure of the œsophagus and the action of the *longi colli* and *recti antici*. They are also flat behind, where small processes rise, to which the internal ligaments are fixed. The upper surface of the body of each vertebra is made hollow, by a slanting thin process which is raised on each side :—the lower surface is also evacuated, but in a different manner ; for here the posterior edge is raised a little, and the one before is produced a considerable way.

The cartilages between these vertebræ are thick, especially at their forepart ; which is one reason why the vertebræ advance forward as they descend, and have larger motion.

The *oblique* processes of these bones of the neck more justly deserve that name than those of any other vertebræ. They are situated slantingly ; the upper ones having their smooth and

almost flat surfaces facing obliquely backward and upward, while the inferior oblique processes have these surfaces facing obliquely forward and downward.

The *transverse* processes of these *vertebræ* are framed in a different manner from those of any other bones of the spine: for, besides the common transverse process rising from between the oblique processes of each side, there is a second one that comes out from the side of the body of each *vertebræ*; and these two processes, after leaving a circular hole for the passage of the cervical artery and vein, unite, and are considerably hollowed at their upper part, with rising sides, to protect the nerves that pass in the hollow; and at last each side terminates in an obtuse point, for the insertion of muscles.

The *spinal* processes of these cervical bones stand nearly straight backward, are shorter than those of any other *vertebræ*, and are forked or double at their ends; and hence allow a more convenient insertion to muscles.

The thick *cartilages* between the bodies of these cervical *vertebræ*, the obliquity of their oblique processes, and the shortness and horizontal situation of their spinal processes, all conspire to allow them large motion.

The *holes* between the bony cross bridges, for the passage of the nerves from the spinal marrow, have their largest share formed in the lowest of the two *vertebræ*, to which they are common.

So far most of the cervical *vertebræ* agree; but they have some particular differences, which oblige us to consider them separately.

The first, from its use of supporting the head, has the name of *atlas*.

This *vertebra*, contrary to all the other *vertebræ* of the spine, has no body; but, instead of it, there is a bony arch.—On the convex forepart of this arch a small rising appears, where the *musculi longi colli* are inserted; and, on each side of this protuberance, a small cavity may be observed, where the *recti minores* take their rise.—The upper and lower parts of the arch are rough and unequal, where the ligaments that con-

nect this vertebra to the os occipitis, and to the second vertebra, are fixed.—The back part of the arch is concave, smooth, and covered with a cartilage, in a recent subject, to receive the tooth-like process of the second vertebra.—In a first vertebra, from which the second has been separated, this hollow makes the passage for the spinal marrow to seem much larger than it really is : on each side of it a small rough sinuosity may be remarked, where the ligaments going to the sides of the tooth-like process of the following vertebra are fastened ; and on each side a small rough protuberance and depression is observable, where the transverse ligament, which secures the tooth-like process in the sinuosity, is fixed, and hinders that process from injuring the medulla spinalis in the sections of the head.

The atlas has as little spinal process as body ; but, instead thereof, there is a large bony arch, that the muscles which pass over this vertebra at that place might not be hurt in extending the head. On the back and upper part of this arch there are two depressions, where the recti postici minores take their rise ; and at the lower part are two other sinuosities, into which the ligaments which connect this bone to the following one are fixed.

The superior oblique processes of this atlas are large, oblong, hollow, and more horizontal than in any other vertebra. They rise more in their external than internal brim ; by which their articulations with the condyloid processes of the os occipitis are firmer.—Under the external edge of each of these oblique processes is the fossa, or deep open channel, in which the vertebral arteries make the circular turn, as they are about to enter the great foramen of the occipital bone, and where the tenth pair of nerves go out. This fossa is sometimes covered with bone, the inferior oblique processes, extending from within outward and downward, are large, concave, and circular. So that this vertebra, contrary to the other six, receives the bones with which it is articulated both above and below.

The transverse processes here are not much hollowed or forked ; but are longer and larger than those of any other vertebra of the neck, for the origin and insertion of several muscles ; of which those that serve to move this vertebra on the second have a con-

siderable lever to act with, because of the distance of their insertion from the axis of revolution.

The hole for the spinal marrow is larger in this than in any other vertebra, not only on account of the marrow being largest here, but also to prevent its being hurt by the motions of this vertebra on the second one. This large hole, and the long transverse processes, make this the broadest vertebra of the neck.

The condyles of the os occipitis move forward and backward in the superior oblique processes of this vertebra; but from the figure of the bones forming these joints, it appears, that very little motion can here be allowed to either side; and there must be still less circular motion.

In new-born children this vertebra has only the two lateral pieces ossified; the arch, which it has at its forepart instead of a body, being cartilaginous.

The second vertebra colli is called *dentata*, from the tooth-like process on the upper part of its body.

The body of this vertebra is somewhat of a pyramidal figure, being large, and produced downward, especially at its foreside, to enter into a hollow of the vertebra below; while the upper part has a square process, with a small point standing out from it. This it is that is imagined to resemble a tooth, and has given name to the vertebra.—The side of this process, on which the hollow of the anterior arch of the first vertebra plays, is convex, smooth, and covered with a cartilage; and it is of the same form behind, for the ligament, which is extended transversely from one rough protuberance of the first vertebra to the other, and is cartilaginous in the middle, to move on it.—A ligament likewise goes out in an oblique transverse direction, from each side of the processus dentatus, to be fixed at its other end to the first vertebra, and the occipital bone; and another ligament rises up from near the point of the process to the os occipitis.

The superior oblique processes of this vertebra *dentata* are large, circular, very nearly in an horizontal position, and slightly convex, to be adapted to the inferior oblique processes of the first vertebra.—The inferior oblique processes answer exactly

to the description given of those common to all the cervical vertebræ.

The transverse processes of the vertebra dentata are short, very little hollowed at their upper part, and not forked at their ends; and the canals through which the cervical arteries pass are reflected outward about the middle substance of each process; so that the course of these vessels may be directed towards the transverse processes of the first vertebra. Had this curvature of the arteries been made in a part so moveable as the neck is, while they were not defended by, and fixed to that bone, scarce a motion could have been performed without the utmost hazard of compression, and a stop put to the course of the liquids. Hence we observe this same mechanism several times made use of, when there is any occasion for a sudden curvature of a large artery.

The spinal process of this vertebra dentata is thick, strong, and short, to give sufficient origin to the recti majores postici and obliqui inferiores, and to prevent the contusion of these and other muscles in pulling the head back.

This second vertebra consists, at the birth, of four bony pieces: for, besides the three which I already mentioned as common to all the vertebræ, the tooth-like process of this bone is begun at this time to be ossified in its middle, and is joined as an appendix to the body of the bone.

The head then moves forward and backward on the first vertebra, as was already said, while the atlas performs the circumgyratio upon the second vertebra; the inferior oblique processes of the first vertebra shuffling easily in a circular way on the superior oblique processes of the second, and its body or anterior arch having a rotation on the tooth-like process, by which the perpendicular ligament that is sent from the point of the tooth-like process to the occipital bone is twisted, while the lateral ligaments that fix the processus dentatus to the sides of the first vertebra, and to the os occipitis, are very differently affected; for the one upon the side towards which the face is turned by the circumgyratio is much shortened and lax, while the opposite one is stretched and made tense, and, yielding at last no more, prevents the head from turning any farther round on the axis. Besides

the revolution on this axis, the first vertebra can move a small way to either side; but is prevented from moving backward and forward by its anterior arch, and by the cross ligament, which are both closely applied to the tooth-like process. Motion forward here would have been of very bad consequence, as it would have brought the beginning of the spinal marrow upon the point of the processus dentatus.

The use of the rotatory motion of the head is of course apparent, and the axis of rotation was altogether proper to be at this place; for, if it had been at a greater distance from the head; the weight of the head, if it had at any time been removed from a perpendicular bearing to the small very moveable joint, and thereby had acquired a long lever, would have broken the ligaments at every turn inconsiderately performed, or these ligaments must have been formed much stronger than could have been connected to such small bones. Neither could this circular motion be performed on the first vertebra without danger, because the immoveable part of the medulla oblongata is so near, that at each large turn, the beginning of the spinal marrow would have been in danger of being twisted, and of suffering by the compression this would have made.

It is necessary to observe, that the lateral or moderator ligaments confine so much the motion of the first vertebra upon the second, that though this joint may serve us on several occasions, yet we are often obliged to turn our faces farther round than could be done by this joint alone, without the greatest danger of twisting the spinal marrow too much, and also of luxating the oblique processes; therefore, in large turns of this kind, the rotation is assisted by all the vertebræ of the neck and loins; and if this is not sufficient, we employ most of the joints of the lower extremities.—This combination of a great many joints towards the performance of one motion, is also to be observed in several other parts of the body; notwithstanding such motion's being generally said to be performed by some single joint only.

The third, fourth, fifth, and sixth vertebræ, have nothing particular in their structure, but all their parts come under the ge-

neral description formerly given, each of them being larger as they descend.

The seventh vertebra of the neck is near to the form of those of the back, having the upper and lower surfaces of its body less hollow than the others : the oblique processes are more perpendicular ; neither spinal nor transverse processes are forked. This seventh and the sixth vertebra of the neck have the hole in each of their transverse processes more frequently divided by a small cross bridge, that goes between the cervical vein and artery, than any of the other vertebræ.

The twelve DORSAL may be distinguished from the other vertebræ of the spine by the following marks.

Their bodies are of a middle size betwixt those of the neck and loins :—they are more convex before than either of the other two sorts ; and are flattened laterally by the pressure of the ribs, which are inserted into small cavities formed in their sides. This flattening on their sides, which makes the figure of these vertebræ almost an half oval, is of good use ; as it affords a firm articulation to the ribs, allows the trachea to divide at a small angle, and the other large vessels to run secure from the action of the vital organs.—These bodies are more concave behind than any of the other two classes.—Their upper and lower surfaces are horizontal.

The cartilages interposed between the bodies of these vertebræ are thinner than in any other of the true vertebræ ; and contribute to the concavity of the spine in the thorax, by being thinnest at their forepart.

The oblique processes are placed almost perpendicular ; the upper ones slanting but a little forward, and the lower ones slanting as much backward. Between these of opposite sides, several sharp processes stand out from the upper and lower parts of the plates which join to form the spinal process ; into these sharp processes strong ligaments are fixed for connecting the vertebræ.

The transverse processes of the dorsal vertebræ are long, thicker at their ends than in the middle, and turned obliquely backward ; which may be owing to the pressure of the ribs, the

tubercles of which are inserted into a depression near the end of these processes.

The spinal processes are long, small-pointed, and sloping downward and backward: from their upper and back part a ridge rises, which is received by a small channel in the superior and forepart of the spinal process immediately above, which is here connected to it by a ligament.

The conduit of the spinal marrow is here more circular, but, corresponding to the size of that cord, is smaller than in any of the other vertebræ; and a larger share of the holes in the bony bridges, for the transmission of the nerves, is formed in the vertebra above than in the one below.

The connection of the dorsal vertebræ to the ribs, the thinness of their cartilages, the erect situation of the oblique processes, the length, sloping, and connection of the spinal processes, all contribute to restrain these vertebræ from much motion, which might disturb the actions of the heart and lungs; and in consequence of the little motion allowed here, the intervertebral cartilages sooner shrivel, by becoming more solid: and therefore the first remarkable curvature of the spine observed, as people advance to old age, is in the least stretched vertebræ of the back.

The bodies of the four uppermost dorsal vertebræ deviate from the rule of the vertebræ becoming larger as they descend: for the first of the four is the largest, and the other three below gradually become smaller, which allows the trachea and large vessels to divide at smaller angles.

The two uppermost vertebra of the back, instead of being very prominent forward, are flatted by the action of the muscoli longi colli and recti majores.

The proportional size of the two little depressions in the body of each vertebra for receiving the heads of the ribs, seems to vary in the following manner; the depression on the upper edge of each vertebra decreases as far down as the fourth, and after that increases.

The transverse processes are longer in each lower vertebra to the seventh or eighth, with their smooth surfaces, for the tuber-

cles of the ribs, facing gradually more downward; but afterward, as they descend, they become shorter, and the smooth surfaces are directed more upward.

The spinous processes of the vertebræ of the back become gradually longer and more slanting from the first, as far down as the eighth or ninth vertebra; from which they manifestly turn shorter and more erect.

The first vertebra, besides an oblong hollow in its lower edge, that assists in forming the cavity wherein the second rib is received, has the whole cavity for the head of the first rib formed in it.

The eleventh often has the whole cavity for the eleventh rib in its body, and wants the smooth surface on each transverse process.

The twelfth always receives the whole head of the last rib, and has no smooth surface on its transverse processes, which are very short.—The smooth surfaces of its inferior oblique processes face outward as the lumbar do.—And we may say in general, that the upper vertebræ of the back lose gradually their resemblance to those of the neck, and the lower ones come nearer to the figure of the lumbar.

The articulation of the vertebræ of the back with the ribs, shall be more particularly considered after the ribs are described. Only it may be proper now to remark, that the ligaments which serve that articulation assist in connecting the vertebræ.

The lowest order of the true vertebræ is the LUMBAR, which consists of five bones; that may be distinguished from any others by these

marks:—1. Their bodies, though of a circular form at their forepart, are somewhat oblong from one side to the other; which may be occasioned by the pressure of the large vessels, the aorta and cava, and of the viscera. The epiphyses on their edges are larger; and therefore the upper and lower surfaces of their bodies are more concave than in the vertebræ of the back. 2. The cartilages between these vertebræ are much the thickest of any, and render the spine convex within the abdomen, by their greatest thickness being at their forepart. 3. The oblique processes are strong and deep; those in opposite sides being almost placed in parallel planes; the superior, which are concave facing inward,

and the convex inferior ones facing outward : and therefore each of these vertebræ receives the one above it, and is received by the one below ; which is not so evident in the other two classes already described. 4. Their transverse processes are small, long, and almost erect, for allowing large motion to each bone, and sufficient insertion to muscles, and for supporting and defending the internal parts. 5. Betwixt the roots of the superior oblique and transverse processes a small protuberance may be observed, where some of the muscles that raise the trunk of the body are inserted. 6. Their spinal processes are strong, straight, and horizontal, with broad flat sides, and a narrow edge above and below ; this last being depressed on each side by muscles. And at the root of these edges, we see rough surfaces for fixing the ligaments. 7. The canal for the numerous cords called *cauda equina*, into which the spinal marrow divides, is rather larger in these bones than what contains that marrow in the vertebræ of the back. 8. The holes for the passage of the nerves are more equally formed out of both the contiguous vertebræ than in the other classes ; the upper one furnishes, however, the larger share of each hole.

The thick cartilages between these lumbar vertebræ, their deep oblique processes, and their erect spinal processes, are all fit for allowing large motion : though it is not so great as what is performed in the neck ; which appears from comparing the arches which the head describes when moving on the neck or the loins only.

The lumbar vertebræ, as they descend, have their oblique processes at a greater distance from each other, and facing more backward and forward.

Both transverse and spinal processes of the middlemost vertebræ of the loins are longest and thickest ; in the vertebræ above and below, they are less : so that these processes of the first and fifth are the least, to prevent their striking on the ribs or ossa ilium, or their bruising the muscles in the motions of the spine.

The epiphyses round the edges of the bodies of the lumbar vertebræ are most raised in the two lowest ; which conse-

quently make them appear hollower in the middle than the others are.

The body of the fifth vertebra is rather thinner than that of the fourth. The spinal process of this fifth is smaller, and the oblique processes face more backward and forward than in any other lumbar vertebra.

THE FALSE VERTEBRÆ.

The false vertebræ compose the under pyramid of the spine. They are distinguished from the bones already described justly enough by this epithet of *false* ; because, though each bone into which they can be divided in young people resembles the true vertebræ in figure, yet none of them contribute to the motion of the trunk of the body ; they being intimately united to each other in adults, except at their lower part, where they are moveable ; whence they are commonly divided into two bones, *os sacrum* and *coccygis*.

The *os sacrum* is of an irregular triangular shape, broad above, narrow below, convex behind, for the advantageous origin of the muscles that move the spine and thigh backward ; and concave before, for enlarging the cavity of the pelvis. Four transverse lines, of a colour different from the rest of the bone which are seen on its forepart, are the marks of division of the five different bones of which it consists in young persons.

The forepart of the *os sacrum*, analogous to the bodies of the true vertebræ, is smooth and flat, to allow a larger space for the contained bowels, without any danger of hurting them, or this flat figure may be, in some degree, owing to the equal pressure of these bowels, particularly of the last gut. The back part of it has not only so large a cavity as the vertebræ have ; because the spinal marrow, now separated into the *cauda equina*, is small. The bridges between the bodies and processes of these bones are much thicker, and in proportion shorter, than in the former class of bones. The strength of these cross bridges is remarkable in the three upper bones.

There are only two oblique processes of the *os sacrum* ; one standing out on each side from the upper part of the first bone.

Their plain erect surfaces face backward, and are articulated with the inferior oblique processes of the last vertebræ of the loins, to which each of these processes is connected by a strong ligament, which rises from a scabrous cavity round their roots, where mucilaginous glands are also lodged. Instead of the other oblique processes of this bone, four rough tubercles are to be seen on each side of its surface behind, from which the *musculus sacer*, a part of the *multifidus spinæ*, has its origin.

The transverse processes here are all grown together into one large strong oblong process on each side ; which, so far as it answers to the first three bones, is very thick, and divided into two irregular cavities by a long perpendicular ridge. The foremost of the two cavities has commonly a thin cartilaginous skin covering it in the recent subject, and is adapted to the unequal protuberance of the *os ilium* ; and a strong ligament connects the circumference of these surfaces of the two bones. The cavity behind is divided by a transverse ridge into two, where strong ligamentous strings that go from this bone to the *os ilium*, with a cellular substance containing mucus, are lodged.

The transverse processes of the two last bones of the *os sacrum* are much smaller than the former. At their back part near their edge, a knob and oblong flat surface give rise to two strong ligaments which are extended to the *os ischium* ; and are therefore called *sacrosciatic*.

The spinal processes of the three uppermost bones of the *os sacrum* appear short, sharp, and almost erect, while the two lower ones are open behind ; and sometimes a little knob is to be seen on the fourth, though generally it is bifurcated, without the two legs meeting into a spine ; in which condition also the first is often to be seen ; and sometimes none of them meet, but leave a sinus, or rather fossa, instead of a canal. The *latissimus* and *longissimus dorsi*, *sacrolumbalis*, and *glutæus maximus*, have part of their origins from these spinal processes.

The canal between the bodies and processes of this bone, for the *cauda equina*, is triangular ; and becomes smaller as it descends, and the nerves are given off. Below the third bone, this passage is no more a complete bony canal, but is open behind ;

and is only there defended by a strong ligamentous membrane stretched over it, which, with the muscles that cover it, and are very prominent on each side, is a sufficient defence for the bundle of nerves within.

At the root of each oblique process of this bone, the notch is conspicuous ; by which, and such another in the last vertebra of the loins, a passage is left for the twenty-fourth spinal nerve ; and in viewing the os sacrum, either before or behind, four large holes appear in each side, in much the same height as where the marks of the union of its several bones remain. Some of the largest nerves of the body pass through the anterior holes ; and superficial grooves, running outward from them in different directions, show their course.—From the intervals of these grooves, the pyriformis muscle rises. The holes in the back part of the bone are covered by membranes which allow small nerves to pass through them. The two uppermost of these holes, especially on the foreside, are the largest ; and as the bone descends, the holes turn smaller. Sometimes a notch is formed at the lower part of each side of this bone ; and in other subjects there is a hole common to it and the os coccygis, through which the twenty-ninth pair of spinal nerves pass ; and frequently a bony bridge is formed on the back part of each side by a process sent up from the back part of the os coccygis, and joined to the little knobs which the last bone of the os sacrum has instead of a spinal process. Under this bridge or jugum, the twenty-ninth pair of spinal nerves runs in its course to the common holes just now described.

The upper part of the body of the first bone resembles the vertebræ of the loins ; but the small fifth bone is oblong transversely, and hollow in the middle of its lower surface.

The *substance* of the os sacrum is very spongy, without any considerable solid external plates, and is lighter proportionally to its bulk than any other bone in the body ; but is secured from injuries by the thick muscles that cover it behind, and by the strong ligamentous membranes that closely adhere to it. As this is one of the most remarkable instances of this sort of defence afforded a soft weak bone, we may make the general observation, That wherever we meet with such a bone, one or

other, or both these defences are made use of; the first to ward off injuries, and the second to keep the substance of the bone from yielding too easily.

Articulation.

This bone is *articulated* above to the last vertebra of the loins, in the manner that the lumbar vertebræ are joined; and therefore the same motions may be performed here. The articulation of the lower part of the os sacrum to the os coccygis, seems well enough adapted for allowing considerable motion to this last bone, were it not much confined by ligaments. Laterally, the os sacrum is joined to the ossa ilium by an immoveable synchondrosis, or what almost deserves the name of a suture: for the cartilaginous crust on the surface of the bones is very thin; and both their surfaces are so scabrous and unequal, as to be indented into each other; which makes such a strong connection, that great force is required to separate them, after all the muscles and ligaments are cut. Frequently the two bones grow together in old subjects.

The *uses* of the os sacrum are, to serve as the common base and support of the trunk of the body, to guard the nerves proceeding from the end of the spinal marrow, to defend the back part of the pelvis, and to afford sufficient origin to the muscles which move the trunk and thigh.

The bones that compose the os sacrum of infants, have their bodies separated from each other by a thick cartilage, and, in the same manner as the true vertebræ, each of them consists of a body and two lateral plates, connected together by cartilages; the ends of the plates seldom being contiguous behind.

Os Coccygis is that triangular chain of bones depending from the os sacrum; each bone becoming smaller as they descend, till the last ends almost in a point. The os coccygis is convex behind, and concave before; from which crooked pyramidal figure, which was thought to resemble a cuckow's beak, it has got its name.

This bone consists of four pieces in people of middle age:—in children, very near the whole of it is cartilage: in old subjects, all the bones are united, and become frequently one continued bone with the os sacrum.

The highest of the four bones is the largest, with shoulders extended farther to each side than the end of the os sacrum.—The upper surface of this bone is a little hollow.—From the back of that bulbous part called its *shoulders*, a process often rises up on each side, to join with the bifurcated spine of the fourth and fifth bones of the os sacrum, to form the bony bridge mentioned in the description of the os sacrum. Sometimes these shoulders are joined to the sides of the fifth bone of the os sacrum, to form the hole in each side common to these two bones, for the passage of the twenty-ninth pair of spinal nerves. Immediately below the shoulders of the os coccygis, a notch may be remarked in each side. The lower end of this bone is formed into a small head, which very often is hollow in the middle.

The three lower bones are gradually become smaller, and are spongy; but are strengthened by a strong ligament which covers and connects them. Their ends, by which they are articulated, are formed in the same manner as those of the first bone are.

Between each of these four bones of young subjects a cartilage is interposed; and their articulation is analogous to that of the bodies of the vertebræ of the neck: for, as has been above remarked, the lower end of the os sacrum, and of each of the three superior bones of the os coccygis, has a small depression in the middle; and the upper part of all the bones of the os coccygis is a little concave, and consequently the interposed cartilages are thickest in the middle, to fill up both cavities; by which they connect the bones more firmly. When the cartilages ossify, the upper end of each bone is formed into a cavity, exactly adapted to the protuberant lower end of the bone immediately above. From this sort of articulation, it is evident, that, unless when these bones grow together, all of them are capable of motion; of which the first and second, especially this last, enjoys the largest share.

The lower end of the fourth bone terminates in a rough point, to which a cartilage is appended.

To the sides of these bones of the os coccygis, the coccygæ muscles, and part of the levatores ani, and of the glutæi maximi, are fixed.

The *substance* of these bones is very spongy, and in children

cartilaginous ; there being only a part of the first bone ossified in a new born infant.

From the description of this bone, we see how little it resembles the vertebræ ; since it seldom has processes, never has any cavity for the spinal marrow, nor holes for the passage of nerves. Its connection hinders it from being moved to either side ; and its motion backward and forward is much confined : yet, as its ligaments can be stretched by a considerable force, it is a great advantage in the excretion of the fæces, and much more in child-bearing, that this bone should remain moveable. The mobility of the os coccygis diminishing as people advance in age, especially when its ligaments and cartilages have not been kept flexible by being stretched, is probably one reason why the women, who are old maids before they marry, have generally hard labour in child-bed.

The os coccygis serves to sustain the intestinum rectum ; and, in order to perform this office more effectually, it is made to turn with a curve forward ; by which also the bone itself, as well as the muscles and teguments, is preserved from any injury when we sit with our body reclined back.

OF THE PELVIS.

The second part of the trunk of the skeleton, the pelvis, is the cylindrical cavity at the lower part of the abdomen, formed by the os sacrum, os coccygis, and ossa innominata ; which last therefore fall now in course to be examined.

OSSA INNOMINATA.

The *ossa innominata* are two large broad bones, which form the forepart and sides of the pelvis, and the lower part of the sides of the abdomen. In children, each of these bones is evidently divided into three ; which are afterward so intimately united, that scarce the least mark of their former separation remains : notwithstanding this, they are described as consisting each of three bones, to wit, the os ilium, ischium, and pubis ;

which we shall first describe separately, and then shall consider what is common to any two of them, or to all the three.

Os ILIUM, or *haunch-bone*, is situated highest of the three, and reaches as far down as one third of the great cavity into which the head of the thigh-bone is received.

The external side of this bone is unequally convex, and is called its *dorsum*. The semicircular edge at the highest part of this bone, which is tipped with a cartilage in the recent subject, is named the *crista*, into which the external or descending oblique muscle of the abdomen is inserted; and from it the internal ascending oblique, and the transverse muscles of the belly, with the glutæus maximus, quadratus lumborum, and latissimus dorsi, have their origin. The ends of the *crista* are more prominent than the surface of the bone below them; therefore are reckoned processes. From the anterior spinal process, the sartorius and facialis muscles have their rise, and the outer end of the doubled tendon of the external oblique muscle of the abdomen, commonly called *Faltopius's* or *Poupart's* ligament, is fixed to it. The inside of the posterior spinal process, and of part of the spine forward from that, is made flat and rough where the sacro-lumbalis and longissimus dorsi rise; and to its outside are fixed ligaments, extended to the os sacrum and transverse processes of the fifth and fourth vertebræ of the loins.—Below the anterior spinal process another protuberance stands out, which by its situation may be distinguished from the former, by adding the epithet of *inferior*, where the rectus tibiæ has its origin. Betwixt these two anterior processes the bone is hollowed where the beginning of the sartorius muscle is lodged. Below the posterior spinal process, a second protuberance of the edge of this bone is in like manner observable, which is closely applied to the os sacrum. Under this last process a considerable large niche is observable in the os ilium; between the sides of which and the strong ligament that is stretched over from the os sacrum to the sharp-pointed process of the os ischium of the recent subject, a large hole is formed, through which the musculus pyriformis, the great sciatic nerve, and the posterior crural vessels, pass, and are protected from compression.

The external broad side or dorsum of the os ilium is a little hollow toward the forepart; farther back, it is as much raised; then is considerably concave; and, lastly, it is convex. These inequalities are occasioned by the actions of the muscles that are situated on this surface. From behind the uppermost of the two anterior spinal processes, in such bones as are strongly marked by the muscles, a semicircular ridge is extended to the hollow passage of the sciatic nerve. Between the spine and this ridge, the glutæus medius takes its rise. Immediately from above the lowest of the anterior spinal processes, a second ridge is stretched to the niche. Between this and the former ridge, the glutæus minimus has its origin. On the outside of the posterior spinal processes, the dorsum of the os ilium is flat and rough, where part of the glutæus maximus and pyriformis rises. The lowest part of this bone is the thickest, and is formed into a large cavity with high brims, to assist in composing the great acetabulum; which shall be considered, after all the three bones that constitute the os innominatum are described.

The internal surface of the os ilium is concave in its broadest forepart, where the internal iliac muscle has its origin, and some share of the intestinum ilium and colon is lodged. From this large hollow, a small sinuosity is continued obliquely forward, at the inside of the anterior inferior spinal process, where part of the psoas and iliacus muscles pass. The large concavity is bounded below by a sharp ridge, which runs from behind forward; and, being continued with such another ridge of the os pubis, forms a line of partition between the abdomen and pelvis. Into this ridge the broad tendon of the psoas parvus is inserted.

All the internal surface of the os ilium, behind this ridge, is very unequal: For the upper part is flat, but spongy, where the sacro-lumbalis and longissimus dorsi rise.—Lower down, there is a transverse ridge from which ligaments go out to the os sacrum.—Immediately below this ridge, the rough unequal cavities and prominences are placed, which are exactly adapted to those described on the side of the os sacrum.—In the same manner, the upper part of this rough surface is porous, for the firmer adhesion of the ligamentous cellular substance; while the lower

part is more solid, and covered with a thin cartilaginous skin, for its immoveable articulation with the os sacrum. From all the circumference of this large unequal surface, ligaments are extended to the os sacrum, to secure more firmly the conjunction of these bones.

These passages of the medullary vessels are very conspicuous in some bones, but in others they are inconsiderable.

The posterior and lower parts of these bones are thick; but they are generally exceeding thin and compact at their middle, where they are exposed to the actions of the musculi glutæi and iliacus internus, and to the pressure of the bowels. The substance of the ossa ilium is mostly cellular, except a thin external table.

In a ripe child, the spine of the os ilium is cartilaginous; and is afterward joined to the bone, in form of an epiphyse. The large lower end of this bone is not completely ossified.

Os ISCHIUM, or *hip-bone*, is of a middle bulk between the two other parts of the os innominatum, is situated lowest of the three, and is of a very irregular figure. Its extent might be marked by an horizontal line drawn near through the middle of the acetabulum; for the upper bulbous part of this bone forms some less than the lower half of that great cavity, and the small leg of it rises to much the same height on the other side of the great hole common to this bone and the os pubis.

From the upper thick part of the os ischium, a sharp process, called *spinous*, stands out backward, from which chiefly the musculus coccygæus and superior gemellus, and part of the levator ani, rise; and the anterior or internal sacrosciatic ligament is fixed to it. Between the upper part of this ligament and the bones, it was formerly observed that the pyriform muscle, the posterior crural vessels, and the sciatic nerve, pass out of the pelvis. Immediately below this process, a sinuosity is formed for the tendon of the musculus obturator internus. In a recent subject this part of the bone, which serves as a pulley on which the obturator muscle plays, is covered with a ligamentous cartilage, that, by two or three small ridges, points out the interstices of the fibres in the tendon of this muscle.

The outer surface of the bone at the root of this spinous process is made hollow by the pyriformis or iliacus externus muscle.

Below the sinuosity for the obturator muscle, is the great knob or tuberosity, covered with cartilage.—The upper part of the tuberosity gives rise to the inferior gemellus muscle.—To a ridge at the inside of this, the external or posterior sacrosciatic ligament is so fixed, that between it, the internal ligament, and the sinuosity of the os ischium, a passage is left for the internal obturator muscle.—The upper thick smooth part of the *tuber* has two oblique impressions on it. The inner one gives origin to the long head of the biceps flexor tibiæ, and semitendinosus muscles; and the semimembranosus rises from the exterior one, which reaches higher and nearer the acetabulum than the other.—The lower, thinner, more scabrous part of the knob which bends forward, is also marked with two flat surfaces; whereof the internal is what we lean upon in sitting, and the external gives rise to the largest head of the triceps adductor femoris. Between the external margin of the tuberosity and the great hole of the os innominatum, there is frequently an obtuse ridge extended down from the acetabulum, which gives origin to the quadratus femoris.—As the tuber advances forward, it becomes smaller, and is rough, for the origin of the musculus transversalis and erector penis.—The small leg of it, which mounts upward to join the os pubis, is rough and prominent at its edge, where the two lower heads of the triceps adductor femoris take their rise.

The upper and back part of the os ischium is broad and thick; but its lower and forepart is narrower and thinner.—Its substance is of the structure common to broad bones.

The os ilium and pubis of the same side are the only bones which are contiguous to the os ischium.

The part of the os ischium, which forms the acetabulum, the spinous process, the great tuber, and the recurved leg, are all cartilaginous at birth.—The tuber, with part of the leg or process above it, becomes an epiphyse before this bone is fully formed.

The Os PUBIS, or *share-bone*, is the least of the three parts of the os innominatum, and is placed at the upper forepart of it.

—The thick largest part of this bone is employed in forming the acetabulum; from which becoming much smaller, it is stretched inward to its fellow of the other side, where again it grows larger, and sends a small branch downward to join the end of the small leg of the os ischium.—The upper forepart of each os pubis is tuberosus and rough where the rectus and pyramidalis are inserted.—From this a ridge is extended along the upper edge of the bone, in a continued line with such another of the os ilium, which divides the abdomen and pelvis. The ligament of Fallopius is fixed to the internal end of this ridge, and the smooth hollow below it is made by the anterior crural vessels and nerves passing beneath the ligament.—Some way below the former ridge, another is extended from the tuberosus part of the os pubis downward and outward towards the acetabulum; between these two ridges the bone is hollow and smooth, for lodging the head of the pectineus muscle.—Immediately below, where the lower ridge is to take the turn downward, a winding niche is made, which is comprehended in the great foramen of a skeleton; but is formed into a hole by a subtended ligament in the recent subject, for the passage of the posterior crural nerve, an artery, and a vein.—The internal end of the os pubis is rough and unequal, for the firmer adhesion of the thick

ligamentous cartilage that connects it to its fellow of the other side.—The process which goes down from that to the os ischium is broad and rough before, where the gracilis and upper heads of the triceps adductor femoris have their origin.

The substance of the os pubis is the same as of other broad bones.

Only a part of the large end of this bone is ossified, and the whole leg is cartilaginous, in a child born at the full time.

Between the os ischium and pubis a very large irregular hole is left, which has been called *thyroid*. This hole is all, except the notch for the posterior crural nerve, filled up in a recent subject, with a strong ligamentous membrane, that adheres very firmly to its circumference. From this membrane chiefly the two obturator muscles, external and internal, take their rise.—The great design of this hole, besides rendering the bone lighter, is to allow a strong enough origin to the ob-

trurator muscles, and sufficient space for lodging their bellies, that there may be no danger of distributing the functions of the viscera of the pelvis by the actions of the internal or of the external being bruised by the thigh bone, especially by its lesser trochanter, in the motions of the thigh inward: both which inconveniences must have happened, had the ossa innominata been complete here, and of sufficient thickness and strength to serve as the fixed point of these muscles.

In the external surface of the ossa innominata, near the outside of the great hole, a large deep cavity is formed by all the three bones conjunctly: for the os pubis constitutes about one fifth, the os ilium makes something less than two fifths, and the os ischium as much more than two fifths. The brims of this cavity are very high, and are still much more enlarged by the ligamentous cartilage, with which they are tipped in a recent subject. From this form of the cavity it has been called *acetabulum*. Round the base of the supercilia the bone is rough and unequal, where the capsular ligament of the articulation is fixed.—The brims at the upper and back part of the acetabulum are much larger and higher than any where else; which is very necessary to prevent the head of the femur from slipping out of its cavity at this place, where the whole weight of the body bears upon it, and consequently would otherwise be constantly in danger of thrusting it out.—As these brims are extended downward and forward, they become less; and at their internal lower part a breach is made in them; from the one side of which to the other, a ligament is placed in the recent subject; under which a large hole is left, which contains a fatty cellular substance and vessels. The reason of which seems evidently to be for allowing a larger motion to the thigh inwardly, that the vessels which are distributed to the joint may safely enter at the sinuosity in the bottom of the breach; and that the larger mucilaginous gland of the joint may escape below the ligament, when the head of the thigh-bone is in hazard of pressing too much upon it in the motions of the thigh outwardly. Besides this difference in the height of the brims, the acetabulum is otherwise unequal: for the lower internal part of it is depressed below the cartilaginous surface of the upper part, and is not covered with cartilage; into

the upper part of this particular depression, where it is deepest and of a semilunar form, the ligament of the thigh-bone, improperly called the *round* one, is inserted; while, in its more superficial lower part, the large mucilaginous gland of this joint is lodged. The largest share of this depression is formed in the os ischium.

From what has been said of the condition of the three bones composing this acetabulum in new-born children, it must be evident that a considerable part of this cavity is cartilaginous in them.

Articulation.

The *ossa innominata* are joined at their back part to each side of the os sacrum by a sort of suture, with a very thin intervening cartilage, which serves to cement those bones together; and strong ligaments go from the circumference of this unequal surface, to connect them more firmly. The *ossa innominata* are connected together at their forepart by the ligamentous cartilage interposed between the two *ossa pubis*. These bones can therefore have no motion in a natural state, except what is common to the trunk of the body, or to the os sacrum.

Each os innominatum affords a socket (the acetabulum) for the thigh-bones to move in; and the trunk of the body rolls here so much on the heads of the thigh-bones, as to allow the most conspicuous motions of the trunk, which are commonly thought to be performed by the bones of the spine. This articulation is to be more fully described after the *ossa femoris* are examined.

The pelvis then has a large open above, where it is continued with the abdomen; is strongly fenced by bones on the sides, back and forepart; and appears with a wide opening below, in the skeleton; but in a recent subject, a considerable part of the opening is filled by the sacrosciatic ligaments, pyriform, internal obturator, levatores ani, gemini, and coccygæi muscles, which support and protect the contained parts better than bones could have done; so that space is only left at the lowest part of it, for the large excretories, the vesica urinaria, intestinum rectum, and in females the uterus, to discharge themselves.

OF THE THORAX.

The thorax or *chest*, which is the only part of the trunk of the body which we have not yet described, reaches from below the neck to the belly ; and by means of the bones that guard it, is formed into a large cavity : the figure of which is somewhat conoidal : but its upper smaller end is left open for the passage of the windpipe, gullet, and large blood-vessels ; and its lower part or base, has no bones, and is shorter before than behind ; so that to complete our comparison, it appears like an oblique section of the conoid. Besides which we ought also to remark, that the lower part of this cavity is narrower than some way above ; and that the middle of its back part is considerably diminished by the bones standing forward into it.

The bones which form the thorax are the twelve dorsal vertebræ behind the ribs on the sides, and the sternum before.

The vertebræ have already been described as part of the spine, and therefore are now to be passed.

THE RIBS.

The ribs or *costæ*, are the long crooked bones placed at the side of the chest, in an oblique direction downward in respect of the backbone.—Their number is generally twelve on each side ; though frequently eleven or thirteen have been found.—Sometimes the ribs are found preternaturally conjoined or divided.

The ribs are all concave internally ; where they are also made smooth by the action of the contained parts, which, on this account, are in no danger of being hurt by them ; and they are convex externally, that they might resist that part of the pressure of the atmosphere which is not balanced by the air within the lungs during *inspiration*.—The ends of the ribs next the vertebræ are rounder than they are after these bones have advanced forward, when they become flatter and broader, and have an upper and lower edge ; each of which is made rough by the action of the intercostal muscles inserted into them. The

upper edge of the ribs is more obtuse and rounder than the lower, which is depressed on its internal side by a long fossa, for lodging the intercostal vessels and nerves; on each side of which there is a ridge, to which the intercostal muscles are fixed. The fossa is not observable, however, at either end of the ribs; for, at the posterior or root, the vessels have not yet reached the ribs; and at the fore-end they are split away into branches, to serve the parts between the ribs.

At the posterior end of each rib, a little head is formed, which is divided by a middle ridge into two plain or hollow surfaces; the lowest of which is the broadest and deepest in most of them. The two plains are joined to the bodies of two different vertebræ, and the ridge forces itself into the intervening cartilage.—A little way from this head, we find, on the external surface, a small cavity, where mucilaginous glands are lodged; and round the head, the bone appears spongy, where the capsular ligament of the articulation is fixed.—Immediately beyond this a flated tubercle rises, with a small cavity at and roughness about its root, for the articulation of the rib with the transverse process of the lowest of the two vertebræ, with the bodies of which the head of the rib is joined.—Advancing farther on this external surface, we observe in most of the ribs another smaller tubercle, into which ligaments which connect the ribs to each other, and to the transverse processes of the vertebræ and portions of the longissimus dorsi, are inserted.—Beyond this the ribs are made flat by the sacro-lumbalis muscle, which is inserted into the part of this flat surface farthest from the spine, where each rib makes a considerable curve, called its *angle*.—Then the rib begins to turn broad, and continues so to its anterior end, which is hollow and spongy, for the reception of, and firm coalition with the cartilage that runs thence to be inserted into the sternum, or to be joined with some other cartilage.—In adults, generally the cavity at this end of the ribs is smooth and polished on its surface; by which the articulation of the cartilage with it has the appearance of being designed for motion, but it has none.

The *substance* of the ribs is spongy, cellular, and only covered with a very thin external lamellated surface, which increases in thickness and strength as it approaches the vertebræ.

To the fore end of each rib a long broad and strong cartilage is fixed, and reaches thence to the sternum, or is joined to the cartilage of the next rib. This course, however, is not in a straight line with the rib; for generally the cartilages make a considerable curve, the concave part of which is upward; therefore, at their insertion into the sternum, they make an obtuse angle above, and an acute one below.—These cartilages are of such a length as never to allow the ribs to come to a right angle with the spine; but they keep them situated so obliquely as to make the angle very considerably obtuse above, till a force exceeding the elasticity of the cartilage is applied.—These cartilages, as all others, are firmer and harder internally than they are on their external surface; and sometimes, in old people, all their middle substance becomes bony, while a thin cartilaginous lamella appears externally. The ossification, however, begins frequently at the external surface.—The greatest alternate motions of the cartilages being made at their great curvature, that part remains frequently cartilaginous after all the rest is ossified.

Articulation.

The ribs then are *articulated* at each end, of which the one behind is doubly joined to the vertebræ; for the head is received into the cavities of two bodies of the vertebræ, and the larger tubercle is received into the depression in the transverse process of the lower vertebra.—When one examines the double articulation, he must immediately see, that no other motion can here be allowed than upward and downward; since the transverse process hinders the rib to be thrust back; the resistance on the other side of the sternum prevents the ribs coming forward; and each of the two joints, with the other parts attached, oppose its turning round. But then it is likewise as evident, that even the motion upward and downward can be but small in any one rib at the articulation itself. But as the ribs advance forward, the distance from their centre of motion increasing, the motion must be larger; and it would be very conspicuous at their anterior ends, were not they resisted there by the cartilages, which yield so little, that the principal motion is performed by the middle part of the ribs, which turns outward and upward, and occasions

the twist remarkable in the long ribs at the place near their fore end where they are most resisted.

Hitherto we have laid down the structure and connection which most of the ribs enjoy, as belonging to all of them; but must now consider the specialities wherein any of them differ from the general description given, or from each other.

In viewing the ribs from above downward, their figure is still straighter; the uppermost being the most crooked of any.—Their obliquity in respect of the spine increases as they descend; so that though their distances from each other are very little different at their back part, yet at their fore ends the distances between the lower ones must increase.—In consequence, too, of this increased obliquity of the lower ribs, each of their cartilages makes a greater curve in its progress from the rib towards the sternum; and the tubercles, that are articulated to the transverse processes of the vertebræ, have their smooth surfaces gradually facing more upward.—The ribs becoming thus more oblique, while the sternum advances forward in its descent, makes the distance between the sternum and the anterior end of the lower ribs greater than between the sternum and the ribs above; consequently the cartilages of those ribs that are joined to the breast-bone, are longer in the lower than in the higher ones.—These cartilages are placed nearer to each other as the ribs descend, which occasions the curvature of the cartilages to be greater.

The length of the ribs increases from the first and uppermost rib, as far down as the seventh; and from that to the twelfth, as gradually diminishes.—The superior of the two plain, or rather hollow surfaces, by which the ribs are articulated to the bodies of the vertebræ, gradually increases from the first to the fourth rib, and is diminished after that in each lower rib.—The distance of their angles from the heads always increases as they descend to the ninth, because of the greater breadth of the sacrolumbalis muscle.

The ribs are commonly divided into *true* and *false*.

The *true* costæ are the seven upper ones of each side, whose cartilages are all gradually longer as the ribs descend, and are joined to the breast-bone: so that, being pressed constantly be

tween two bones, they are flatted at both ends; and are thicker, harder, and more liable to ossify, than the other cartilages that are not subject to so much pressure. These ribs include the heart and lungs.

The five inferior ribs of each side are the *false*, whose cartilages do not reach to the sternum; and, therefore, wanting the resistance at their forepart, they are there pointed; and on this account, having less pressure, their substance is softer.—The cartilages of these false ribs are shorter as the ribs descend.—To all these five ribs the circular edge of the diaphragm is connected; and its fibres, instead of being stretched immediately transversely, and so running perpendicular to the ribs, are pressed so as to be often, especially in expiration, parallel to the plane in which the ribs lie: nay, one may judge by the attachments which these fibres have so frequently to the sides of the thorax a considerable way above where their extremities are inserted into the ribs, and by the situation of the viscera always to be observed in a dead subject laid supine, that there is constantly a large concavity formed on each side by the diaphragm within these bastard-ribs, in which the stomach, liver, spleen, &c. are contained.

The first rib of each side is so situated, that the flat sides are above and below, while one edge is placed inward and the other outward, or nearly so: therefore sufficient space is left above it for the subclavian vessels and muscle; and the broad concave surface is opposed to the lungs. But then, in consequence of this situation, the channel for the intercostal vessels is not to be found; and the edges are differently formed from all the other, except the second; the lower one being rounded, and the other sharp.—The head of this rib is not divided into two plain surfaces by a middle ridge, because it is only articulated with the first vertebra of the thorax.—Its cartilage is ossified in adults, and is united to the sternum at right angles.—Frequently this first rib has a ridge rising near the middle of its posterior edge, where one of the heads of the scalenus muscles rises.—Farther forward it is flatted, or sometimes depressed by the clavicle.

The fifth, sixth, and seventh, or rather the sixth, seventh, eighth, and sometimes the fifth, sixth, seventh, eighth, ninth ribs, have their cartilages at least contiguous; and frequently they are joined to each other by cross cartilages; and most commonly the cartilages of the eighth, ninth, tenth, are connected to the former and to each other by firm ligaments.

The eleventh, and sometimes the tenth rib, has no tubercle for its articulation with the transverse process of the vertebra, to which it is only loosely fixed by ligaments.—The fossa in its lower edge is not so deep as in the upper ribs, because the vessels run more towards the interstice between the ribs.—Its fore-end is smaller than its body, and its short small cartilage is but loosely connected to the cartilage of the rib above.

The twelfth rib is the shortest and straightest. Its head is only articulated with the last vertebra of the thorax; therefore is not divided into two surfaces. This rib is not joined to the transverse process of the vertebra; and therefore has no tubercle, being often pulled necessarily inward by the diaphragm, which an articulation with the transverse process would not have allowed. The fossa is not found at its under edge, because the vessels run below it. The forepart of this rib is smaller than its middle, and has only a very small pointed cartilage fixed to it. To its whole internal side the diaphragm is connected.

The heads and tubercles of the ribs of a new-born child have cartilages on them; part of which become afterward thin epiphyses. The bodies of the ribs encroach gradually after birth upon the cartilages; so that the latter are proportionably shorter, when compared to the ribs, in adults than in children.

The end of the bones of the limbs remain in a cartilaginous state after birth, and are many years before they are entirely united to the main body of their several bones; whereas the condyles of the occipital bone, and of the lower jaw, are true original processes, and ossified before birth; and the heads and tubercles of the ribs are nearly in the same condition; and therefore the weight of the large head is firmly supported; the actions of sucking, swallowing, respiration, &c. which are indispensably necessary for us as soon as we come into the world, are performed without danger of separating the parts of the bones that are most

pressed on in these motions: whereas, had these processes of the head, jaw, and ribs, been epiphyses at birth, children must have been exposed to danger of dying by such a separation; the immediate consequences of which would be the compression of the beginning of the spinal marrow, or want of food, or a stop put to respiration.

THE STERNUM.

The sternum, or breast-bone, is the broad flat bone, or pile of bones, at the forepart of the thorax. In adults of a middle age, it is composed of three bones, which easily separated after the cartilages connecting them are destroyed. Frequently the two lower bones are found intimately united; and very often, in old people, the sternum is a continued bony substance from one end to the other; though we still observe two, sometimes three, transverse lines on its surface; which are marks of the former divisions.

When we consider the sternum as one bone, we find it broadest and thickest above, and becoming smaller as it descends. The internal surface of this bone is somewhat hollowed for enlarging the thorax; but the convexity on the external surface is not so conspicuous, because the sides are pressed outward by the true ribs; the round heads of whose cartilages are received into seven smooth pits formed in each side of the sternum, and are kept firm there by strong ligaments, which on the external surface have a particular radiated texture. Frequently the cartilaginous fibres thrust themselves into the bony substance of the sternum, and are joined by a sort of suture. The pits at the upper part of the sternum are at the greatest distance one from another, and, as they descend, are nearer; so that the two lowest are contiguous.

The *substance* of the breast-bone is cellular, with a very thin external plate, especially on its internal surface, where we may frequently observe a cartilaginous crust spread over it. On both surfaces, however, a strong ligamentous membrane is closely braced; and the cells of this bone are so small, that a consider-

able quantity of osseous fibres must be employed in the composition of it. Whence, with the defence which the muscles give it, and the moveable support it has from the cartilages, it is sufficiently secured from being broken: for it is strong by its quantity of bone; its parts are kept together by ligaments; and it yields enough to elude considerably the violence offered.

So much may be said of this bone in *general*; but the *three* bones, of which, according to the common account, it is composed in adults, are each to be examined.

The *first* is somewhat of the figure of a heart, as it is commonly painted; only it does not terminate in a sharp point. This is the uppermost thickest part of the sternum.

The upper middle part of this first bone, where it is thickest, is hollowed, to make place for the trachea; though this cavity is principally formed by the bone being raised on each side of it, partly by the clavicles thrusting it inward, and partly by the sternomastoidei muscles pulling it upward.—On the outside of each tubercle there is an oblong cavity, that, in viewing it transversely from before backward, appears a little convex. Into these glenæ the ends of the clavicles are received. Immediately below these, the sides of this bone begin to turn thinner; and in each a superficial cavity or a rough surface is to be seen, where the first ribs are received or joined to the sternum. In the side of the under-end of this first bone, the half of the pit for the second rib on each side is formed. The upper part of the surface behind is covered with a strong ligament, which secures the clavicles; and is afterward to be more particularly taken notice of.

The *second* or middle division of this bone is much longer, narrower, and thinner, than the first; but excepting that it is a little narrower above than below, it is nearly equal all over in its dimensions of breadth or thickness. In the sides of it are complete pits for the third, fourth, fifth, and sixth ribs, and half of the pits for the second and seventh; the lines, which are marks of the former division of this bone, being extended from the middle of the pits of one side to the middle of the corresponding pits of the other side. Near its middle an unossified part of the bone is sometimes found; which, freed of the ligamentous

membrane or cartilage that fills it, is described as a hole: and in this place, for the most part, we may observe a transverse line, which has made authors divide this bone into two. When the cartilage between this and the first bone is not ossified, a manifest motion of this upon the first may be observed in respiration, or in raising the sternum, by pulling the ribs upward, or distending the lungs with air in a recent subject.

The *third* bone is much less than the other two, and has only one half of the pit for the seventh rib formed in it; wherefore it might be reckoned only an appendix of the sternum. In young subjects it is always cartilaginous, and is better known by the name of *cartilago xiphoides* or *ensiformis* than any other. This third bone is seldom of the same figure, magnitude, or situation, in any two subjects; for sometimes it is a plain triangular bone, with one of the angles below, and perpendicular to the middle of the upper side, by which it is connected to the second bone. In other people the point is turned to one side, or obliquely forward or backward. Frequently it is all nearly of an equal breadth, and in several subjects it is bifurcated, or else it is unossified in the middle. In the greatest number of adults, it is ossified, and tipped with a cartilage; in some, one half of it is cartilaginous; and in others, it is all in a cartilaginous state. Generally several oblique ligaments, fixed at one end to the cartilages of the ribs, and by the other to the outer surface of the xiphoid bone, connect it firmly to those cartilages.

Articulation.

The sternum is *joined* by cartilages to the seven upper ribs, unless when the first coalesces with it in an intimate union of substance; and its unequal cavity on each side of its upper end is fitted for the ends of the clavicles.

The sternum most frequently has four round small bones, surrounded with cartilage, in children born at the full time; the uppermost of these, which is the first bone, being the largest.—Two or three other very small bony points are likewise to be seen in several children. The number of bones increases for some years, and then diminishes, but uncertainly, till they are at last united into those above described of an adult.

The *uses* of this bone are, to afford origin and insertion to se-

veral muscles ; to sustain the mediastinum ; to defend the vital organs, the heart and lungs, at the forepart ; and lastly, by serving as a moveable fulcrum of the ribs, to assist considerably in respiration.

OF THE SUPERIOR EXTREMITIES.

The SUPERIOR EXTREMITIES are divided into the shoulder, arm, fore-arm, and hand.

BONES OF THE SHOULDER.

The SHOULDER consists of the *clavicle* and *scapula*.

CLAVICULA.

CLAVICULA, or *collar-bone*, is the long crooked bone, in figure like an Italic *f*, placed almost horizontally between the upper lateral part of the sternum and what is commonly called the top of the shoulder ; which, as a *clavis* or beam, it bears off from the trunk of the body.

The clavicle, as well as other long round bones, is larger at its two ends than in the middle. The end next to the sternum is triangular : the angle behind is considerably protruded, to form a sharp ridge, to which the transverse ligament, extended from one clavicle to the other, is fixed. The side opposite to this is somewhat rounded. The middle of this protuberant end is as irregularly hollowed as the cavity in the sternum for receiving it is raised : but in a recent subject, the irregular cavities of both are supplied by a moveable cartilage ; which is not only much more closely connected every where by ligaments to the circumference of the articulation than those of the lower jaw are, but it grows to the two bones at both its internal and external end ; its substance at the external end being soft, but very strong, and resembling the intervertebral cartilages.

From this internal end the clavicle, for about two-fifths of its length, is bended obliquely forward and downward. On the upper and forepart of this curvature a small ridge is seen, with a

plain rough surface before it ; whence the sterno-hyoideus and sterno-mastoideus have in part their origin. Near the lower angle a small plain surface is often to be remarked, where the first rib and this bone are contiguous, and connected by a firm ligament. From this a rough plain surface is extended outward, where the pectoral muscle has part of its origin. Behind, the bone is made flat and rough by the insertion of the larger share of the subclavian muscle. After the clavicle begins to be bended backward, it is round : but it soon after becomes broad and thin, which shape it retains to its external end. Along the external concavity, a rough sinuosity runs, from which some part of the deltoid muscle takes its rise ; opposite to this, on the convex edge, a scabrous ridge gives insertion to a share of the cucullaris. The upper surface of the clavicle here is flat ; but the lower is hollow, for lodging the beginning of the subclavius ; and toward its back part a tubercle rises, to which, and a roughness near it, the short thick ligament connecting this bone to the coracoid process of the scapula is fixed.

The external end of this bone is horizontally oblong, smooth, sloping at the posterior side, and tipped in a recent subject with a cartilage, for its articulation with the acromion scapulæ. Round this the bone is spongy, for the firmer connection of the ligaments.

The medullary arteries having their direction obliquely outward, enter the clavicles by one or more small passages in the middle of their back part.

The *substance* of this bone is the same as of the other round long bones.

Articulation.

The internal end which is articulated to the sternum, owing to the strength of the ligaments which surround it, has very little motion ; but the external end, which is at a great distance from that axis, enjoys conspicuous motion in every direction. The articulation of the exterior end of the clavicle shall be considered after the description of the scapula.

The clavicles of infants are not deficient in any of their parts ; nor have they any epiphyses at their extremities joined afterward

to their bodies, as most other such long bones have, which preserves them from being bended too much, and from the danger of any unossified parts being separated by the force which pulls the arms forward.

The *uses* of the clavicles are, to keep the scapulæ, and consequently all the superior extremities, from falling in and forward upon the thorax; by which, as in most quadrupeds, the motions of the arms would be much confined, and the breast made too narrow. The clavicles likewise afford origin to several muscles, and a defence to large vessels.

SCAPULA.

Scapula, or *shoulder blade*, is the triangular bone situated on the outside of the ribs; with its longest side, called its *base*, towards the spinal processes of the vertebræ; and with the angle at the upper part of this side about three inches, and the lower angle at a greater distance from these processes. The back part of the scapula has nothing but the thin ends of the serratus anticus major and subscapularis muscles between it and the ribs: but as this bone advances forward, its distance from the ribs increases. The upper or shortest side, called the *superior costa* of the scapula, is nearly horizontal, and parallel with the second rib. The lower side, which is named the *inferior costa*, is extended obliquely from the third to the eighth rib: this situation of the bone is when people allow the member to remain in the most natural easy posture. The inferior angle of the scapula is very acute; the upper one is nearly a right angle; and what is called the anterior does not deserve the name, for the two sides do not meet to form an angle. The body of this bone is concave toward the ribs, and convex behind, where it has the name of *dorsum*. Three processes are generally reckoned to proceed from the scapula. The first is the large *spine* that rises from its convex surface behind, and divides it unequally, terminating in the *acromion*. The second process stands out from the forepart of the upper side; and, from its imaginary resemblance to a crow's beak, is named *coracoides*. The third process is the whole thick bulbous forepart of the bone.

The particular description will now be more easily understood.

The base, which is tipped with cartilage in a young subject, is not all straight: for above the spine it runs obliquely forward to the superior angle, that here it might not be too protuberant backward, and so bruise the muscles and teguments. Into the oblique space the angularis scapula is inserted. At the root of the spine, on the back part of the base, a triangular plain surface is formed by the pressure of the lower fibres of the trapezius. Below this the edge of the scapula is scabrous and rough, for the insertion of the serratus major anticus and rhomboid muscles.

The back part of the inferior angle is made smooth by the latissimus dorsi passing over it. This muscle also alters the direction of the inferior costa some way forward from this angle: and so far it is flatted behind by the origin of the teres major. As the inferior costa advances forward it is of considerable thickness, is slightly hollowed and made smooth behind by the teres minor, while it has a fossa formed in it below by part of the subscapularis; and between the two a ridge with a small depression toward the forepart appears, where the longus extensor cubiti has its origin.

The superior costa is very thin: and near its forepart there is a similunar notch, from one end of which to the other a ligament is stretched; and sometimes the bone is continued to form one, or sometimes two holes for the passage of the suprascapular blood-vessels and nerves. Immediately behind this similunar cavity the omohyoid muscle has its rise. From the notch to the termination of the fossa for the teres minor, the scapula is narrower than any where else, and supports the third process. This part has the name of *cervix*.

The whole dorsum of the scapula is always said to be convex; but by reason of the raised edges that surround it, it is divided into two cavities by the spine, which is stretched from behind forward, much nearer to the superior than to the inferior costa. The cavity above the spine is really concave where the supraspinatus muscle is lodged; while the surface of this bone be-

low the spine, on which the infra-spinatus muscle is placed, is convex, except a fossa that runs at the side of the inferior costa.

The internal or anterior surface of this bone is hollow, except in the part above the spine, which is convex.—The subscapularis muscle is extended over this surface, where it forms several ridges and intermediate depressions; they point out the interstices of the bundles of fibres of which the subscapularis is composed.

The spine rises small at the base of the scapula, and becomes higher and broader as it advances forward.—On the sides it is unequally hollowed and crooked, by the actions of the adjacent muscles.—Its ridge is divided into two rough flat surfaces: into the upper one the trapezius muscle is inserted; and the lower one has part of the deltoid fixed to it.—The end of the spine called *acromion*, or top of the shoulder, is broad and flat, and is sometimes only joined to the spine by a cartilage.—The anterior edge of the acromion is flat, smooth, and covered with a cartilage, for its articulation with the external end of the clavicle; and it is hollowed below, to allow a passage to the infra and supra spinati muscles, and free motion to the os humeri.

The coracoid process is crooked, with its point inclining forward; so that a hollow is left at the lower side of its root for the passage of the subscapularis muscle.—The end of this process is marked with three plain surfaces. Into the internal, the pectoralis minor is inserted: from the external, one head of the biceps flexor cubiti rises; and from the lower one, the coracobrachialis has its origin. At the upper part of the root of this process, immediately before the semilunar notch, a smooth tubercle appears, where a ligament from the clavicle is fixed. From all the external side of this coracoid apophyse, a broad ligament goes out, which becomes narrower where it is fixed to the acromion.

From the cervix scapulæ the third process is produced. The forepart of this is formed into a glenoid cavity, which is of the shape of the longitudinal section of an egg, being broad below and narrow above. Between the brims of this hollow and the forepart of the root of the spine, a large sinuosity is left for the

transmission of the supra and infra spinati muscles ; and on the upper part of these brims we may remark a smooth surface, where the second head of the biceps flexor cubiti has its origin. The root of the supercilia is rough all round, for the firmer adhesion of the capsular ligament of the articulation, and of the cartilage which is placed on these brims, where it is thick, but becomes very thin as it is continued towards the middle of the cavity, which it lines all over.

The medullary vessels enter the scapula near the base of the spine.

The *substance* of the scapula, as in all other broad flat bones, is cellular, but of unequal thickness: for the neck and third process are thick and strong ; the inferior costa, spine, and coracoid process, are of a middle thickness ; and the body is so pressed by the muscles, as to become thin and diaphanous.

Articulation.

The scapula and clavicle are *joined* by plain surfaces, tipped with cartilage. Owing to the strength of the ligaments at this joint, these bones have but a little rotatory motion during which the oblong smooth articulated surfaces of the clavicle and scapula pass not in the same plane, but a little transversely, or across each other, and thereby preserve this joint from luxations, to which it would be subject if either of the bones was to move on the other perpendicularly up and down, without any rotation.— Sometimes a moveable ligamentous cartilage is found in this joint ; and at other times such a cartilage is only interposed at the anterior half of it. The scapula is connected to the head, os hyoides, vertebræ, ribs, and arm-bone, by muscles, that have one end fastened to these bones, and the other to the scapula, which can move it upward, downward, backward, or forward ; by the quick succession of these motions, its whole body is carried in a circle. But being also often moved as upon an axis perpendicular to its plane, its circumference turns in a circle whose centre this axis is. Whichever of these motions it performs, it always carries the outer end of the clavicle and the arm along with it.— The glenoid cavity of this bone receives the os humeri, which plays in it as a ball in a socket, as will be explained more hereafter.

The *use* of the scapula is, to serve as a fulcrum to the arm; and by altering its position on different occasions, to allow always the head of the os humeri a right-situated socket to move in; and thereby to assist and to enlarge greatly the motions of the superior extremity, and to afford the muscles which rise from it more advantageous actions, by altering their directions to the bone which they are to move.—This bone also serves to defend the back part of the thorax, and is often employed to sustain weights, or to resist forces, too great for the arm to bear.

The base, acromion, coracoid process, and head of the scapula, are all in a cartilaginous state at birth; and the three first are joined as epiphyses; while the head, with the glenoid cavity, is not formed into a separate bone, but is gradually produced by the ossification of the body of this bone being continued forward.

BONE OF THE ARM.

The *arm* has only one bone, best known by the Latin name of *os humeri*, which is long, round, and nearly straight.

The upper end of this bone is formed in a large round smooth head, whose middle point is not in a straight line with the axis of the bone, but stands obliquely backward from it.—The extent of the head is distinguished by a circular fossa surrounding its base where the head is united to the bone, and the capsular ligament of the joint is fixed.—Below the forepart of its base two tubercles stand out: the smallest one, which is situated most to the inside, has the tendon of the subscapularis muscle inserted into it.—The larger more external protuberance is divided, at its upper part, into three smooth plain surfaces; into the anterior of which the supra-spinatus; into the middle or largest, the infra-spinatus into the one behind, the *teres minor* is inserted.—Between these two tubercles, exactly in the forepart of the bone, a deep long fossa is formed, for lodging the tendinous head of the *biceps flexor cubiti*. To these tubercles and in the fossa there are remarkable holes, in the recent subject penetrated by vessels, and by tendinous and ligamentous fibres.—On each side of this fossa, as it descends in the

os humeri, a rough ridge, gently flattened in the middle, runs from the roots of the tubercles. The tendon of the pectoral muscle is fixed into the anterior of these ridges, and the latissimus dorsi and teres major are inserted into the internal one. A little behind the lower end of this last, another rough ridge may be observed, where the caraco-brachialis is inserted. From the back-part of the root of the largest tubercle a ridge also is continued, from which the brevis extensor cubiti rises. This bone is flattened on the inside, about its middle, by the belly of the biceps flexor cubiti. In the middle of this plain surface, the entry of the medullary artery is seen slanting obliquely downward. At the foreside of this plane the bone rises in a sort of ridge, which is rough, and often has a great many small holes in it, where the tendon of the strong deltoid muscle is inserted; on each side of which the bone is smooth and flat, where the brachius internus rises. The exterior of these two flat surfaces is the largest; behind it is a superficial spiral channel, formed by the musculo cutaneous nerve and the vessels that accompany it, runs from behind forward and downward. The body of the os humeri is flattened behind by the extensors of the fore-arm.

Near the lower end of this bone, a large sharp ridge is extended on its outside, from which the musculus supinator radii longus, and the extensor carpi radialis longior rise. Opposite to this, there is another small ridge to which the aponeurotic tendon, that gives origin to the fibres of the brachiaëus internus, and the third head of the triceps are fixed; and from a little depression on the fore-side of it, the pronator radii teres rises.

The body of the os humeri becomes gradually broader toward the lower end, where it has several processes; at the roots of which there is a cavity before and another behind. The anterior is divided by a ridge into two; the external, which is the least, receives the end of the radius; and the internal receives the coronoid process of the ulna in the flexions of the fore arm, while the posterior deep triangular cavity lodges the olecranon in its extensions. The bone betwixt these two cavities is pressed so thin by the processes of the ulna, as to appear diaphanous in several subjects. The sides of the posterior cavity are stretched out into two processes, one on each side: these are called con-

dyles; from each of which a strong ligament goes out to the bones of the fore arm. The external condyle, which has an oblique direction also forward in respect of the internal, when the arm is in the most natural posture, is equally broad, and has an obtuse smooth head rising from it forward. From the rough part of the condyle, the extensor carpi radialis brevior, the extensor digitorum communis, extensor carpi ulnaris, anconæus, and some part of the supinator radii brevis, take their rise; and on the smooth head the upper end of the radius plays. Immediately on the outside of this, there is a sinuosity made by the extensor radialis brevior carpi, upon which the musculao cutaneous nerve is placed. The internal condyle is more pointed and protuberant than the external, to give origin to some part of the flexor carpi radialis, pronator radii teres, palmaris longus, flexor digitorum sublimis, and flexor carpi ulnaris. Between the two condyles, is the trochlea or pulley; which consists of two lateral protuberances, and a middle cavity, that are smooth and covered with cartilage. When the fore arm is extended, the tendon of the brachii internus is lodged in the forepart of the cavity of this pulley. The external protuberance, which is less than the other, has a sharp edge behind; but forward, this ridge is obtuse, and only separated from the little head, already described, by a small fossa, in which the joined edges of the ulna and radius move. The internal protuberance of the pulley is largest and highest; and therefore, in the motions of the ulna upon it, that bone would be inclined outward, were it not supported by the radius on that side. Between this internal protuberance and condyle, a sinuosity may be remarked, where the ulnar nerve passes.

The *substance* and the internal structure of the os humeri is the same, and disposed in the same way, as in other long bones.

Articulation.

The round head at the upper end of this bone is *articulated* with the glenoid cavity of the scapula; which being superficial, and having long ligaments, allows the arm a free and extensive motion. But the acromion and coracoid process, with the strong broad ligaments stretched betwixt them, secure the articulation above, where the greatest and most frequent force is applied to thrust the head of the bone out of its place.

The motions which the arm enjoys by this articulation are to every side ; and by the succession of these different motions, a circle may be described. Besides which, the bone performs a small rotation round its own axis. But though this can be performed with the round head in all positions ; yet as these vary, the effects upon the body of the bone are very different : for if the middle of the head is the centre of rotation, as it is when the arm hangs down by the side, the body of the bone is only moved forward and backward ; because the axis of motion of the head is nearly at right angles with the length of the bone ; whereas, when the arm is raised to right angles with the trunk of the body, the centre of motion, and the axis of the bone, come to be of the same straight line ; and therefore the body of the *os humeri* performs the same motion with its head. Though the motions of the arm seem to be very extensive, yet the larger share of them depends on the motions of the scapula. The lower end of the *os humeri* is articulated with the bones of the fore-arm, and carries them with it in all its motions, but serves as a base on which they perform the motions peculiar to themselves.

Both the ends of this bone are cartilaginous in a new-born infant ; and the large head with the two tubercles, and the trochlea with the two condyles, become epiphyses before they are united to the body of the bone.

BONES OF THE FORE-ARM.

The fore-arm consists of two long bones, the *ulna* and *radius*, in the description of which we shall understand by the term of *posterior*, that part which is in the same direction with the back of the hand ; by *anterior*, that answering to the palm ; by *external*, that on the same side with the thumb ; and by *internal*, side nearest to the little finger.

ULNA.

Ulna, so named from its being used as a measure, is the longest of the two bones of the fore arm, and situated on the outside of the radius.

At the upper end of the ulna are processes.—The posterior is largest, and formed like a hook, whose concave surface moves upon the pulley of the os humeri, and is called *olecranon*, or top of the cubit. The convex back part of it is rough and scabrous, where the triceps cubiti is inserted. The olecranon makes it unnecessary that the tendons of the extensor muscles should pass over the end of the os humeri; which would have been of ill consequence in the great flexions of this joint, or when any considerable force is applied to this part. The anterior process is not so large, nor does it reach so high, as the one behind; but is sharper at its end, and therefore is named *coronoid*. Between these two processes, a large semicircular or sigmoid cavity is left; the surface of which, on each side of a middle rising, is slanting, and exactly adapted to the pulley of the humerus. Across the middle of it, there is a small sinuosity for lodging mucilaginous glands; where, as well as in a small hollow on the internal side of it, the cartilage that lines the rest of its surface is wanting. Round the brims of this cavity the bone is rough, where the capsular ligament of the joint is implanted. Immediately below the olecranon, on the back part of the ulna, a flat triangular spongy surface appears, on which we commonly lean. At the external side of this, there is a larger hollow surface, where the anconæus is lodged; and the ridge at the outside of this gives rise to the supinator radii brevis. Between the top of the ridge and the coronoid process is the semilunated smooth cavity, lined with cartilage; in which, and a ligament extended from the one to the other end of this cavity, the round head of the radius plays. Immediately below it, a rough hollow gives lodging to mucilaginous glands. Below the root of the coronoid process, this bone is scabrous where the brachiaeus internus is inserted. On the inside of that, we observe a smooth cavity, where begins the flexor digitorum profundus.

The body of the ulna is triangular. The internal angle is very sharp where the interosseous ligament that connects the two bones is fixed: the sides which make this angle are flat and rough, by the action and adhesion of the many muscles situated here. At the distance of one-third of the length of the ulna

from the top, in its forepart, the passage of the medullary vessels is to be remarked slanting upward. The external side of this bone is smooth, somewhat convex, and the angles at each edge of it are blunted by the pressure of the muscles equally disposed about them.

As this bone descends, it becomes gradually smaller; so that its lower end terminates in a little head, standing on a small neck. Toward the fore and inner part of which last, an oblique ridge runs, that gives rise to the pronator radii quadratus. The head is round, smooth, and covered with a cartilage on its external side, to be received into the semilunar cavity of the radius; while a styloid process rises from its inside, to which is fixed a strong ligament that is extended to the os cuneiforme and pisiforme of the wrist. Between the back part of that external smooth side and this process, a sinuosity is left for the tendon of the extensor carpi ulnaris. On the forepart of the root of the process, such another depression may be remarked for the passage of the ulnar artery and nerve. The end of the bone is smooth, and covered with a cartilage. Between it and the bones of the wrist, a doubly concave moveable cartilage is interposed; which is a continuation of the cartilage that covers the lower end of the radius, and is connected loosely to the root of the styloid process, and to the rough cavity there; in which mucilaginous glands are lodged.

Articulation.

The ulna is articulated above with the lower end of the os humeri, where these bones have depressions and protuberances corresponding to each other, so as to allow an easy and secure extension of the fore-arm to almost a straight line with the arm, and flexion to a very acute angle; but, by the slanting position of the pulley, the lower part of the fore-arm is turned outward in the extension, and inward in the flexion; and a very small kind of rotation is likewise allowed in all positions, especially when the ligaments are most equally relaxed by the fore-arm being in a middle degree of flexion. The ulna is also articulated with the radius and carpus, in a manner to be related afterward.

RADIUS.

Radius, so called from its imagined resemblance to a spoke of a wheel, is the bone placed at the outside of the fore arm. Its upper end is formed into a circular little head, which is hollowed for an articulation with the tubercle at the side of the pulley of the os humeri; and the half of the round circumference of the head next to the ulna is smooth, and covered with a cartilage, in order to be received into the semilunated cavity of that bone. Below the head, the radius is much smaller; therefore this part is named its *cervix*, which is made round by the action of the supinator radii brevis. At the internal root of this neck, a tuberos process rises; into which the biceps flexor cubiti is inserted. From this a ridge runs downward and outward, where the supinator radii brevis is inserted; and a little below, and behind this ridge, there is a rough scabrous surface, where the pronator radii teres is fixed.

The body of the radius is not straight, but convex on its external and posterior surfaces; where it is also made round by the equal pressure of the circumjacent muscles, particularly of the extensors of the thumb; but the surfaces next to the ulna are flatted and rough, for the origin of the muscles of the hand; and both terminate in a common sharp spine, to which the strong ligament extended betwixt the two bones of the fore arm is fixed. A little below the beginning of the plain surface, on its forepart, where the flexor muscle of the last joint of the thumb takes its origin, the passage of the medullary vessels is seen slanting upward. The radius becomes broader and flatter toward the lower end, especially on its forepart, where its pronator quadratus muscle is situated.

The lower end of the radius is larger than the superior; though not in such a disproportion as the upper end of the ulna is larger than its lower end.—Its back part has a flat strong ridge in the middle, and fossæ on each side.—In a small groove, immediately on the inside of the ridge, the tendon of the extensor tertii internodii pollicis plays. In a large one beyond this, the tendons of the indicator and of the common extensor muscles of the fingers

pass.—Contiguous to the ulna there is a small depression made by the extensor minimi digiti.—On the outside of the ridge there is a broad depression, which seems again subdivided, where the two tendons of the extensor carpi radialis, are lodged, The external side of this end of the radius is also hollowed by the extensors of the first and second joint of the thumb ; immediately above which a little rough surface shows where the supinator radii longus is inserted.—The ridges at the sides of the grooves, in which the tendons play, have an annular ligament fixed to them, by which the several sheaths for the tendons are formed. The forepart of this end of the radius is also depressed, where the flexors of the fingers and flexor carpi radialis pass.—The internal side is formed into a semilunated smooth cavity, lined with a cartilage, for receiving the lower end of the ulna.—The lowest part of the radius is formed into an oblong cavity ; in the middle of which is a small transverse rising, gently hollowed, for lodging mucilaginous glands ; while the rising itself is insinuated into the conjunction of the two bones of the wrist that are received into the cavity.—The external side of this articulation is fenced by a remarkable process of the radius, from which a ligament goes out to the wrist, as the styloid process of the ulna with its ligament guards it on the inside.

These bones are considerably distant in the middle where the interosseous ligament is expanded, which gives origin, and, by its depth, protection to several muscles. But this ligament is wanting near the upper end of the fore arm, where the supinator radii brevis, and flexor digitarum profundus, are immediately connected.

Both ends of the bones of the fore arm are first cartilages, and then epiphyses, in children.

Articulation.

As the head of the radius receives the tubercle of the os humeri, it is not only bended and extended along with the ulna, but may be moved round its axis in any position ; and that this motion round its axis may be sufficiently large, the ligament of the articulation is extended further down than ordinary on the neck of this bone, before it is connected to it ; and it is very thin at its upper and lower part, but makes a firm ring in the

middle. This bone is also joined to the ulna by a double articulation: for above, a tubercle of the radius plays in the socket of the ulna; whilst below, the radius gives the socket, and the ulna the tubercle. But then the motion performed in these two is very different: for, at the upper end, the radius does no more than turn round its axis; while, at the lower end, it moves in a sort of cycloid upon a round part of the ulna; and as the hand is articulated and firmly connected here with the radius, they must move together.—When the palm is turned uppermost, the radius is said to perform the *supination*: when the back of the hand is above, it is said to be *prone*. But then the quickness and large extent of these two motions are assisted by the ulna, which, as was before observed, can move with a kind of small rotation on the sloping sides of the pulley. This lateral motion, though very inconsiderable in the joint itself, is conspicuous at the lower end of such a long bone; and the strong ligament connecting this lower end to the carpus, makes the hand more readily obey these motions. When we design a large circular turn of our hand, we increase it by the rotation of the os humeri, and sometimes employ the spine and inferior extremities to make these motions of pronation or supination of the hand large enough.

BONES OF THE HAND.

The hand comprehends all from the joint of the wrist to the points of the fingers. Its back part is convex, for greater firmness and strength; and it is concave before, for containing more surely and conveniently such bodies as we take hold of. One half of the hand has an obscure motion in comparison of what the other has, and serves as a base to the moveable half; which can be extended back very little farther than to a straight line with the fore arm, but can be considerably bended forward.

As the bones that compose the hand are of different shapes and uses, while several of them that are contiguous agree in some general characters; the hand is, on this account, commonly divided into carpus, metacarpus, and fingers; among which last the thumb is reckoned.

CARPUS.

The carpus is composed of eight small spongy bones, situated at the upper part of the hand. In describing these bones we shall begin with the range concerned in the moveable joint of the wrist, or connected to the fore arm, and shall afterward consider the four that support the thumb and ossa metacarpi of the fingers.

The eight bones of the CARPUS are, *os scaphoides*, *lunare*, *cuneiforme*, *pisiforme*, *trapezium*, *trapezoides*, *magnum*, *unciforme*.

The *scaphoides* is situated most externally of those that are articulated with the fore arm. The *lunare* is immediately on the inside of the former.—The *cuneiforme* is placed still more internally, but does not reach so high up as the other two.—The *pisiforme* stands forward in the palm from the *cuneiforme*.—The *trapezium* is the first of the second row, and is situated betwixt the *scaphoides* and first joint of the thumb.—The *trapezoides* is immediately on the inside of the *trapezium*.—The *os magnum* is still more internal.—The *unciforme* is farther to the side of the little finger.

Os scaphoides is the largest of the eight, excepting one. It is convex above, concave and oblong below; from which small resemblance of a boat it has got its name. Its smooth convex surface is divided by a rough middle fossa, which runs obliquely cross it. The upper largest division is articulated with the radius. Into the fossa the common ligament of the joint of the wrist is fixed; and the lower division is joined to the *trapezium* and *trapezoides*. The cavity receives more than an half of the round head of the *os magnum*. The internal side of this hollow is formed into a semilunar plane, to be articulated with the following bone.—The external, posterior, and anterior edges are rough, for fixing the ligaments that connect it to the surrounding bones.

Os lunare has a smooth convex upper surface, by which it is articulated with the radius. The external side, which gives the name to the bone, is in the form of a crescent, and is joined

with the scaphoid ;—the lower surface is hollow, for receiving part of the head of the os magnum. On the inside of this cavity is another smooth, but narrow, oblong sinuosity, for receiving the upper end of the os unciforme :—on the inside of which a small convexity is found, for its connection with the os cuneiforme. Between the great convexity above, and the first deep inferior cavity, there is a rough fossa, in which the circular ligament of the joint of the wrist is fixed.

Os cuneiforme is broader above, and toward the back of the hand, than it is below and forward ; which gives it the resemblance of a wedge. The superior slightly convex surface is included in the joint of the wrist, being opposed to the lower end of the ulna.—Below this the cuneiforme bone has a rough fossa, wherein the ligament of the articulation of the wrist is fixed.—On the external side of this bone, where it is contiguous to the os lunare, it is smooth and slightly concave. Its lower surface, where it is contiguous to the os unciforme, is oblong, somewhat spiral, and concave. Near the middle of its anterior surface a circular plane appears, where the os pisiforme is sustained.

Os pisiforme is almost spherical, except one circular plane, or slightly hollow surface, which is covered with cartilage for its motion on the cuneiforme bone, from which its whole rough body is prominent forward into the palm ; having the tendon of the flexor carpi ulnaris, and a ligament from the styloid process of the ulna, fixed to its upper part ; the transverse ligament of the wrist is connected to its external side ; ligaments extended to the unciform bone, and to the os metacarpi of the little finger, are attached to its lower part ; the abductor minimi digiti has its origin from its forepart ; and, at the external side of it, a small depression is formed, for the passage of the ulnar nerve.

Trapezium has four unequal sides and angles in its back part, from which it has got its name.—Above, its surface is smooth, slightly hollowed, and semicircular, for its conjunction with the os scaphoides.—Its internal side is an oblong concave square, for receiving the following bone. The inferior surface is formed into a pulley ; the two protuberant sides of which are external

and internal. On this pulley the first bone of the thumb is moved.—At the inferior part of the internal side, a small oblong smooth surface is formed by the os metacarpi indicis. The forepart of the trapezium is prominent in the palm, and near to the internal side has a sinuosity in it, where the tendon of the flexor carpi radialis is lodged; on the ligamentous sheath of which the tendon of the flexor tertii interodii pollicis plays: and more externally the bone is scabrous, where the transverse ligament of the wrist is connected, the abductor and flexor primi internodii pollicis have their origin, and ligaments go out to the first bone of the thumb.

Os trapezoides, so called from the irregular quadrangular figure of its back part, is the smallest bone of the wrist, except the pisiforme. The figure of it is an irregular cube. It has a small hollow surface above, by which it joins the scaphoides; a long convex one externally, where it is contiguous to the trapezium; a small internal one, for its conjunction with the os magnum; and an inferior convex surface, the edges of which are, however, so raised before and behind, that a sort of pulley is formed, where it sustains the os metacarpi indicis.

Os magnum, so called because it is the largest bone of the carpus, is oblong, having four quadrangular sides, with a round upper end, and a triangular plain one below. The round head is divided by a small rising, opposite to the connection of the os scaphoides and lunare, which together form the cavity for receiving it. On the outside a short plain surface joins the os magnum to the trapezoides. On the inside is a long narrow surface, where it is contiguous to the os unciforme. The lower end, which sustains the metacarpal bone of the middle finger, is triangular, slightly hollowed, and farther advanced on the external side than on the internal, having a considerable oblong depression made on the advanced outside by the metacarpal bone of the fore-finger; and generally there is a small mark of the os metacarpi digiti annularis on its internal side.

Os unciforme has got its name from a thin broad process that stands from it forward into the palm, and is hollow on its out-

side, for affording passage to the tendons of the flexors of the fingers. To this process also the transverse ligament is fixed that binds down and defends these tendons; and the flexor and abductor muscles of the little finger have part of their origin from it. The upper plain surface is small, convex, and joined with the os lunare: the external side is long, and slightly convex, adapted to the contiguous os magnum. The internal surface is oblique, and irregularly convex, to be articulated with the cuneiform bone. The lower end is divided into two concave surfaces; the internal is joined with the metacarpal bone of the little finger; and the external one is fitted to the metacarpal bone of the ring-finger.

In the description of these eight bones, their plain articular surfaces only have been mentioned; their scabrous surfaces, however, toward the back and palm of the hand, are, in the recent subject, entirely covered by ligaments inserted into them.

As the surfaces of these bones are largest behind, the figure of the whole conjoined must be convex there, and concave before; which concavity is still more increased by the os pisiforme, and process of the os unciforme, standing forward on one side, as the trapezium does on the other: and the bones are securely kept in this form by the broad strong transverse ligament connected to those parts of them that stand prominent into the palm of the hand. The convexity behind renders the whole fabric stronger, where it is most exposed to injuries; and the large anterior hollow is necessary for a safe passage to the numerous vessels, nerves, and tendons of the fingers.

The *substance* of these bones is spongy and cellular, but strong in respect of their bulk.

Articulation.

The three first bones of the carpus make an oblong head, by which they are *articulated* with the cavity at the lower ends of the bones of the fore-arm, so as to allow motion to all sides; and by a quick succession of these motions, they may be moved in a circle. But as the joint is oblong, and therefore the two dimensions are unequal, no motion is allowed to the carpus round its axis, except what it has in the pronation and supination along

with the radius. The articulation of the first three bones of the superior row, with the bones of the inferior, is such as allows of motion, especially backward and forward; to the security and easiness of which, the reception of the os magnum into the cavity formed by the scaphoides and lunare contributes considerably: and the greatest number of the muscles that serve for the motion of the wrist on the radius, being inserted beyond the conjunction of the first row of bones with the second, act equally on this articulation as they do on the former; but the joint formed with the radius being the most easily moved, the first effect of these muscles is on it; and the second row of the carpus is only moved afterward. By this means a larger motion of the wrist is allowed than otherwise it could have had safely; for if as large motion had been given to one joint, the angle of flexion would have been very acute, and the ligaments must have been longer than was consistent with the firmness and security of the joint. The other articulations of the bones here being by nearly plain surfaces, scarce allow of any more motion, because of the strong connecting ligaments, than to yield a little, and so elude the force of any external power; and to render the back of the wrist a little more flat, or the palm more hollow, on proper occasions.

The *uses* of the carpus are to serve as a base to the hand, to protect its tendons, and to afford it a free large motion.

All the bones of the carpus are in a cartilaginous state at the time of birth.

METACARPUS.

Metacarpus consists of four bones which sustain the fingers. Each bone is long and round, with its ends larger than its body. The upper end, which some call the base, is flat and oblong, without any considerable head or cavity; but it is however somewhat hollowed, for the articulation with the carpus: it is made flat and smooth on the sides where these bones are contiguous to each other. Their bodies are flattened on their back part by the tendons of the extensors of the fingers. The anterior surface of

these bodies is a little concave, especially in their middle ; along which a sharp ridge stands out, which separates the muscoli interossei placed on each side of these bones, which are there made flat and plain by these muscles.

Their lower ends are raised into large oblong smooth heads, whose greatest extent is forward from the axis of the bone. At the forepart of each side of the root of each of these heads, one or two tubercles stand out, for fixing the ligaments that go from one metacarpal bone to another, to preserve them from being drawn asunder. Round the heads a rough ring may be remarked, for the capsular ligaments of the first joints of the fingers to be fixed to ; and both sides of these heads are flat, by pressing on each other.

The *substance* of the metacarpal bones is the same with that of all long bones.

At the time of birth, these bones are cartilaginous at both ends, which afterward become epiphyses.

Articulation.

The metacarpal bones are *joined* above to the ossa carpi and to each other by nearly plain surfaces. These connections are not fit for large motions. Their particular articulations will be noticed in the description of each bone.

The concavity on the forepart of these metacarpal bones, and the placing their bases on the arched carpus, cause them to form a hollow in the palm of the hand, which is useful. The spaces between them lodge muscles, and their small motion makes them fit supporters for the fingers to play on.

Though the ossa metacarpi so far agree, yet they may be distinguished from each other by the following marks.

The *os metacarpi indicis* is generally the longest. Its base, which is articulated with the os trapezoides, is hollow in the middle. The small ridge on the external side of this oblong cavity is smaller than the one opposite to it, and is made flat on the side by the trapezium. The interior ridge is also smooth, and flat on its outside, for its conjunction with the os magnum ; immediately below which a semicircular smooth flat surface shows the articulation of this to the second metacarpal bone. The back part of this base is flattened where the long head of the extensor carpi

radialis is inserted, and its forepart is prominent where the tendon of the flexor carpi radialis is fixed. The internal side of the body of this bone is more hollowed by the action of muscles, than the external. The tubercle at the external root of its head is larger than the internal. Its base is so firmly fixed to the bone it is connected with, that it has no motion.

Os metacarpi medii digiti is generally the second in length; but often it is as long as the former; sometimes it is longer; and frequently it appears only to equal the first by the os magnum being farther advanced downward than any other bone of the wrist. Its base is a broad superficial cavity, slanting outward; the external posterior angle of which is so prominent, as to have the appearance of a process. The external side of this base is made plain in the same way as the internal side of the former bone, while its internal side has two hollow circular surfaces, for joining the third metacarpal bone; and between these surfaces there is a rough fossa, for the adhesion of a ligament, and lodging mucilaginous glands. The extensor carpi radialis brevior is inserted into the back part of this base. The two sides of this bone are almost equally flattened; only the ridge on the forepart of the body inclines inward. The tubercles at the forepart of the root of the head are equal. The motion of this bone is very little more than the first metacarpal one has; and therefore these two firmly resist bodies pressed against them by the thumb or fingers, or both.

Os metacarpi digiti annularis is shorter than the second metacarpal bone. Its base is semicircular and convex, for its conjunction with the os unciforme. On its external side are two smooth convexities, and a middle fossa, adapted to the second metacarpal bone. The internal side has a triangular smooth concave surface to join it with the fourth one. The anterior ridge of its body is situated more to the in than to the outside. The tubercles near the head are equal. The motion of this third metacarpal bone is greater than the motion of the second.

Os metacarpi minimi digiti is the smallest and sharpest. Its base is irregularly convex, and rises slanting outward. Its external side is exactly adapted to the third metacarpal bone. The

internal has no smooth surface, because it is not contiguous to any other bone; but it is prominent where the extensor carpi ulnaris is inserted. As this metacarpal bone is furnished with a proper moving muscle, has the plainest articulation, is most loosely connected and least confined, it not only enjoys a much larger motion than any of the rest, but draws the third bone with it, when the palm of the hand is to be made hollow by its advancement forward, and by the prominence of the thumb opposite to it.

THUMB AND FINGERS.

The thumb and four fingers are each composed of three long bones.

The thumb is situated obliquely in respect of the fingers, neither opposite directly to them, nor in the same plane with them. All its bones are much thicker and stronger in proportion to their length, than the bones of the fingers are: which are extremely necessary, since the thumb counteracts all the fingers.

The first bone of the thumb has its base adapted to the double pulley of the trapezium: for, in viewing it from one side to the other, it appears convex in the middle; but when considered from behind forward, it is concave there. The edge at the forepart of this base is produced farther than any other part; and round the back part of the base a rough fossa may be seen, for the connection of the ligaments of this joint. The body and head of this bone are of the same shape as the ossa metacarpi; only that the body is shorter, and the head flatter, with the tubercles at the forepart of its root larger.

The articulation of the upper end of this bone is uncommon: for, though it has protuberances and depressions adapted to the double pulley of the trapezium; yet it enjoys a circular motion, as the joints do where a round head of the one plays in the orbicular socket of another; only it is somewhat more confined, and less expeditious, but stronger and more secure than such joints generally are.

This bone of children is in the same state with the metacarpal bones.

The second bone of the thumb has a large base formed into an oblong cavity, whose greatest length is from one side to the other. Round it several tubercles may be remarked, for the insertion of ligaments. Its body is convex, or a half-round behind; but flat before, for lodging the tendon of the long flexor of the thumb, which is tied down by ligamentous sheaths that are fixed on each side to the angle at the edge of this flat surface. The lower end of this second bone has two lateral round protuberances, and a middle cavity, whose greatest extent of smooth surface is forward.

The articulation and motion of the upper end of this second bone is as singular as that of the former. For its cavity being joined to the round head of the first bone, it would seem at first view to enjoy motion in all directions; yet, because of the strength of its lateral ligaments, oblong figure of the joint itself, and mobility of the first joint, it only allows flexion and extension; and these are generally much confined.

The third bone of the thumb is the smallest, with a large base, whose greatest extent is from one side to the other. This base is formed into two cavities and a middle protuberance, to be adapted to the pulley of the former bone. Its body is rounded behind; but is flatter than in the former bone, for sustaining the nail. It is flat and rough before, by the insertion of the flexor tertii internodii. This bone becomes gradually smaller, till near the lower end, where it is a little enlarged, and has an oval scabrous edge.

The motion of this third bone is confined to flexion and extension.

The orderly disposition of the bones of the FINGERS into three rows, has made them generally obtain the name of three *phalanges*. All of them have half-round convex surfaces, covered with an aponeurosis, formed by the tendons of the extensors, lumbricales, and interossei, and placed directly backward, for their greater strength; and their flat concave part is forward, for taking hold more surely, and for lodging the tendons of the flexor muscles. The ligaments for keeping down these tendons are

fixed to the angles that are between the convex and concave sides.

The bones of the first phalanx of the fingers answer to the description of the second bone of the thumb ; only that the cavity in their base is not so oblong ; nor is their motion on the metacarpal bones so much confined ; for they can be moved laterally or circularly ; but have no rotation, or a very small degree of it, round their axis.

Both the ends of this first phalanx are in a cartilaginous state at the birth ; and the upper one is afterward affixed in form of an epiphyse.

The second bone of the fingers has its base formed into two lateral cavities, and a middle protuberance ; while the lower end has two lateral protuberances and a middle cavity ; therefore it is joined at both ends in the same manner, which none of the bones of the thumb are.

This bone is in the same condition with the former in children.

The third bone differs nothing from the description of the third bone of the thumb, excepting in the general distinguishing marks ; and therefore the second and third phalanx of the fingers enjoy only flexion and extension.

The upper end of this third phalanx is a cartilage in a ripe child ; and is only an epiphyse after, till the full growth of the body.

All the difference of the *phalanges* of the several fingers consists in their magnitude. The bones of the *middle finger* being the longest and largest ; those of the *fore-finger* come next to that in thickness, but not in length, for those of the *ring-finger* are a little longer. The *little finger* has the smallest bones. Which disposition is the best contrivance for holding the largest bodies ; because the longest fingers are applied to the middle largest periphery of such substances as are of a spherical figure.

The *sesamoid bones* are described after the bones of the feet.

OF THE INFERIOR EXTREMITIES.

The INFERIOR EXTREMITIES depend from the acetabula of the ossa innominata; and are commonly divided into three parts, viz. the thigh, leg, and foot.

BONE OF THE THIGH.

The thigh has only one bone; which is the longest of the body, and the largest and strongest of any of the cylindrical bones. The situation of it is not perpendicular; for the lower end is inclined considerably inward; so that the knees are almost contiguous, while there is a considerable distance between the thigh-bones above; by which means sufficient space is left for the external parts of generation, the two great cloacæ of urine and fæces, and for the large thick muscles that move the thigh inward. At the same time this situation of the thigh-bones renders our progression quicker, surer, straighter, and in less room: for, had the knees been at a greater distance from each other, we must have been obliged to describe some part of a circle with the trunk of our body in making a long step; and when one leg was raised from the ground, our centre of gravity would have been too far from the base of the other, and we should consequently have been in danger of falling; so that our steps would neither have been straight or firm, nor would it have been possible to walk in a narrow path, had our thigh-bones been otherwise placed. In consequence, however, of the weight of the body bearing so obliquely on the joint of the knee by this situation of the thigh bones, weak ricketty children become inn-knee'd.

The upper end of the thigh-bone is not continued in a straight line with the body of it, but is set off obliquely inward and upward, whereby the distance here between these two bones at their upper part is considerably increased.—This end is formed into a large smooth round head, which is the greater portion of a sphere unequally divided. Toward its lower internal part a round rough spongy pit is observable, where the strong liga-

ment, commonly, but unjustly, called the *round one*, is fixed, to be extended thence to the lower internal part of the receiving cavity, where it is considerably broader than near to the head of the thigh-bone. The small part below the head, called the *cervix*, of the os femoris, has a great many large holes, into which the fibres of the strong ligament, continued from the capsular, enter, and are thereby surely united to it; and round the root of the neck, where it rises from the bone, a rough ridge is found, where the capsular ligament of the articulation itself is connected. Below the back part of this root, the large unequal protuberance, called *trochanter major*, stands out; the external convex part of which is distinguished into three different surfaces: whereof the one on the forepart is scabrous and rough, for the insertion of the glutæus minimus; the superior one is smooth, and has the glutæus medius inserted into it; and the one behind is made flat and smooth, by the tendon of the glutæus maximus passing over it. The upper edge of this process is sharp and pointed at its back part, where the glutæus medius is fixed; but forward it is more obtuse, and has two superficial pits formed in it: into the superior of these the pyriformis is implanted; and the obturator internus and gemini are fixed into the lower one. From the backmost prominent part of this great trochanter, a rough ridge runs backward and downward, into which the quadratus is inserted. In the deep hollow, at the internal upper side of this ridge, the obturator externus is implanted. More internally, a process, called *trochanter minor*, rises for the insertion of the musculus psoas and iliacus internus; and the pectineus is implanted into a rough hollow below its internal root. The muscles inserted into those two processes being the principal instruments of the rotatory motion of the thigh, have occasioned the name of *trochanters* to the processes.

The body of the os femoris is convex on the forepart, and made hollow behind, by the action of the muscles that move it and the leg, and for the conveniency of sitting, without bearing too much on these muscles; and probably the weight of the legs depending from the thighs in that posture contributes to this curvature. The forepart of the thigh-bone is a little flattened

above by the beginning of the cruræus muscle, as it is also below by the same muscle and the rectus. Its external surface is likewise flat below by the vastus externus, where it is separated from the former by an obtuse ridge. The vastus internus depresses a little the lower part of the internal surface. The posterior concave surface has a ridge rising in its middle, commonly called *linea aspera*, into which the triceps is inserted, and the short head of the biceps flexor tibiæ rises from it. At the upper part of it the medullary vessels enter by a small hole that runs obliquely upward: a little above which there is a rough fossa or two, where the tendon of the glutæus maximus is fixed. The lower end of the *linea aspera* divides into two, which descend toward each other. The two vasti muscles have part of their origin from these ridges; and the long tendon of the triceps is fixed to the internal, by means of part of the fascia aponeurotica of the thigh. Near the beginning of the internal ridge, there is a discontinuation of it, where the crural artery passes through the aponeurosis. Between these two rough lines, the bone is made flat by the large blood-vessels and nerves which pass upon it; and near the end of each of these ridges a small smooth protuberance may often be remarked, where the two heads of the gastrocnemius take their rise, and where sesamoid bones are sometimes found; and from the forepart of the internal tubercle a strong ligament is extended to the inside of the tibia.

The lower end of the os femoris is larger than any other part of it, and is formed into a great protuberance on each side, called its *condyles*; between which a considerable cavity is found, especially at the back part, in which the crural vessels and nerves lie immersed in fat. The internal condyle is longer than the external, which must happen from the oblique position of this bone, to give less obliquity to the leg. Each of these processes seem to be divided into its plain smooth surface. The mark of division on the external is a notch, and on the internal a small protuberance. The forepart of this division, on which the rotula moves, is formed like a pulley, the external side of which is highest. Behind, there are two oblong large heads, whose greatest extent is backward, for the motion of the tibia: and from the rough cavity between them, but near to the base

of the internal condyle, the strong ligament, commonly called the *cross one*, has its rise.—A little above which a protuberance gives insertion to the tendon of the triceps. The condyles, both on the outer and inner side of the knee are made flat by the muscles passing along them. On the back part of the internal, a slight depression is made by the tendons of the gracilis and sartorius; and on the external such another is formed by the biceps flexor cruris; behind which a deep fossa is to be observed, where the poplitæus muscle has its origin. From the tubercle immediately before this cavity, a strong ligament goes out to the upper part of the fibula. Round this lower end of the thigh-bone, large holes are found, into which the ligaments for the security of the joint are fixed, and blood-vessels pass to the internal substance of the bone.

All the processes of the femur are cartilaginous in new-born children; and afterward become small apophyses, from a large epiphysis.

Articulation.

The thigh-bone being articulated above with the acetabulum of the ossa innominata, which affords its round head a secure and extensive play, can be moved to every side; but is restrained in its motion outward by the high brims of the cavity, and by the round ligament; for otherwise the head of the bone would have been frequently thrust out at the breach of the brims on the inside, which allows the thigh to move considerably inward.—The body of this bone enjoys little or no rotatory motion, though the head most commonly moves round its own axis; because the oblique progress of the neck and head from the bone is such, that the rotatory motion of the head can only bring the body of the bone forward and backward. Nor is the head, as in the arm, ever capable of being brought to a straight direction with its body; so far, however, as the head can move within the cavity backward and forward, the rest of the bone may have a partial rotation. The os femoris is articulated below to the tibia and rotula in the manner afterward to be described.

BONES OF THE LEG.

The leg is composed, according to the common account, of two bones, *tibia* and *fibula*, though it seems to have a very good title to a third, the *rotula*; which bears a strong analogy to the olecranon of the ulna, and moves always with the other two.

TIBIA.

TIBIA, so called from its resemblance to an old musical pipe or flute, is the long, thick, triangular bone, situated at the internal part of the leg, and continued in almost a straight line from the thigh-bone.

The upper end of the tibia is large, bulbous, and spongy, and is divided into two cavities by a rough, irregular protuberance, which is hollow at its most prominent part, as well as before and behind. The anterior of the two ligaments that compose the great cross one is inserted into the middle cavity, and the depression behind receives the posterior ligament.—The two broad cavities at the sides of this protuberance are not equal: for the internal is oblong and deep, to receive the internal condyle of the thigh-bone; while the external is more superficial and rounder, for the external condyle.—In each of these two cavities of the recent subject, a semilunar cartilage is placed. The circumference of these cavities is rough and unequal, for the firm connection of the ligaments of the joint. Immediately below the edge at its back part, two rough flatted protuberances stand out: into the internal, the tendon of the semimembranosus muscle is inserted; and a part of the cross ligament is fixed to the external.—On the outside of this last tubercle, a smooth slightly-hollowed surface is formed by the action of the popliteus.

Below the forepart of the upper end of the tibia, a considerable rough protuberance rises, to which the strong tendinous ligament of the *rotula* is fixed.—On the internal side of this, there is ^a broad scabrous slightly-hollowed surface, to which the inter-

nal long ligament of the joint, the aponeurosis of the vastus internus, and the tendons of the semitendinosus, gracilis, and sartorius, are fixed. Below the external edge of the upper end of the tibia, there is a flat circular surface, covered in a recent subject with cartilage, for the articulation of the fibula; between which and the anterior knob there is a rough hollow, from which the tibialis anticus, and extensor digitorum longus, take their origin. From the smooth flat surface, a ridge runs obliquely downward and inward, to give rise to part of the solæus, tibialis posticus, and flexor digitorum longus, and insertion to the aponeurosis of the semimembranosus which covers the poplitæus, and to some of the external fibres of this last-named muscle. At the inside of this ridge an oblique plain surface is left, where the greatest part of the musculus poplitæus is inserted. The remaining body of the tibia is triangular. The anterior angle is very sharp, and is commonly called the *spine* or *shin*. This ridge is not straight, but turns first inward, then outward, and lastly inward again. The plain internal side is smooth and equal, being little subjected to the actions of muscles; but the external side is hollowed above by the tibialis anticus, and below by the extensor digitorum longus and extensor pollicis longus. The two angles behind these sides are rounded by the action of the muscles; the posterior side comprehended between them is not so broad as those already mentioned, but is more oblique and flatted by the action of the tibialis posticus and flexor digitorum longus. Some way above the middle of the bone, the internal angle terminates, and the bone is made round by the pressure of the solæus. Near to this the passage of the medullary vessels is seen slanting obliquely downward.

The lower end of the tibia is made hollow, but so as a small protuberance rises in the middle. The internal side of this cavity, which is smooth, and in a recent subject is covered with cartilage, is produced into a considerable process, named *malleolus internus*; the point of which is divided by a notch, and from it ligaments are sent out to the foot. We ought to observe here, that this internal malleolus is situated more forward than the internal condyle of the upper end of this bone. The external side of this end of the tibia has a rough irregular semilunar

cavity formed in it for receiving the lower end of the fibula. The posterior side has two lateral grooves, and a small middle protuberance. In the internal depression, the tendons of the *musculus tibialis posticus* and *flexor digitorum longus* are lodged; and in the external, the tendon of the *flexor longus pollicis* plays. From the middle protuberance, ligamentous sheaths go out, for tying down these tendons.

Both the ends of the tibia are cartilages at birth, and become afterward epiphyses.

FIBULA.

FIBULA is the small long bone, placed on the outside of the leg, opposite to the external angle of the tibia; the shape of it is irregularly triangular.

The head of the fibula has a superficial circular cavity formed on its inside, which, in a recent subject, is covered with a cartilage, but so closely connected to the tibia by ligaments, as to allow only a small motion backward and forward. This head is protuberant and rough on its outside, where a strong round ligament and the biceps are inserted; and below the back part of its internal side, a tubercle may be remarked, that gives rise to the strong tendinous part of the *solæus*.

The body of this bone is a little crooked inward and backward; which figure is owing to the actions of the muscles; but is still further increased by nurses, who often hold children carelessly by the legs. The sharpest angle of the fibula is forward; on each side of which the bone is considerably, but unequally depressed by the bellies of the several muscles that rise from or act upon it; and in old people, these muscles make distinct sinuosities for themselves. The external surface of the fibula is depressed obliquely from above downward and backward by the two *peronæi*. Its internal surface is unequally divided into two narrow longitudinal planes, by an oblique ridge extended from the upper part of the anterior angle, to join with the lower end of the internal angle. To this ridge the ligament stretched between the two bones of the leg is connected. The anterior of the two planes is very narrow above, where the *extensor longus digito-*

rum and extensor longus pollicis arise from it; but is broader below, where it has the print of the *nonus vesalii*. The posterior plane is broad and hollow, giving origin to the larger share of the *tibialis posticus*. The internal angle of this bone has a tendinous membrane fixed to it, from which fibres of the *flexor digitorum longus* take their rise. The posterior surface of the fibula is the plainest and smoothest; but is made flat above by the *solæus*, and is hollowed below by the *flexor pollicis longus*. In the middle of this surface the canal for the medullary vessels may be seen slanting downward.

We have taken particular notice of the entry and direction of the medullary vessels of the large bones of the extremities, because there seems to be a particular design in the contrivance of these canals; those in the *os humeri*, *tibia*, and *fibula* running obliquely downward from their external entry; whereas in the *radius*, *ulna*, and *os femoris*, they slant upward, whereby the arteries and nerves which are sent into these three last bones must suffer a considerable reflexion before they come at the cancelli. The reason of this diversity may perhaps be, that the arteries, which are so small within the bones as to have little strong contractile propelling force in their coats, ought to have, at least in their passage through the bone, a favourable descent for their liquids: which, it is evident, they have in the descending oblique passages formed for them in the first class of bones, to wit, the *os humeri*, *tibia*, and *fibula*, which are generally depending; and they also most frequently acquire the like advantage in the *radius*, *ulna*, and *os femoris*; because the hand, in the most natural posture, is higher than the elbow: and when we sit or lie, the lower end of the thigh-bone comes to be at least as high raised as the upper. This reasoning seems to be still enforced, by observing, that this passage is always nearer the upper than the lower ends of these bones.

The lower end of the *fibula* is extended into a spongy oblong head; on the inside of which is a convex, irregular, and frequently a scabrous surface, that is received by the external hollow of the *tibia*, and so firmly joined to it by a very thin intermediate cartilage and strong ligaments, that it scarce can move.—Below this the *fibula* is stretched out into a coronoid process, that

is smooth, covered with cartilage on its internal side, and is there contiguous to the outside of the first bone of the foot, the astragalus, to secure the articulation. This process, named *malleolus externus*, being situated further back than the internal malleolus, and in an oblique direction, obliges us naturally to turn the forepart of the foot outward. At the lower internal part of this process, a spongy cavity for mucilaginous glands may be remarked; from its point ligaments are extended to the astragalus, os calcis, and os naviculare, bones of the foot; and from its inside short strong ones go out to the astragalus. On the back part of it a sinuosity is made by the tendons of the peronæi muscles.

Articulation.

The conjunction of the upper end of the fibula with the tibia is by plain surfaces tipped with cartilage; and at its lower end the cartilage seems to glue the two bones together; not however so firmly in young people, but that the motion at the other end of such a long radius is very observable.—In old subjects we often see the two bones of the leg grown together at their lower ends.

The principal use of this bone is to afford origin and insertion to muscles; the direction of which may be a little altered on proper occasions, by its upper part shuffling backward and forward.—It likewise helps to make the articulation of the foot more secure and firm.—The ends of the tibia and fibula being larger than their middle, a space is here left, which is filled up with such another ligament as was described extended between the bones of the fore-arm; and which is also discontinued at its upper part, where the tibialis anticus immediately adheres to the solæus and tibialis posticus; but every where else it gives origin to muscular fibres.

Both the ends of this bone are cartilaginous in a ripe child, and assume the form of appendices before they are united to its body.

ROTULA.

ROTULA is the small flat bone situated at the forepart of the joint of the knee.—Its shape resembles the common figure of the heart with its point downward.—The anterior convex surface of the rotula is pierced by a great number of holes, into which fibres of the strong ligament that is spread over it enter.—Behind its surface is smooth, covered with cartilage, and divided by a middle convex ridge into two cavities, of which the external is largest; and both are exactly adapted to the pulley of the os femoris, on which they are placed in the most ordinary unstraining postures of the leg: but when the leg is much bended, the rotula descends far down on the condyles; and when the leg is fully extended, the rotula rises higher in its upper part than the pulley of the thigh-bone.—The plain smooth surface is surrounded by a rough prominent edge, to which the capsular ligament adheres: below, the point of the bone is scabrous, where the strong tendinous ligament from the tubercle of the tibia is fixed. The upper horizontal part of this bone is flattened and unequal, where the tendons of the extensors of the leg are inserted.

The substance of the rotula is cellular, with very thin external firm plates; but then these cells are so small, and such a quantity of bone is employed in their formation, that scarce any bone of its bulk is so strong. Besides, it is covered all over with a thick ligament (as it was observed that this sort of bones generally is), to connect its substance, and is moveable to one side or other: therefore it is sufficiently strong to resist the ordinary actions of the large muscles that are inserted into it, or any common external force applied to it; while a fixed process, such as the olecranon, would not have been sufficient to bear the whole weight of our bodies, which frequently falls on it, and would have hindered the rotatory motion of the leg.

At the ordinary time of birth, the rotula is entirely cartilaginous, and scarcely assumes a bony nature so soon as most epiphyses do.

Articulation.

The parts which constitute the joint of the knee being now described, let us examine what are its motions, and how performed.—The two principal motions are flexion and extension. In the former of these, the leg may be brought to a very acute angle with the thigh, by the condyles of the thigh-bones being round and made smooth far backward. In performing this, the rotula is pulled down by the tibia. When the leg is to be extended, the rotula is drawn upward, consequently the tibia forward, by the extensor muscles, which, by means of the protuberant joint, and of this thick bone with its ligament, have in effect the chord with which they act fixed to the tibia at a considerable angle, therefore act with advantage; but are restrained from pulling the leg farther than to a straight line with the thigh, by the posterior part of the cross ligament, that the body might be supported by a firm perpendicular column: for at this time the thigh and leg are as little moveable in a rotatory way, or to either side, as if they were one continued bone.—But when the joint is a little bended, the rotula is not tightly braced, and the posterior ligament is relaxed; therefore this bone may be moved a little to either side, or with a small rotation in the superficial cavities of the tibia; which is done by the motion of the external cavity backward and forward, the internal serving as a sort of axis. Seeing, then, one part of the cross ligament is situated perpendicularly, and the posterior part is stretched obliquely from the internal condyle of the thigh outward, that posterior part of the cross ligament prevents the leg's being turned at all inward; but it could not hinder it from turning outward almost round, was not that motion confined by the lateral ligaments of this joint, which can yield little. This rotation of the leg outward is of good advantage to us in crossing our legs, and turning our feet outward, on several necessary occasions; though it is altogether fit this motion should not be very large, to prevent frequent luxations here.—While all these motions are performing, the part of the tibia that moves immediately on the condyles is only so much as is within the cartilaginous rings, which by the thickness on their outsides make the cavities of the tibia more horizontal, by raising their external side where the surface of the tibia slants downward. By this

means the motions of this joint are more equal and steady than otherwise they would have been. The cartilages being capable of changing a little their situation, are fit for doing this office in the different motions and postures of the member, and likewise contribute to make the motions larger and quicker.

BONES OF THE FOOT.

THE foot is divided, as well as the hand, into three parts, viz. *tarsus*, *metatarsus*, and *toes*. In the description of which the several surfaces shall be named, according to their natural situation, viz. the broad of the foot shall be called *superior*; the sole, *inferior*; the side on which the great toe is, *internal*; that where the little toe is, *external*.

TARSUS.

The tarsus consists of seven spongy bones; to wit, the astragalus, os calcis, naviculare, cuboides, cuneiforme externum, cuneiforme medium, and cuneiforme internum.

The *astragalus* is the uppermost of these bones.—The *os calcis* is below the astragalus, and is considerably prominent backward beyond the other bones, to form the heel.—The *os naviculare* is in the middle of the internal side of the tarsus.—The *os cuboides* is the most external of the row of four bones at its forepart.—The *os cuneiforme externum* is placed at the inside of the cuboid.—The *cuneiforme medium* is between the external and internal cuneiform bones; and the *internal cuneiforme* is put at the internal side of the foot.

That the description of these bones may not be swelled by repetition, it is necessary to observe, that wherever a ridge is mentioned, without a particular use assigned, a ligament is understood to be fixed to it; or where a spongy rough cavity, depression, or fossa, is remarked, without naming its use, a ligament is inserted, and mucilaginous glands are lodged.

Astragalus. The upper part of the astragalus is formed into a large smooth head, which is slightly hollowed in the middle, and therefore resembles a superficial pulley, by which it is fitted

to the lower end of the tibia.—The internal side of this head is flat and smooth, to play on the internal malleolus.—The external side has also such a surface, but larger, for its articulation with the external malleolus. Round the base of this head there is a rough fossa; and immediately before the head, as also below its internal smooth surface, we find a considerable rough cavity.

The lower surface of the astragalus is divided by an irregular deep rough fossa; which at its internal end is narrow, but gradually widens as it stretches obliquely outward and forward. The smooth surface, covered with cartilage, behind this fossa, is large, oblong, extended in the same oblique situation with the fossa, and concave for its conjunction with the os calcis. The back part of the edge of this cavity is produced into two shap-pointed rough processes; between which is a depression made by the tendon of the flexor pollicis longus.—The lower surface before the fossa is convex, and composed of three distinct smooth planes.—The long one behind, and the exterior or shortest, are articulated with the heel-bone; while the internal, which is the most convex of the three, rests and moves upon a cartilaginous ligament, that is continued from os calcis to the os scaphoides. Without which ligament the astragalus could not be sustained; but would be pressed out of its place by the great weight it supports, and the other bones of the tarsus would be separated. Nor would a bone be fit here, because it must have been thicker than could conveniently be allowed; otherwise it would break, and would not prove such an easy bending base, to lessen the shock which is given to the body in leaping, running, &c.

The forepart of this bone is formed into a convex oblong smooth head, which is received by the os naviculare. Round the root of this head, especially on the upper surface, a rough fossa may be remarked.

Articulation.

The astragalus is articulated above to the tibia and fibula, which together form one cavity. Though in this articulation the bones have prominences and cavities, so small as might allow motions in all directions, yet the flexion and extension are the most considerable, the other motions being confined by the

malleoli, and by the strong ligaments which go out from the points of these processes to the astragalus and os calcis.—When the foot is bended, so far as it is commonly when we stand, no lateral or rotatory motion is allowed in this joint; for then the head of the astragalus is sunk deep between the malleoli, and the ligaments are tense: but when the foot is extended, the astragalus can move a little to either side, and with a small rotation. By this contrivance the foot is firm, when the weight of the body is to be supported on it; and when it is raised, we are at liberty to direct it more exactly to the place we intend next to step upon. The astragalus is joined below to the os calcis; and before to the os naviculare, in the manner to be explained when these bones are described. The other articulations of tarsus, &c. will be described along with the bones.

A considerable share of this bone is ossified in a new-born infant.

Os calcis is the largest bone of the seven.—Behind, it is formed into a large knob, commonly called the *heel*: the surface of which is rough behind, where the tendo Achillis is inserted into it; and above it, it is hollow and spongy. Farther forward, on the upper surface of the os calcis, there is an irregular oblong smooth convexity, adapted to the cavity at the back part of the astragalus: and beyond this a narrow fossa is seen, which divides it from two small concave smooth surfaces, that are joined to the forepart of the astragalus. Behind the posterior of these smooth surfaces, which is the largest, a small sinuosity is made by the tendon of the flexor digitorum longus; at the forepart of which a small rough protuberance appears, that gives rise to the musculus extensor digitorum brevis.

The external side of this bone is flat, with a superficial fossa running horizontally, in which the tendon of the musculus peronæus longus is lodged. The internal side of the heel-bone is hollowed, for lodging the origin of the massa cornea Jac. Sylvii, and for the safe passage of tendons, nerves, and arteries. Under the side of the internal smooth concavity, a particular groove is made by the tendon of the flexor pollicis longus; and from the thin protuberance of this internal side the cartilaginous ligament that supports the astragalus, goes out to the

os naviculare; on which ligament, and on the edge of this bone to which it is fixed, the groove is formed for the tendon of the flexor digitorum profundus.

The lower surface of this bone is pressed flat at the back part, by the weight of our bodies; and immediately before this plane, there are two tubercles, from the internal of which the musculus abductor pollicis, flexor digitorum sublimis, as also part of the aponeurosis plantaris, and of the abductor minimi digiti, have their origin; and the other part of the abductor minimi digiti and aponeurosis plantaris rises from the external. Before these protuberances this bone is concave, for lodging the flexor muscles; and at its forepart we may observe a rough depression, from which, and a tubercle behind it, the ligament goes out that prevents this bone from being separated from the os cuboides.

The forepart of the os calcis is formed into an oblong pulley-like smooth surface, which is circular at its upper external end, but is pointed below. The smooth surface is fitted to the os cuboides.

Though the surfaces by which the astragalus and os calcis are articulated, seem fit enough for motion, yet the very strong ligaments by which these bones are connected, prevent it, and render this principal part of our base, the os calcis, firm.

A large share of the heel-bone is ossified at the ordinary time of birth, and the large knob appears afterward in form of an epiphyse.

Os naviculare is somewhat circular. It is formed into an oblong concavity behind, for receiving the anterior head of the astragalus. On the upper surface there is a rough fossa. Below, the os naviculare is very unequal and rough; but hollow for the safety of the muscles. On its inside a large knob rises out, from which the abductor pollicis takes in part its origin, the tendon of the tibialis posticus is inserted into it, and two remarkable ligaments are fixed to it; the first is the strong one, formerly mentioned, which supports the astragalus; the second is stretched from this bone obliquely cross the foot, to the metatarsal bones of the middle toe, and of the toe next to the little one. On the outside of the os naviculare there is a semicircular smooth sur-

face, where it is joined to the os cuboides. The forepart of this bone is all covered with cartilage, and is divided into three smooth planes, fitted to the three ossa cuneiformia.

The os naviculare and astragalus are joined as a ball and socket; and the naviculare moves in all directions in turning the toes inward, or in raising or depressing either side of the foot, though the motions are greatly restrained by the ligaments which connect this to the other bones of the tarsus.

The os naviculare is wholly cartilaginous in a new-born infant.

Os cuboides is a very irregular cube. Behind, it is formed into an oblong unequal concavity, adapted to the forepart of the os calcis. On its internal side, there is a small semicircular smooth cavity, to join the os naviculare. Immediately before which, an oblong smooth plane is made by the os cuneiforme externum. Below this the bone is hollow and rough. On the internal side of the lower surface, a round protuberance and fossa are found, where the musculus adductor pollicis has its origin. On the external side of this same surface, there is a round knob, covered with cartilage; immediately before which a smooth fossa may be observed, in which the tendon of the peronæus primus runs obliquely cross the foot; and on the knob the thin flat cartilage proper to this muscle plays; in place of which sometimes a bone is found. More externally than the knob, a rough hollow is made, for the strong ligaments stretched betwixt this bone and the os calcis. Before, the surface of the os cuboides is flat, smooth, and slightly divided into two planes, for sustaining the os metatarsi of the little toe, and of the toe next to it.

The form of the back part of the os cuboides, and the ligaments connecting the joint there with the os calcis, both concur in allowing little motion in this part.

The ossification of this bone is scarcely begun at the birth.

Os cuneiforme externum, if we regard its situation or medium by its bulk, is much of the shape of a wedge, being broad and flat above, with long sides running obliquely downward, and terminating in a sharp edge. The upper surface of this bone is an oblong square. The one behind is nearly a triangle, but not complete at the inferior angle, and is joined to the os naviculare.

The external side is an oblong square divided as it were by a diagonal; the upper half of it is smooth, for its conjunction with the os cuboides: the other is a scabrous hollow, and in its superior anterior angle a small smooth impression is made by the os metatarsi of the toe next to the little one. The internal side of this bone is also quadrangular, with the forepart of its edge made flat and smooth by the os metatarsi of the toe next to the great one, and the back part is also flat and smooth where the os cuneiforme medium is contiguous to it. The forepart of this bone is an oblong triangle, for sustaining the os metatarsi of the middle toe.

Os cuneiforme medium, or minimum, is still more exactly the shape of a wedge than the former. Its upper part is square;—its internal side has a flat smooth surface above and behind, for its conjunction with the following bone; with a small rough fossa below; and a considerable share of it is rough and hollow. The external side is smooth and a little hollowed, where it is contiguous to the last described bone.—Behind, this bone is triangular, where it is articulated with the os naviculare; and it is also triangular at its forepart, where it is contiguous to the os metatarsi of the toe next to the great one.

Os cuneiforme maximum, or internum, differs from the two former in its situation, which is more oblique than theirs.—Besides, its broad thick part is placed below, and the small thin point is above and outward; while its under broad surface is concave, for allowing a safe passage to the flexor of the great toe. The surface of this os cuneiforme behind, where it is joined to the os naviculare, is hollow, smooth, and of a circular figure below, but pointed above. The external side consists of two smooth and flat surfaces, whose directions are nearly at right angles with each other. With the posterior, that runs obliquely from below forward and upward, the os cuneiforme minimum is joined; and with the anterior, whose direction are longitudinal, the os metatarsi of the toe next to the great one is connected. The forepart of this bone is semilunar, but flat and smooth, for sustaining the os metatarsi of the great toe. The internal side is scabrous, with two remarkable tubercles below, from which the

abductor pollicis rises, and the tibialis anticus is inserted into its upper part.

The three cuneiform bones are all so secured by ligaments, that very little motion is allowed in any of them, and they are cartilaginous in a foetus of nine months.

These seven bones of the *tarsus*, when joined, are convex above, and leave a concavity below, for lodging safely the several muscles, tendons, vessels, and nerves, that lie in the sole of the foot. In the recent subject, their upper and lower surfaces are covered with strong ligaments, which adhere firmly to them; and all the bones are so tightly connected by these and the other ligaments, which are fixed to the rough ridges and fossæ mentioned in the preceding description of the particular bones, that, notwithstanding the many surfaces covered with cartilage, some of which are of the form of the very moveable articulations, no more motion is here allowed, than only to prevent too great a shock of the fabric of the body in walking, leaping, &c. by falling on too solid a base; which, if it was one continued bone, would likewise be much more liable to be broken; and, in order to make our foot accommodate itself to the surfaces we tread on, by becoming more or less hollow, or by raising or depressing either side of it, as might be judged by what was said of the particular bones.

METATARSUS.

Metatarsus is composed of five bones, which, in their general characters, agree with the metacarpal bones; but may be distinguished from them by the following marks: 1. They are longer, thicker, and stronger. 2. Their anterior round ends are not so broad, and are less in proportion to their bases. 3. Their bodies are sharper above and flatter on their sides, with their inferior ridge inclined more to the outside. 4. The tubercles at the lower part of the round head are larger.

The first or internal metatarsal bone is easily distinguished from the rest by its thickness. The one next to it is the longest, and with its sharp edge almost perpendicular. The others are shorter and more oblique, as their situation is more external.

Which general remarks, with the description I am now to give of each, may teach us to distinguish them from each other.

Os metatarsi pollicis is by far the thickest and strongest, as having much the greatest weight to sustain. Its base is oblong, irregularly concave, and of a semilunar figure, to be adapted to the *os cuneiforme maximum*. The inferior edge of this base is a little prominent and rough, where the tendon of the *peronæus primus* muscle is inserted. On its outside an oblique circular depression is made by the second metatarsal bone. Its round head has generally on its forepart a middle ridge, and two oblong cavities, for the *ossa sesamoidea*; and on the external side a depression is made by the following bone.

Os metatarsi of the *second toe*, is the longest of the five, with a triangular base supported by the *os cuneiforme medium* and the external side produced into a process; the end of which is an oblique smooth plane, joined to the *os cuneiforme externum*. Near the internal edge of the base, this bone has two small depressions, made by the *os cuneiforme maximum*, between which is a rough cavity. Farther forward we may observe a smooth protuberance, which is joined to the foregoing bone. On the outside of the base are two oblong smooth surfaces, for its articulation with the following bone; the superior smooth surface being extended longitudinally, and the inferior perpendicularly; between which there is a rough fossa.

Os metatarsi of the *middle toe*, is the second in length. Its base, supported by the *os cuneiforme externum*, is triangular, but slanting outward, where it ends in a sharp-pointed little process; and the angle below is not completed.

The internal side of this base is adapted to the preceding bone; and the external side has also two smooth surfaces covered with cartilage, but of a different figure; for the upper one is concave, and, being round behind, turns smaller as it advances forward; and the lower surface is little, smooth, convex, and very near the edge of the base.

Os metatarsi of the *fourth toe*, is near as long as the former, with a triangular slanting base joined to the *os cuboides*, and made round at its external angle; having one hollow smooth

surface on the outside, where it is pressed upon by the following; and two on the internal side, corresponding to the former bone; behind which is a long narrow surface impressed by the *os cuneiforme externum*.

Os metatarsi of the *little toe*, is the shortest, situated with its two flat sides above and below, and with the ridges laterally.—The base of it, part of which rests on the *os cuboides*, is very large, tuberos, and produced into a long-pointed process externally, where part of the *abductor minimi digiti* is fixed; and into its upper part the *peronæus secundus* is inserted. Its inside has a flat conoidal surface, where it is contiguous to the preceding bone.

When we stand, the fore-ends of these metatarsal bones, and the *os calcis*, are our only supporters; and therefore it is necessary they should be strong, and should have a confined motion.

TOES.

The bones of the toes are much akin to those of the thumb and fingers; particularly the two of the great toe are precisely formed as the two last of the thumb; only their position, in respect of the other toes, is not oblique; and they are proportionally much stronger, because they are subjected to a greater force; for they sustain the force with which our bodies are pushed forward by the foot behind at every step we make; and on them principally the weight of the body is supported, when we are raised on our tip-toes.

The three bones in each of the other four toes, compared to those of the fingers, differ from them in these particulars. They are less, and smaller in proportion to their lengths: their bases are much larger than their anterior ends: their bodies are more narrow above and below, and flatter on the sides. The first phalanx is proportionably much longer than the bones of the second and third, which are very short.

Of the four, the toe next to the great one has the largest bones in all dimensions, and more externally the toes are less. The little toe, and frequently that next to it, have the second and third bones intimately united into one; which may be

owing to their little motion, and the great pressure they are subject to.

The toes are of good use to us in walking; for, when the sole is raised, they bring our body, with its centre of gravity, perpendicular to the advanced foot.

The bodies of the metatarsus and toes, are in the same condition in children as those of the metacarpus and fingers.

The only bones now remaining to complete the description of the skeleton, are the small ones which are found at the joints of the fingers and toes and in some other parts, called

OSSA SESAMOIDEA.

These are of very different figures and sizes, though they are generally said to resemble the seed of the sesamum. They seem nothing else than the ligaments of the articulations, or the firm tendons of strong muscles, or both, become bony by the compression which they suffer. Thus the sesamoid bones at the beginning of the gastrocnemii muscles, are evidently composed of the tendinous fibres only. These, at the first joint of the great toe, are as plainly the same continued substance with the ligaments and the tendons of the adductor, flexor, brevis, and abductor. That which is sometimes double at the second joint of that toe is part of the capsular ligament; and if we enumerate the other sesamoid bones that are at any time found, we may observe all of them formed in this manner. Their number, figure, situation, and magnitude, are so uncertain, that it were in vain to insist on the differences of each; and therefore I shall only in general remark.


1. That wherever the tendons and ligaments are firmest, the tendons of the muscles strongest, and the compression greatest, there such bones are most commonly found.

2. That *cæteris paribus*, the older the subject is in which they are sought, their number is greater, and their size larger.

3. The more labour any person is inured to, he has, *cæteris paribus*, the most numerous and largest ossa sesamoidea.

However, as the two at the first joint of the great toe are

much larger than any other, are early formed, and are seldom wanting in an adult, we may judge, that besides the more forcible cause of their formation there should also be some particular advantage necessary at this place, rather than elsewhere; which may possibly be, to allow the flexor muscles to send their tendons along this joint, secure from compression in the hollow between the two oblong sesamoid bones; while, by removing these tendons from the centre of motion, and giving them the advantage of an angle at their insertion, the force of the muscle is increased, and therefore the great superincumbent weight of our body in progression is more easily raised.



MARKS OF A FEMALE SKELETON.

To finish the description of the bones, is generally to conclude the osteology: but, that no part of the subject may be left untouched, we think it necessary to subjoin the distinguishing marks of the male and female skeletons; and have chosen to illustrate them principally in the latter; because women having a more delicate constitution, and affording lodging and nourishment to their tender foetuses till they have sufficient strength and firmness to bear the injuries of the atmosphere, and contact of other more solid substances, their bones are frequently incomplete, and always of a make in some parts of the body different from those of the robust male; which agree to the description already given, unless where the proper specialities of the female are remarked.

The causes of the following specialities of the female bones may be reduced to these three: 1. A weak lax constitution. 2. A sedentary unactive life, increasing that constitution. 3. A proper frame for being mothers.

The most striking of these characteristics is probably the one observed by Mr. Soemmerring, namely, that the female skull in proportion to the other parts of the skeleton, exceeds in bulk and weight that of the male, and that the vertebra canal in it is larger.

The bones of women are smaller in proportion to their length than those of men, because the force of their muscles is not so great, nor is such strong external force applied to them to prevent their stretching out in length. This is the opinion of the first MONRO; it is therefore *erroneously* that SOEMMERRING thinks this a discovery of his own.

The *depressions, ridges, scabrous surfaces*, and other inequalities made by the *muscles*, are not so conspicuous in them; because their *muscles* are neither so thick or strong, nor so much employed, as to make strong prints on their bones.

The *os frontis* is more frequently divided by a continuation of the sagittal suture, which depends on the first and second general causes assigned above for the specialties in their bones, as will appear after reflecting on the account given formerly of the middle internal spine of this bone.

Their *clavicles* are less crooked; because their arms have been less forcibly pulled forward; which, in our European women, especially those of distinction, is more hindered by their dress.

Their *sternum* is more raised by long cartilages below, that the thorax might be there widened in some proportion to what it is shortened by the pressure upon the diaphragm when they are with child.

The defect of bone, or the hole, in the middle of the *sternum*, is oftenest found in them from the less forcible power of ossification.

The *cartilago xiphoides* is oftener bifurcated in women than men, for the reason assigned in the preceding paragraph.

The superior cartilages of the ribs sooner ossify, to support the weight of the *mammæ*.

The middle cartilages are more flat and broad by the weight of the breasts.

The inferior cartilages are longer, for enlarging the chest.

Weak women, who have born many children when young, often have the *vertebræ* of their back bended forward, and their *sternum* depressed, or become round-shouldered and flat-breasted, by the pressure and weight of the impregnated uterus, and by the strong action of the abdominal muscles.

The *os sacrum* is broader, and turned much more backward, for enlarging the pelvis.

The *os coccygis* is more moveable, and much less bended forward, to facilitate the birth.

The *ossa ilium* are more hollow, and more reflected outward, and consequently further removed from each other, in order to widen the lower part of their abdomen, and for the better support of the impregnated uterus.

The *ridge* on the upper part of the *os pubis* is larger in such women as have born children, being extended by the strong action of the *musculi recti abdominis*.

The *cartilage* between the two *ossa pubis*, especially in women who have born children, is thicker than in men, by which the pelvis is more capacious in females.

The *conjoined surfaces* of the *ossa pubis*, and of the *ossa innominata* and *sacrum*, are less, the angle under the *symphysis* of the *ossa pubis* is much larger, and the arches formed below and behind by the *ossa ilium* and *ischium* are wider, which, with the straighter *os sacrum*, and more distant *tubera ischii*, leave a larger passage for the exclusion of the child in birth.

The great *tuberossity* of the *ossa ischium* is flatter in women than in men, because it is more pressed upon in the sedentary life which females enjoy.

In consequence of the *pelvis* of women being wider, the articulations of their thigh-bones must be farther removed from each other; and therefore a larger space is left for the birth of children; which distance of the thighs may be one reason why women in running shuffle more from one side to the other than men, to preserve the centre of gravity of their bodies from falling too far to a side of the joint of the thigh that supports them when the other is raised, which would endanger their tumbling to the ground.

SECTION V.

SYNCHONDROLOGY AND SYNDESMOLOGY.

OF THE CARTILAGES OF THE HEAD.

THE condyloid processes of the os occipitis, the glenoid cavities or articular fossulæ of the ossa temporum, the eminences next these cavities, and the condyloid processes of the lower jaw, are all covered with very white and smooth cartilages ; and there is likewise an interarticular or moveable cartilage in each articulation of the lower jaw with the temporal bones.

This cartilage is thick near the circumference ; very thin and transparent, and sometimes perforated in the middle. The lower side is uniformly concave, answering to the oblong convexity of the maxillary condyle ; but the upper side is partly concave, and partly convex, suited to the fossula and eminence of the temporal bone. It is fixed by its circumference to the inner side of the capsular ligament.

The remaining cartilages of the bones of the head, viz. the cartilaginous septum, and other cartilages of the nose, the small cartilaginous pulley in each orbit, the cartilages of the outward ear, and those which are joined to the os hyoides, must be referred to another place.

The ligaments of the bones of the head are, Those of the articulation of the lower jaw with the temporal bones ; those between the occipital bone and vertebræ of the neck ; and those by which the os hyoides is connected to the styloid process.

OF THE LIGAMENTS BY WHICH THE LOWER JAW IS FIXED TO THE TEMPORAL BONES.

The capsular ligaments, composed of firm and strong fibres, fixed by one extremity round the glenoid or articular fossula and eminence of each temporal bone ; by their middle round the interarticular cartilage, and by their other extremity round each

condyle of the lower jaw, in such a manner as to allow the intermediate cartilages to follow the motions of the condyles, and to change their situation from the glenoid cavities to the tubercles of the zygomatic processes, and to return again, as was mentioned in the description of the bones.

The lateral ligaments, which arise from the inner surface of the angles of the lower jaw, near the passage where the vessels and nerves go into the bone; and are fixed to the root of the styloid process, and to the posterior margin of the articular cavity of the temporal bone. They assist in keeping the jaw in its proper place.

LIGAMENTS BETWEEN THE OCCIPITAL BONE AND VERTEBRÆ OF THE NECK.

Capsular ligaments, arise from the edges of the condyloid processes of the os occipitis, and are fixed to the edges of the superior oblique processes of the first vertebræ.

Broad anterior ligament, arises from the forepart of the foramen magnum, and runs down to be fixed to the anterior arch of the first vertebra of the neck.

Broad posterior ligament, arises from the posterior margin of the foramen magnum occipitis, and is inserted into the upper part of the posterior arch of the first vertebra.

Perpendicular ligament, arises from the forepart of the foramen magnum, and runs down to be fixed to the processus dentatus of the second vertebra. This ligament is short, but remarkably strong; it assists in fixing the head to the spine, but is twisted in the rotation.

Lateral ligaments, are two short, but very strong ligaments, which run over from each side of the processus dentatus to be fixed to the inner side of the first vertebra, and to the edge of the foramen magnum. See description of the vertebræ.

Cervical ligament, arises from the spinous process of the os occipitis, runs down upon the back part of the neck, adhering to the spinous processes of the cervical vertebræ, and giving origin to part of the trapezius muscle.

The synovial glands of the maxillary and occipital articulations have nothing peculiar to them : they are proportioned to the joints to which they belong, and lie between the capsular ligaments and the circumference of the cartilages.

CARTILAGES OF THE VERTEBRÆ.

The cartilages of the vertebræ in general are of two kinds ; one proper to each vertebra, the other common to the two vertebræ that lie next each other. The first may be termed *cartilages of articulation* ; the others, *cartilages of symphysis*.

The proper articular cartilages of each vertebra of the spine, are those four which cover the surfaces of the oblique processes. In the natural state they are very white and smooth, and much thicker than in dry bones. Their circumference is the same with that of the articulated sides of the processes, except in those places where there are small superficial notches. In the first vertebra of the neck and vertebræ of the loins these cartilages are thicker than in the rest.

The cartilages of the two inferior oblique processes of the first vertebra, and of the two superior oblique of the second, seem to be disproportionate, though not so much as in dry bones ; and in some subjects we find moveable or interarticular cartilages between the processes of these two vertebræ.

The first vertebra of the neck has a cartilaginous covering on the back part of the anterior arch, corresponding with another on the foreside of the processus dentatus of the next vertebra ; so that each of these two vertebræ has five articular cartilages, besides the interarticular ones already mentioned.

The vertebræ of the back, besides the four cartilages of their oblique processes, have others which do not belong to their articulations with each other, viz. those that cover the lateral fossulæ in the bodies of these vertebræ, and the fossulæ of their transverse processes, by both of which they are articulated with the ribs.

The cartilages of symphysis lie between the bodies of the ver-

tebræ, uniting them closely together ; the breadth and circumference of them answering exactly to that of the surfaces to which they are connected ; but their height or thickness is different in each class of the vertebræ. Between the vertebræ of the loins, they are a quarter or third part of an inch in thickness, according to the size of the subject : in those of the neck, they are not so thick ; and the thinnest of all are between the vertebræ of the back.

These cartilages are not of an equal thickness in all their parts. Those on the neck and loins appear to be thickest on the foreside, and those of the back rather thickest on the backside ; but these differences are most remarkable in the vertebræ that lie near the middle of each class.

The internal structure of these cartilages is different from that of all the other cartilages of the body, and indeed they resemble the rest in nothing but in whiteness and elasticity. When we view their circumferences only, they seem to be one uniform mass as the others generally are ; but when they are divided by an incision parallel to that surface of the vertebræ to which they are joined, we see they are composed of many cartilaginous concentric lamellæ contained within each other. The most external lamellæ are fibrous, thickest and firmest, and separated by considerable intervals : the internal approach nearer and nearer together, becoming gradually thinner, and of a softer consistence, till at last they are almost in the form of a glairy liquor in the centre.

These rings do not form an entire circumference ; being turned inward on the backside, answering to the forepart of the passage for the spinal marrow. They lie horizontally between the vertebræ. The interstices of the rings are filled with a mucilaginous substance, less fluid than that of the joints. Each lamina taken separately is very pliable according to its length ; but taken together, they are not so easily bent, partly because of their circular figure, and partly because of their vicinity and multiplicity. They yield, however, in the inflections of the spine ; and their external surface, which in the ordinary situation of the spine, is even with the surface of the vertebræ, becomes prominent or juts out on that side toward which the in-

flexion is made, the cartilages being then compressed by the vertebræ.

They likewise yield on all sides, without any inflection of the spine, to the weight of the upper part of the body; but this is done by very small and imperceptible degrees, and most of all at the under part of the true vertebræ, and when the body is loaded with any exterior weight.

They restore themselves afterward merely by being freed from compression; so that a man is really taller after lying, than after he has walked or carried a burden for a length of time: the most natural and simple reason that can be given for the different height of the same person at different times, first observed in England, and afterward confirmed by Mr. Morand, a member of the Royal Academy of Sciences, being the different state of the intervertebral cartilages. According to Sabatier, &c. the same person is sometimes more than four or five lignes, or twelfths of an inch, higher in the morning than in the evening. The intervertebral cartilages of the neck lying for the most part between the convex side of one vertebra, and the concave side of another, are of a greater extent in proportion to the size of these vertebræ, than those of the back and loins. Without this convexity and hollowness in these vertebræ, which are the least of all, the cartilages could not have been made large enough to be able to resist strains and great exertions.

LIGAMENTS OF THE VERTEBRÆ.

The vertebræ are strongly connected to each other by different kinds of ligaments; some of which are proper to a certain number, others are common to the whole.

Transverse ligament of the first vertebra, arises from a rough protuberance on the inner side of the first vertebræ, and goes across to the other side behind the processus dentatus, which it prevents from wounding the spinal marrow in the rotation of the head. About the middle of the fore-side, its texture is very close where the processus dentatus plays upon it.

The ligaments of the processus dentatus of the second vertebra have been already described.

Common anterior ligament of the vertebræ. One of the most remarkable is a strong ligamentous band, which embraces their convex surface from the upper to the under end of the spine. It begins at the second vertebra of the neck, and passes down as low as the os sacrum, becoming gradually larger and stronger in its descent. The fibres of this ligament have a longitudinal direction; but it is much thicker in its middle than at its sides. After it has arrived at the last lumbar vertebra, it spreads over the anterior surface of the os sacrum, where it becomes thinner, and by degrees vanishes near the end of this bone. Through its whole course it sends off many small processes to be fixed to the bodies of the vertebræ, by which their connection is made more secure.

Intervertebral ligaments. Behind the former ligament each vertebra is connected to that above and below it by numerous, short, but strong ligaments, which cross each other obliquely, and are fixed round the edges of the body of each vertebra. These crucial ligaments cover the circumference of the intervertebral cartilages, and adhere closely to them. They seem to be looser in the cervical and lumbar vertebræ than in those of the back; and by that means yield to the cartilages in the different flexions of the spine already mentioned.

Common posterior ligament of the vertebræ. The spinal canal is lined with a ligament somewhat similar to that which covers the anterior convex surface of the vertebræ. It begins at the second vertebra of the neck; and after having sent a considerable process, which passes behind the transverse ligament of the first vertebra, to be fixed to the anterior part of the foramen magnum, it descends on all the other vertebræ, to end at the lower part of the os sacrum. The real ligamentous fibres occupy little more than the middle of the bodies of the vertebræ. Those which are stretched over the lateral parts are very thin, and properly speaking purely membranous. Winslow describes this as a complete tube, while Weitbrecht denies its existence at the back part of the canal; but admits of an additional membrane there adhering firmly to the dura mater. It is only attached to the superior and inferior edges of the vertebræ, leaving at their middle a space occupied by a kind of transverse sinus,

which communicates with others situated longitudinally upon the sides of the posterior part of the whole canal.

Interspinal ligaments, are short and firm ligaments, which run from the whole upper edge of the bony bridge and spinous processes of one vertebra, to the corresponding parts of the vertebra next it; and thereby joining the different vertebræ together, and dividing the muscles on the right from those on the left side of the spine.

Intertransverse ligaments, are short small ligaments placed between the extremities of all the transverse processes.

Capsular ligaments, are formed of numerous, short, strong, ligamentous fasciculi, arising from and surrounding the oblique processes of all the vertebræ. The two oblique processes of the os sacrum are joined to the inferior oblique processes of the last vertebra of the loins, in the same manner as those of the lumbar vertebræ.

CARTILAGES OF THE STERNUM AND RIBS.

The sternum of an adult has commonly sixteen cartilages; fourteen of which are articular, the other two symphyses. Of the articular cartilages, two belong to the articulations of the clavicles; and twelve to those of the true ribs, from the second to the seventh inclusive. The two symphyses are those between the sternum and the first rib on each side.

There is likewise another symphysis, by which the upper portion of the sternum is connected to the lower; the cartilage of which is often obliterated in an advanced age. But at an early period of life this cartilage can be distinctly seen; and it allows a considerable degree of motion between these two bones.

The cartilago ensiformis is often bony toward the sternum, and more or less cartilaginous at the other end. In very aged persons it has been found entirely ossified, and sometimes wholly cartilaginous even in adults.

All the ribs have cartilaginous portions, which differ from each other in length, breadth, incurvation, adhesion, and in their extremities; all which were explained in the description of the skeleton. The cartilages of the false ribs are naturally more

slender and pliable than those of the true ribs: the middle or inner substance acquires the consistence of bones in old age; and their extremities sometimes ossify; and are immoveably fixed to the sternum. The posterior extremities of the ribs are likewise tipped with cartilage where they are joined to the vertebræ.

LIGAMENTS PROPER TO THE STERNUM.

Proper membrane of the sternum, is a firm expansion, composed of many tendinous fibres, running in different directions, but chiefly longitudinally, covering both the external and internal surface of the sternum. On the forepart of the sternum the external fibres begin at the articulations of the cartilages of the ribs, and run across in a radiated manner to their fellows on the opposite side, while the internal fibres have a longitudinal direction.

Ligament of the xyphoid cartilage, is composed of tendinous fibres similar to the former, arising from the cartilaginous extremity of the seventh rib and corresponding part of the sternum; and after descending obliquely, are fixed to the cartilago ensiformis. The fibres of this are intermixed with those of the membrana sterni.

LIGAMENTS BETWEEN THE STERNUM AND RIBS.

Capsular ligaments of the cartilages of the true ribs, arise round the cartilages of the seven true ribs, to be fixed to the articular pits in the sides of the sternum. On the upper and under side of each articulation, these ligaments are very short; but on the anterior side many fibres are produced, which run in a radiated manner on the forepart of the sternum to the cartilages on the opposite side.

LIGAMENTS PROPER TO THE RIBS.

Proper ligaments of the ribs, by which the ribs are joined to each other. They descend somewhat in a perpendicular direction from the cartilage of each rib to that of the next one; but

the ligaments between the three last ribs are longer and looser than those of the rest. Hence the two last ribs are less steady in their motions.

LIGAMENTS BETWEEN THE RIBS AND VERTEBRÆ.

Capsular ligaments of the greater heads of the ribs, are short ligamentous fasciculi which arise round the cartilaginous surface of the head of each rib, and are fixed to the circumference of the small pits in the sides of the bodies of the vertebræ and intervertebral cartilages.

Capsular ligaments of the tubercles of the ribs, arise from the tubercles of the ten uppermost ribs, and are fixed round the articular pit on the point of the transverse processes of the vertebræ of the back; much in the same manner with those between the heads of the ribs and vertebræ.

Internal ligaments of the neck of the ribs, arise from the upper-part of the neck of the ribs, and are fixed to the inferior surface of the transverse processes.

External ligaments of the neck of the ribs, arise from the outer surface of the superior margin of the neck of all the ribs. They ascend obliquely, to be fixed near the inferior oblique processes of all the vertebræ excepting the first.

Peculiar ligaments, arise by a broad origin from the inferior margin of the last rib, and are fixed to the transverse process of the first and second lumbar vertebræ.

The ligamentous expansions of the vertebræ are in place of a periosteum; at least they are blended together both on the inner and outer side of the spine. The sternum and bony portions of the ribs have a periosteum like the other bones.

The cartilaginous portions of the ribs are covered by a membrane of the same kind, termed *perichondrium*. As the internal structure of these bones is cellular or spongy, they contain only small separate portions of marrow, or a red medullary juice, like that in the vertebræ.

The synovial glands of all these articulations are very small; but are accompanied by many other fatty moleculeæ lying round each joint. The inner surface of the ligamentous substance

which lines the bony canal of the spine, is lubricated by an adipose substance, which shall be mentioned hereafter.

CARTILAGES OF THE SUPERIOR EXTREMITIES.

The scapula in many subjects has a small cartilaginous border along its whole basis; which in children is pretty remarkable, but in adults it disappears.

The glenoid cavity of this bone is covered with a cartilage, which is thicker toward the circumference than in the middle, and a little raised above the edge of the bone. This thickness of the cartilaginous circumference makes the cavity greater than it appears in the skeleton; and sometimes, in place thereof, there is an additional border, which is the thickest at the circumference of the cavity, thin toward the bottom, and very narrow. It is of a pliable slippery substance, yet something different from that of a cartilage; resembling, in some measure, the border of the acetabulum of the os innominatum.

The small cartilaginous surface of the acromion, mentioned in the section of the bones, is very little convex, and the triangular surface at the extremity of the spine of the scapula, near the basis, is covered with a very thin cartilaginous lamina; but, being transparent, it does not appear very white. There are no other cartilages commonly found in the scapula; though we sometimes observe in dry bones several places which seem to have been cartilaginous; but this is owing to the dried remains of ligaments and tendons.

The sternal extremity of the clavicle is crusted over with a cartilage which is a little convex, and covers its whole triangular surface; besides which it has another moveable interarticular cartilage, resembling that at the articulation of the lower jaw, and in some measure serving the same purpose. The small cartilaginous surface of the scapular extremity of the clavicle, answering to that of the acromion, appears, like that of the acromion, to be a little convex.

Between these two cartilages of the clavicle and acromion, there is in some subjects a thin interarticular cartilage very smooth on both sides.

LIGAMENTS OF THE CLAVICLE AND SCAPULA.

Interclavicular ligament, is a long narrow strong ligament which goes behind the furca of the sternum, from the internal angle of one clavicle to that of the other.

Anterior capsular ligaments of the clavicle, are short and strong ligaments arising round the sternal extremity of the clavicle, near the edge of the triangular surface; and from thence passing over the interarticular cartilage, to which they adhere, are inserted round the clavicular cavity of the sternum.

Rhomboid ligament, arises from the inferior rough surface at the anterior extremity of the clavicle, and running obliquely, is fixed to the cartilage of the first rib.

Posterior capsular ligaments. The articulation of the scapular end of the clavicle with the acromion, is strengthened quite round by thick strong ligaments which go from one bone to the other.

Trapezoid ligament of the scapula, arises from the internal surface of the coracoid process of the scapula, and ends at the posterior extremity of the clavicle.

Conoid ligament of the scapula, arises from the root of the coracoid process, is inserted to the rough protuberance of the posterior extremity of the clavicle.

Proper anterior ligament of the scapula, arises from the external surface of the coracoid process, and is fixed to the posterior margin of the acromion.

Proper posterior ligament of the scapula, arises from the middle of the superior margin, and terminates at the root of the coracoid process. Under this ligament the vessels and nerves pass to the shoulder.

The cartilage which covers the head of the os humeri is thick in its middle; but becomes gradually thinner towards its edges.

The four surfaces of the tuberosities which appear cartilaginous in dry bones, serve only for the insertion of the tendons of the four muscles which move the os humeri on the scapula.

The channel through which the tendon of the long head of the biceps muscle runs between the tuberosities, is partly covered by a thin crust, which appears rather ligamentous than cartilaginous; and partly by a tendinous stratum.

LIGAMENTS BETWEEN THE SCAPULA AND OS HUMERI.

Capsular ligament of the os humerus, arises from the whole margin of the glenoid cavity of the scapula, and is fixed round the under end of the neck of the os humeri, loosely enclosing the head of this bone. The upper part of the ligament sends down a sheath between the two tuberosities of the humerus, over the tendon of the long head of the biceps muscle, which it accompanies as far as the fleshy part, and prevents it from sliding out of the groove in which it is placed. The capsular ligament is strengthened by other ligamentous bands, which adhere firmly to its anterior surface; but that which seems to give most force to the capsule are the tendons of the neighbouring muscles, which increase its thickness considerably.

The trochlea, and small head of the lower extremity of the os humeri, are covered by a common cartilage, in which the same proportion of thickness is observable as in that of the upper extremity. This holds generally of all the convex articular cartilages. The fossulæ near the pulley are likewise covered with a kind of cartilaginous varnish. The two sigmoid cavities in the upper extremity of the ulna are covered by a cartilage common to both; which is a little interrupted about the middle of the edges of the cavities by the transverse notches mentioned in the description of the bones. This cartilaginous crust seems to be thicker at the edges than in the middle. The cartilage which covers the head of the radius is likewise turned over its cylindrical border; and a lateral portion of the muscular tuberosity, immediately below the neck, is also covered with a thin shining cartilage.

LIGAMENTS OF THE JOINT OF THE ELBOW.

Capsular ligament arises from the lower end of the os humeri, above the edge of the cartilaginous surface, and is fixed to the top of the ulna round the edge of the great sigmoid cavity, including both the apex of the olecranon and that of the coronoid process. It likewise runs over the head of the radius, and is fixed to the coronary ligament quite round. Thus it completely surrounds the articulation of these three bones; and serves to contain the mucilaginous liquor in the cavity of the joint. It appears to be strengthened by a ligamentous web; the fibres of which cross each other in different directions: besides this there are some tendinous fibres of muscles to which the capsular ligament adheres very closely.

Near the under end of the body of the os humeri there are two particular intermuscular ligaments, which are long, narrow, and thin; but strong, fixed by one end along the two lower thirds of the bone, and reaching to both condyles. They increase the surface for the origin of muscles, and thereby supply the place of bones.

The lower extremity of the os humeri is also joined to the bones of the fore-arm by the two following fasciculi of ligamentous fibres.

Brachio-cubital, or internal lateral ligament, arises from the forepart of the internal condyle of the os humeri; and running down over the capsular, to which it closely adheres, is spread out in a radiated manner, to be fixed to the inside of the coronoid process of the ulna. It is covered on the outside by several tendons, which are connected closely to it, and seem to strengthen it.

Brachio-radial, or external lateral ligament, is disposed much after the same manner; but is of a greater extent. It is expanded from the external condyle of the os humeri as from a centre, and is inserted round the coronary ligament, and from thence down to the neck of the radius; and also in the neighbouring parts of the ulna. Through all this passage it covers

the capsular ligament, and is covered by several tendons, adhering closely to both.

LIGAMENTS JOINING THE HEAD OF THE RADIUS TO THAT OF
THE ULNA.

Coronary, or orbicular ligament. The head of the radius is joined to that of the ulna, and this and the following ligaments surround the head of the former, reaching from one side of the small lateral sigmoid cavity of the ulna to the other, in an arch which is about three quarters of a circle. It is very strong, and comes near the solidity of a cartilage. The side next the radius is very smooth; and though it connects that bone closely to the ulna; yet it leaves it room enough to turn in the motions of pronation and supination.

Oblique ligament, arises from the tubercle of the ulna, which gives attachment to the brachii internus muscle, and is inserted to the tubercle of the radius.

LIGAMENTS BETWEEN THE BODIES OF THE RADIUS AND ULNA.

Interosseous ligament fills up the space between the two bones of the fore-arm. It is fixed by one edge along the sharp angle of the radius, and by the other along that of the ulna. The greater number of the fibres which compose it, descend from the radius to the ulna. Some, however, ascend and cross the former obliquely, so as to make it appear as if composed of two planes. Small spaces are left in different parts of it for the passage of blood-vessels; and a large opening is left above, which is occupied by the oblique ligament, &c. The interosseous ligament ties the two bones together, and gives insertion to muscles. In the supination of the hand, it is stretched; and in the pronation, it is relaxed.

All the concave side of the basis of the radius is cartilaginous, and often divided by a small cartilaginous prominent line. The lateral notch of the basis is also covered by a continuation of the same cartilage.

At this end of the radius there is likewise a particular addi-

onal cartilage, or triangular production, longer than it is broad, very thin, and rather flat than concave on both its smooth sides. It is fixed by its basis, or shortest side, to the lateral sigmoid notch of the basis of the radius, in such a manner, that one side of it is on a level with the large cartilaginous surface of the basis of the bone, and its apex directly opposite to the styloid process. The other side touches the flat extremity of the small head of the ulna, but is not fixed to it. This cartilage may be termed the *interarticular cartilage* of the joint of the wrist. It is tied to the radius by very short ligaments; and, playing on the small head of the ulna, it follows all the motions of the radius. It is therefore a sort of particular production of the lower side of the basis of the radius, and fills, in the natural state, the void space which, in the skeleton, appears between the end of the ulna and the neighbouring bone of the carpus. The inferior extremity, or small head of the ulna, is crusted over by a cartilage round its cylindrical border, in the notch near the styloid process, and for some space on the process itself.

LIGAMENTS OF THE INFERIOR EXTREMITY OF THE BONES OF THE FORE-ARM.

Capsular ligament arises round the edge of the glenoid cavity of the lower ends of the radius and ulna. It is fixed to the cartilaginous edges of the three first bones of the carpus.

Capsular, or sacciform ligament, arises from the edges of the semilunar cavity, at the under end of the radius, and surrounds the head of the ulna.

Two transverse ligaments. One of these arises from the styloid process at the under end of the radius, and is inserted into the os naviculare. The other arises from the styloid process at the lower end of the ulna, and is fixed to the os cuneiforme and unciforme.

All the bones of the carpus, metacarpus, and fingers, are crusted over with cartilages at the places which play upon each other. The impressions and notches in which the bodies called *mucilaginous glands* are lodged, are most sensible in the cartilages of fresh bones, because of their thickness.

LIGAMENTS OF THE CARPUS.

Short ligaments of the bones of the carpus, are small short ligaments, running in various directions, and joining the carpal bones; first of the same row, then of the two rows together. They have their names from their figure and the direction of their fibres; as *oblique*, *transverse*, *capsular*, and *proper*.

Common capsular ligament of the carpal bones, arises from the cartilaginous edges of the first row of carpal bones, and is inserted into those of the second row.

LIGAMENTS BETWEEN THE CARPUS AND METACARPUS.

Articular ligaments, short firm ligaments, by which the second series of carpal bones are joined to the posterior extremities of the metacarpal bones. On account of the variety in situation, and diversity of the direction of their fibres, they have got the name of *lateral*, *straight*, *perpendicular*.

Interosseous ligaments of the metacarpus, are small ligaments which join the posterior and anterior extremity of the metacarpal bones together.

LIGAMENTS OF THE BONES OF THE FINGERS.

Capsular ligaments of the phalanges of the fingers join the anterior extremities of the metacarpal bones with the posterior extremities of the first phalanx of the fingers.

Lateral ligaments of the phalanges of the fingers, are strong ligaments, which lie between the bones of the first phalanx of the fingers. They are fixed at each end to the capsular ligaments.

Capsular ligament of the thumb arises from the posterior extremity of the first bone of the thumb, and is fixed round the os trapezium of the carpus.

LIGAMENTS RETAINING THE TENDONS OF THE MUSCLES OF
THE HAND AND FINGERS IN SITU.

External transverse ligament of the carpus, arises from the styloid process of the ulna and os pisiforme of the carpus, and running transversely on the back of the wrist, it spreads broad to end in the styloid process of the radius. Between this ligament and the bones, the tendons of the extensor muscles of the carpus and fingers pass.

Internal transverse ligament of the carpus. This strong ligament adheres to the four eminences on the internal surface of the carpus. The tendons of the flexor muscles pass under it.

Vaginal ligaments adhere to the external ligament and bones, and serve as a kind of sheaths to the extensor tendons.

Transverse ligaments of the extensor tendons, are short tendinous ligaments, running transversely on the back of the hand behind the roots of the fingers, and serving to join the tendons of the extensor digitorum communis together.

Transverse palmar ligaments are fixed to the anterior extremities of the metacarpal bones, from which they run transversely. In their passage they cover the lumbricales, and are inserted into the metacarpal bones and sheaths of the tendons of the flexor muscles.

Vaginal ligaments of the flexor tendons arise from the internal transverse ligament of the wrist, and as sheaths embrace the tendons of the flexor muscles of the fingers; they terminate at last with the tendons of the musculus perforans.

Vaginal, or crucial ligaments of the phalanges, run in a circular and crucial direction over the former vaginae and tendons, and are fixed to the ridges on the concave side of the bones of the fingers. They serve as fræna to the tendons while their muscles are in action.

Accessory ligaments of the flexor tendons, are small but firm tendinous substances, which arise from the first and second phalanx of the fingers; they are covered by the vaginal ligaments

of the tendons, and terminate in the tendons of the two flexor muscles of the fingers.

All the bones of the superior extremities are covered with their periosteum, and the quantity of marrow corresponds with the shape of the bone. All the joints have likewise synovial substances; but they are small when compared with those in the inferior extremities. The most considerable are placed in the cavities at the under end of the os humeri, for lodging the coronoid process and olecranon of the ulna, in the flexion and extension of the fore-arm.

CARTILAGES OF THE PELVIS AND INFERIOR EXTREMITIES.

The cartilages of the ossa innominata are not so numerous as one might imagine on examining the skeleton. We are apt to think we see the dried remains of cartilages on the spine of the os ilium, on the tuberosity of the os ischium, and on the grooves and notches which give passage to the tendons of muscles: but none of these incrustations are true cartilages, being for the most part tendinous, aponeurotic, or ligamentous; though being dried, they look more like cartilages than the true cartilages themselves.

The crust which covers the spine of the os ilium is chiefly tendinous in adult bodies; but in children, and in very aged persons, it appears cartilaginous. In children, the parts which are not completely ossified, are easily taken for true cartilages; and in old age, the tendons are often hardened to so great a degree as to have the very same appearance. The substance which covers the tuberosity of the os ischium is almost entirely tendinous; and that which lines the grooves and notches of the tendons is chiefly ligamentous.

The true cartilages of the ossa innominata are five in number; three common, and two proper. The first and principal common cartilage is that which makes the symphysis of the ossa pubis. It reaches from the interval between the spines of these two bones to the angle formed by the crura where they begin to separate. It is something thicker or broader at its upper part than for a considerable space lower down; but the inferior part

is by much the broadest. It fills the angle already mentioned ; and forms a kind of arch, which is more considerable in women than in men.

The two other common cartilages join the ossa ilium to the os sacrum, but are thinner than that of the ossa pubis.

The proper cartilages are those that line the acetabula. Concerning these, it has been already observed in the description of the skeleton, that in the edge of each there is a notch or opening between the anterior and inferior parts ; and that, in the cavity itself, there is a broad unequal shallow depression for the synovial gland, reaching from the notch beyond the middle of the cavity. All the rest of the surface is covered with a very white, shining, smooth cartilage, which terminates precisely at the edge of the cavity.

The circumference of the acetabulum has, besides, a border of a particular kind ; the substance of which is neither wholly cartilaginous, nor wholly ligamentous ; but it may be rather placed among the ligaments. The os sacrum has no cartilage excepting that between its upper end and the last vertebra of the loins, and those by which it is connected with the ossa innominata. The intervertebral cartilages of this bone are, for the most part, entirely obliterated in the adult. The cartilages which join the different portions of the os coccygis, are preserved in some subjects to a very great age ; in others they soon become entirely ossified.

No part of the os femoris is covered with cartilage, excepting the uniform convexity of its head ; and here the cartilage runs as far as the union between the head and neck of the bone. The trochanters have no true cartilage ; what looks like it being only the remains of tendinous insertions, as was observed of the spine or the os ilium. The cartilaginous substance which, to a certain age, unites the epiphyses to the body of the bone, does not belong to this place, because it is only found in the time of youth, and in adults is converted into bone. The cartilaginous matter by which the head of the os femoris is cemented, deserves however to be observed, because that epiphysis has been separated by violent falls.

LIGAMENTS PROPER TO THE BONES OF THE PELVIS.

Ileo sacral ligaments, are strong ligaments arising from the posterior part of the spine of the os ilium, which is opposed to the side of the os sacrum, and descending obliquely, are fixed to the first, third, and fourth spurious transverse processes of the os sacrum.

Superior and inferior transverse ligaments of the pelvis. Two ligaments arising from the posterior spinous process of the os ilium; the superior is fixed to the transverse process of the last vertebra of the loins; the inferior is fixed to the first transverse process of the os sacrum.

Sacro ischiatic ligaments. Between the os ischium and os sacrum, we find two very strong ligaments called *Sacro-sciatic*; one broad and external, the other small and internal. The external arises from the anterior and external edge of the false transverse processes of the os sacrum. From thence diminishing in breadth, it descends obliquely toward the tuberosity of the os ischium, and is inserted immediately below the sinus, which lies between the tuberosity and spine of that bone. This insertion is afterward continued over the whole internal labium of the inferior portion of the os ischium, and of the crus of that bone, and the inferior portion of the crus of the neighbouring os pubis. When it arrives at the os ischium, it produces a kind of falx; one edge of which is fixed to the bones, the other lies loose; and by this insertion of the falx, it forms, together with the bones, a kind of deep channel or groove.

The internal sacro-sciatic ligament adheres closely to the inside of the posterior portion of the former. It arises internally from the edge of the inferior part of the fourth false transverse process, and from the whole side of the os sacrum, and from the basis of the upper part of the os coccygis. From this it runs up a little obliquely to the spine of the os ischium; to the sharp point and upper part of which it is fixed.

By these two ligaments two openings are formed; a large one, with the superior sciatic sinus, through which the pyriform muscle, the posterior crural vessels, and the sciatic nerve, pass

out of the pelvis ; and a small one for the passage of the internal obturator muscle.

Obturator ligament. The obturator ligament fills up all the foramen thyroideum, except the oblique notch at its upper part for the passage of the obturator vessels and nerves. It is fixed to the edge of that hole from the anterior part of the oblique notch, as far as the symphysis between the os pubis and os ischium. Thence to the posterior part of the inferior notch, it is fixed to the internal labium of the edge of the circumference, forming a kind of small channel with the external labium ; and afterward it is fixed to the common edge of the foramen ovale and cotyloid notch. This ligament not only assists in supporting the parts contained in the pelvis, but also gives origin to the two obturator muscles.

On the inside of the upper and anterior part of the os pubis, there is a transverse ligament fixed by its upper part to the os pubis, from the oblique notch of the foramen ovale, all the way to the lower part of the symphysis, at a small distance from the circumference of the last mentioned hole. This ligament is about half an inch broad in an adult body, and, posteriorly, below the superior oblique notch of the foramen ovale, it joins the obturator ligament by means of a particular fold ; and by parting from it afterward, a deep narrow groove is formed between them ; the transverse ligament being at this place supported by ligamentous fræna of different sizes.

Inguinal, Poupart's, or Fallopius's ligament, the inguinal ligament, is chiefly the under end of the tendon of the external oblique muscle of the abdomen. It is fixed by one end to the anterior superior spinous process of the os ilium, and is stretched over to be fixed by its other end to the spine of the os pubis. The middle portion of it is very narrow, but it expands considerably toward both extremities. Under this ligament the femoral vessels and anterior crural nerve go out of the pelvis.

Capsular ligament of the os coccygis, arises from the upper end of the os coccygis, and is inserted round the under end of the sacrum.

Longitudinal ligaments of the os coccygis, small ligaments

arising from the inner surface of the os coccygis, and terminating in the os sacrum. They fix the two bones firmly together.

LIGAMENTS BETWEEN THE PELVIS AND HEAD OF THE OS FEMORIS.

The *capsular ligament* is the most considerable, largest, and strongest, of all the articular ligaments of the human body. It arises quite round the outer edge of a thick strong cartilago-ligamentous border, on the brim of the acetabulum, and thence largely surrounds the whole head and superior portion of the neck of the os femoris, and is closely inserted to the lower portion of the neck that is between its basis and middle narrow part. This ligament is made up of several sorts of fibres, the chief of which are longitudinal and oblique; and it is much thicker and stronger in some parts than in others. It is very thick on its forepart, on account of two ligamentous bands which run downward and outward from the inferior anterior spinous process of the os ilium to the further extremity of the neck of the thigh bone. It is somewhat thinner on its outer and back part, and thinnest of all at the inner and back part.

Ligamentum teres, or round ligament. This ligament is not round as the name expresses; it resembles a flat cord, being composed of a bundle of fibres closely interwoven; one end of it is in a manner divided into two flat bands, which are fixed to the inner corners of the notch of the acetabulum, and also to the edge of the rough impression at the bottom of the acetabulum. From this insertion it runs obliquely backward and a little upward, between the synovial gland within the acetabulum and the cartilaginous convexity at the head of the os femoris, and ends in the upper part of the small semilunar notch. This insertion is oblique, a little rounded on the upper part, and flat on the lower; and in some subjects there is a sort of depression in the head of the bone for the passage of the ligament.

The periosteum of the bones of the pelvis agrees with that on other flat bones.

The rough unequal depression at the bottom of the acetabulum is filled with a broad synovial gland, bordered with a fatty sub-

stance, and covered by a fine membrane, through which a muco-liginous liquor passes to moisten the joints and facilitate its motions. This membrane rises above the gland, and gives a sort of covering to the ligament contained in the joint.

The blood-vessels of this gland pass between the bottom of the acetabulum and the ligament at the inner edge of that cavity.

The blood-vessels pass chiefly through the small holes in both convex and concave surfaces of these bones ; and ramifying upon the bony cells, they end in a great number of small capillary tubes, which make the medullary juice appear red.

The cartilage which covers the lower extremity of the femur is exactly fitted to the semi-oval convexity of the inferior surface of each condyle, and to the pulley formed by their union.

The two cartilages which cover the two superior surfaces of the head of the tibia are gently hollow ; but the internal is more depressed than the external : the back part of the latter is sensibly depressed. The cartilage is absent where the crucial ligaments are inserted. The patella has a pretty thick cartilage on its posterior side, divided by a superficial longitudinal rising, proportioned to the two portions of the pulley of the os femoris ; at the outer and under part of the head of the tibia another cartilage appears, where the head of the fibula is articulated. The cartilage at the head of the fibula seems to be thicker than that at the lower extremity.

The semilunar cartilages, which get their name on account of their figure, are thick at their outer edge where they are tied to the capsular ligament ; thin at their inner edge, particularly at the middle ; concave superiorly next the condyles of the femur ; flattened below next the tibia ; tied together by a small ligament. Semilunar cartilages are in shape of a crescent, or Roman C. Their convexity or greatest curvature is very thick ; their concavity or smallest curvature very thin ; something like the edge of a sickle. They lie on the two upper surfaces of the head of the tibia ; their thickest part or convexity corresponding with the edges of the head, and their thin sharp edges to the middle of each surface ; their extremities or cornua being turned toward each other. Each cartilage covers about two thirds of the surface of the tibia on which it lies, leaving one-third bare in the

middle. Their under sides being flat, and upper sides hollow, they, together with the middle portions of the surfaces of the head of the tibia, form cavities proportionable to the convexities of the condyles of the os femoris.

LIGAMENTS WITHIN THE JOINT OF THE KNEE.

Crucial ligaments. One of these, called *posterior*, is fixed to the internal superficial impression in the notch between the condyles of the femur; and running almost straight down, is fixed by its other end to the notch in the head of the tibia, behind the cartilaginous tubercle which lies between the two superficial surfaces for receiving the condyles of the femur.

The other, called *anterior*, is fixed by one end to the external impression in the notch of the os femoris; and running obliquely downward and forward, across the former, is fixed by the other end to the head of the tibia a little before the other ligament. These two ligaments cross each other when we turn the point of the foot inward, and they separate from each other when the foot is turned outward. They prevent the leg from being bent forward on the thigh, and from rolling too much inward.

Great and small alar ligaments, are two broad ligaments arising from the inner side of the capsular ligament, and are fixed to the sides of the patella, and to the fatty substance placed there.

LIGAMENTS AT THE JOINT OF THE KNEE.

Internal lateral ligament, is fixed to the femur under the tuberosity, which is near its internal condyle; the fibres spread out in descending, and terminate at the upper and inner part of the tibia; along which they slide from behind forward, till they have got more than two inches and a half under the head of this bone.

External lateral ligament, is narrower and shorter. It is fixed above to the external tuberosity of the femur, and descends to embrace the anterior part of the head of the fibula, where it enlarges a little, though its fibres are not radiated like those of the

external ligament. Its length is about two inches, and it is somewhat loose. These two ligaments are not placed in the middle of the articulation ; they are a little farther back, so as to allow the ready flexion and extension of the limb. They are quite loose in the flexion, and put upon the stretch in the extension of the limb.

Posterior ligament, has an irregular form. It descends from the posterior, inferior, and external part of the outer condyle of the femur ; and having crossed the posterior part of the articulation, it terminates in the posterior, superior, and internal part of the tibia. Some fibres go by the side of the former, to end in the upper and back part of the tibia. The three ligaments above described are firmly fixed to the capsular ligament.

Capsular ligament, is fixed quite round the inferior extremity of the os femoris, at a small distance above the anterior, lateral, and posterior parts of the cartilage, and above the posterior part of the great notch ; from this it runs down to be fixed round the edge of the head of the tibia and in the edge of the patella, in such a way that the patella itself forms a part of the capsula of the joint. It is strengthened by the tendinous aponeurosis and tendons of the muscles which surround the joint, and likewise by the ligaments already mentioned ; internally, it adheres to the semilunar cartilages, and sends off a very fine vagina over the ligaments, &c. within the joint.

Ligament of the semilunar cartilages, are two small ligaments which join the semilunar cartilages to each other, and likewise to the os femoris and tibia.

Ligament of the patella, is a very strong ligament which arises from the point of the patella, and is fixed to the upper and fore-part of the tibia.

The marrow of the os femoris lies in a large mass in the middle cavity of the bone, and in small distinct clusters in the cells of each extremity. The first is penetrated at different distances by the bony filaments or ramifications of the reticular texture, and thereby sustained in the violent motions of the body.

The synovial substances of the knee, which lie near the edges of the patella, are the most considerable of any in the body ;

being disposed in form of fringes, and supported by a great quantity of fatty matter.

This common mass is contained within the capsular ligament; and on the side of the joint is covered by a very fine membrane, which likewise lines the inner surface of the ligament.

The superior portion of this fat is as it were supported by a small ligament fixed in the anterior part of the great notch between the condyles of the femur, and which runs to the upper part of the patella.

There are other fatty substances both above and below the edges of the semilunar cartilages, and likewise in the ham; some of which serve for the joint, the rest for the crucial ligaments. These last lie in folds formed by the internal membrane of the capsular ligament, which give particular coverings to the crucial ligaments, and to the other bundles of ligamentous fibres near them.

LIGAMENTS OF THE FIBULA.

Capsular ligament of its superior extremity, is a very strong ligament, which runs from the head of the fibula to be fixed to the external condyle of the tibia.

Interosseus ligament, fills up the space between the tibia and fibula. One side of it is fixed to the posterior external angle of the tibia, the other to the internal angle of the fibula. It is composed of strong tendinous fibres, which cross each other obliquely, and in various parts leave small spaces for the passage of vessels and nerves. At its upper part there is a large opening, where the vessels and nerves pass to the forepart of the leg, and where the muscles on opposite sides are contiguous. It serves chiefly as a ligamentous septum for the origin of muscles; in which respect it supplies the place of bones.

Ligaments of its inferior extremity, are four short strong ligaments, two of which are anterior and two posterior; they rise from the malleolus externus of the fibula, and are inserted into the under and outer part of the tibia.

The marrow of these bones lies in large masses in the great cavities, and in distinct molecule in the spongy parts, as in

other bones of the same shape. The synovial glands lie in the small spaces, depressions, and superficial notches; near the edges of the cartilages of each joint they are covered by the capsular ligaments, and more or less mixed with a fatty substance.

LIGAMENTS OF THE INFERIOR EXTREMITY OF THE BONES OF THE LEG.

Anterior ligament of the fibula, arises from the forepart of the malleolus externus of the fibula, and is fixed to the upper and outer part of the astragalus.

Middle ligament of the fibula, arises from the point of the malleolus externus, and runs straight down to be fixed to the outside of the os calcis.

Posterior ligament of the fibula, arises from the under and back part of the malleolus externus, and is bent obliquely backward, to be fixed to the outer and back part of the astragalus.

Deltoid ligament of the tibia, arises from the malleolus internus, and is fixed to the astragalus and os naviculare.

Capsular ligament, arises from the whole edge of the articular cavity of the tibia, and is fixed entirely round the astragalus.

LIGAMENTS OF THE BASIS OF THE METATARSAL BONES.

Capsular ligament, joins the metatarsal bone of the great toe to the os cuneiforme internum.

Articular ligaments, join the posterior extremities of the metatarsal to the anterior edges of the tarsal bones. On account of their different situations, they have the name of *plantar*, *dorsal*, and *lateral* ligaments of the foot.

Transverse ligaments of the back of the foot, are three in number, and are situated on the upper part of the foot, and join the bases of all the metatarsal bones together, excepting that which belongs to the great toe.

Transverse ligaments of the sole of the foot, are likewise three, but placed in the sole; and lie partly in the interstices of the bones.

Interosseous metatarsal ligaments, like the former, are also three in number, but run immediately from the side of one bone to that of the bone next it, filling up the interstitial spaces.

LIGAMENTS OF THE BONES OF THE TOES.

Capsular ligaments, arise from the posterior extremities of the first phalanx of the bones of the toes, and are fixed to the anterior extremities of the metatarsal bones.

The second and third phalanges of all the toes are joined by capsular ligaments, much in the same manner with those already mentioned.

Lateral ligaments, lie at the sides of the second and third joint of each of the toes; they arise from the sides of the bases; and are fixed to the sides of the heads of the bones of each of these joints.

All these ligaments, in the same manner as in the hand, are covered and strengthened on the dorsum pedis by an expansion of the tendons of the extensor muscles, in the sole by the sheaths of the tendons of the flexor muscles.

LIGAMENTS RETAINING THE TENDONS OF THE MUSCLES OF THE FOOT AND TOES IN SITU.

Vaginal ligament of the tibia. This strong ligament is part of the tendinous sheath that covers the muscles on the forepart of the leg; one side of it is fixed to the anterior angle at the lower part of the tibia, the other is fixed to the outer part of the fibula.

Transverse or crucial ligaments of the tarsus. These are double ligaments; one part arises in the outer part of the foot above the malleolus externus of the fibula, the other from the process of the os calcis. They run over, the one to be fixed to the malleolus internus, the other to the inner side of the os naviculare; they serve to keep the tendons of the muscles in their places.

Ligament of the peroneal tendons, arises from the forepart of the os calcis, and is fixed to the outer side of an eminence of this bone.

Lancinated ligament, arises from the edge of the malleolus internus, and runs down in a radiated manner to be lost in the fat situated there, then in the membrana propria of the abductor muscle of the great toe, and at last in the inner side of the os calcis; it covers the tendons, vessels, and nerves, running in the hollow of the os calcis.

Vaginal ligament of the extensor of the great toe, surrounds the tendon of this muscle.

Vaginal ligament of flexor of the great toe, surrounds the tendon of the flexor longus pollicis in the hollow of the os calcis; it is fixed to the under and inner part of this bone.

Vaginal ligaments of the flexor tendons. These are ligamentous sheaths surrounding the tendons of the flexor muscles of the toes, and are similar to those of the flexors of the fingers.

Accessory ligaments of the flexor tendons, are short, but strong ligaments, like those on the fingers, arising from the phalanges of the toes; and being included in the sheaths of the tendons, they terminate in the tendons.

Transverse ligaments of the extensor tendons, are small ligaments running between the tendons of these muscles, and serving to bind them together, and to keep them in their places.

The periosteum of all these bones is of the same kind with that of the bones of the leg.

The marrow is suitable to their internal structure; that is, in *moleculæ* in the cavernous portions, and in masses in those which have large cavities. Thus the marrow of all the tarsal bones is dispersed in *moleculæ*, because their internal structure is spongy. In the metatarsal bones and first phalanges of the toes, it is disposed in the same manner as in the tibia and fibula; that is, it lies in *moleculæ* in the extremities, the structure of which is cavernous; but in the middle portions of them, it lies in masses greater or less, according to the size of the cavities. In the other phalanges, which are entirely spongy, it is accordingly disposed in *moleculæ*.

The synovial substances answer in number and figure to the depressions between the cartilaginous edges and ligaments.

SECTION VI.

MYOLOGY.

MUSCLES OF THE TEGUMENTS OF THE CRANIUM.

THE skin that covers the cranium is moved by a single broad digastric muscle, and one small pair.

1. OCCIPITO FRONTALIS.

Arises fleshy from the transverse protuberant ridge near the middle of the os occipitis laterally, where it joins with the temporal bone ; and tendinous from the rest of that ridge backward, opposite to the lateral sinus ; it arises after the same manner on the other side. Thence it comes straight forward, by a broad thin tendon, which covers the upper part of the cranium at each side, as low down as the attollens aurem, to which it is connected, and to the zygoma, it also covers a part of the aponeurosis of the temporal muscle ; when it comes as far forward as near the hair of the front, it becomes fleshy, and descends with straight fibres.

Inserted into the orbicularis palpebrarum of each side, and into the skin of the eyebrows, sending down a fleshy slip between them, as far as the compressor naris and levator labii superioris alæque nasi.

Use. To pull the skin of the head backward ; raise the eyebrows upward ; and, at the same time, to draw up and wrinkle the skin of the forehead.

Epicranius, Albinus, and Soemmerring.

Frontalis et occipitalis, Winslow.

2. CORRUGATOR SUPERCILII.

Arises fleshy from the internal angular process of the os frontis, above the joining of the os nasi, and nasal process of the supe-

rior maxillary bone ; from thence it runs outward, and a little upward.

Inserted into the inner and inferior fleshy part of the occipito-frontalis muscle, where it joins with the orbicularis palpebrarum, and extending outward as far as the middle of the superciliary ridge.

Use. To draw the eyebrow of that side toward the other, and make it project over the inner canthus of the eye : When both act, they pull down the skin of the forehead, and make it wrinkle, particularly between the eyebrows.

Musculus Supercilii, Winslow.

Musculus Frontalis verus, seu Corrugator, Douglas.

MUSCLES OF THE EAR.

THE muscles of the ear may be divided into three classes, viz. the common, proper, and internal. The common may move the whole ear ; the proper only affect the particular parts to which they are connected ; and the internal, the small bones within the tympanum.

The common muscles are three ;

1. ATTOLENS AUREM.

Arises thin, broad, and tendinous, from the tendon of the occipito-frontalis, from which it is almost inseparable, where it covers the aponeurosis of the temporal muscle.

Inserted into the upper part of the ear, opposite to the antihelix.

Use. To draw the ear upward, and make the parts into which it is inserted tense.

Superior auris, Winslow.

Attollens auriculam, Soemmerring.

2. ARTERIOR AURIS,

Arises thin and membranous near the posterior part of the zygoma.

Inserted into a small eminence on the back of the helix, opposite to the concha.

Use. To draw this eminence a little forward and upward.

Prior auriculæ, Soemmerring.

3. RETRAHENTES AURIS,

Arises, sometimes by three, but always by two distinct small muscles, from the external and posterior part of the root of the mastoid process, immediately above the insertion of the sternocleido mastoid muscle.

Inserted into that part of the back of the ear which is opposite to the septum that divides the scapha and concha.

Use. To draw the ear back, and stretch the concha.

Posterior auris, Winslow.

Retrahentes auriculam, Soemmerring.

The proper muscles are five ;

1. HELICIS MAJOR,

Arises from the upper and acute part of the helix anteriorly.

Inserted into its cartilage a little above the tragus.

Use. To depress that part from which it arises a little downward and forward.

2. RELICIS MINOR,

Arises from the inferior and anterior part of the helix.

Inserted into the crus of the helix, near the fissure in the cartilage opposite to the concha.

Use. To contract the fissure.

3. TRAGICUS,

Arises from the middle and outer part of the concha, at the root of the tragus, along which it runs.

Inserted into the point of the tragus.

Use. To pull the point of the tragus a little forward.

4. ANTITRAGICUS,

Arises from the internal part of the cartilage that supports the antitragus; and, running upward, is

Inserted into the tip of the antitragus, as far as the inferior part of the antihelix, where there is a fissure in their cartilage.

Use. Turns the tip of the antitragus a little outward, and depresses the extremity of the antihelix toward it.

5. TRANSVERSUS AURIS,

Arises from the prominent part of the concha on the dorsum of the ear; the fibres not so fleshy as in the former.

Inserted opposite to the outer side of the antihelix.

Use. Draws the parts to which it is connected toward each other, and stretches the scapha and concha.

Transversus auriculæ, Soemmerring.

The muscles of the internal ear are four;

1. LAXATOR TYMPANI.

Arises by a small beginning from the extremity of the spinous process of the sphenoid bone, behind the entry of the artery of the dura mater; then running backward, and a little upward, along with the nerve called *chorda tympani*, in a fissure of the

os temporis near the fossa that lodges the condyle of the lower jaw.

Inserted into the long process of the malleus, within the tympanum, where it rests upon the edge of the fissure between the pars squamosa and petrosa.

Use. To draw the malleus obliquely forward toward its origin, consequently the membrana tympani, by which that membrane is made less concave, or is relaxed.

Externus mallei, Albinus.

Anterior mallei, Winslow.

Obliquus auris, Douglas.

Laxator tympani major, Soemmerring.

2. LAXATOR TYMPANI MINOR,

Arises from the superior and posterior margin of the meatus auditorius, where the membrana tympani adheres to it, then becoming smaller, it descends inward and forward, and is

Inserted into the neck of the malleus near its long process.

Use. To render less concave or to relax the membrane of the Tympanum.

This muscle is altogether omitted by Innes, but is well described by Albinus under the name of *Laxator tympani*, and by Soemmerring under the name here given.

3. TENSOR TYMPANI,

Arises, by a very small beginning, from the cartilaginous extremity of the Eustachian tube, just, where it begins to be covered by the pars petrosa, and spinous process of the sphenoid bone, near the entry of the artery of the dura mater; from thence running backward near the osseous part of the Eustachian tube, forms a very distinct fleshy belly, below a thin osseous plate, between the pars squamosa and labyrinth; and sends off

a slender tendon, which makes a turn into the tympanum along with the nerve called *chorda tympani*.

Inserted into the posterior part of the handle of the malleus, a little lower than the root of its long process.

Use. To pull the malleus and membrana tympani inward toward the pars petrosa, by which the membrane is made more concave and tense.

Internus mallei, Winslow.

Internus auris, Douglas.

4. STAPEDIUS,

Arises, by a small fleshy belly, from a little cavern in the pars petrosa, near the cells of the mastoid process, before the inferior part of the passage for the portio dura of the auditory nerve; its tendon passes straight through a small round hole in the same cavern, enters the anterior part of the tympanum, and is

Inserted into the posterior part of the head of the stapes.

Use. To draw the stapes obliquely upward toward the cavern, by which the posterior part of its base is moved inward, and the anterior part outward.

Musculus stapedis, Winslow.

Stapideus, Douglas.

MUSCLES OF THE EYELIDS.

THE palpebræ, or eyelids, have one muscle common to both, and the upper eyelid one proper to itself.

1. ORBICULARIS PALPEBRARUM,

Arises, by a number of fleshy fibres, from the outer edge of the orbital process of the superior maxillary bone, and from a

tendon near the inner angle of the eye; these run a little downward, then outward, over the upper part of the cheek, below the orbit, covering the under eyelid, and surround the external angle, being loosely connected only to the skin and fat; run over the superciliary ridge of the os frontis, toward the inner canthus, where they intermix with those of the occipito-frontalis and corrugator supercilii; then covering the upper eyelid, descend to the inner angle opposite to the inferior origin of this muscle, firmly adhering to the internal angular process of the os frontis, and to the short round tendon which serves to fix the palpebræ and muscular fibres arising from it.

Inserted, by the short round tendon, into the nasal process of the superior maxillary bone, covering the anterior and upper part of the lachrymal sac; which tendon can be easily felt at the inner canthus of the eye.

Use. To shut the eye, by drawing both lids close together, the fibres contracting from the outer angle toward the inner, to press the eye ball, squeeze the lachrymal gland, and convey the tears toward the puncta lachrymalia.

The *ciliaris* of some authors is only a part of this muscle covering the cartilages of the eyelids, called *cilia* or *tarsi*.

There is often a small fleshy slip which runs down from the outer and inferior part of this muscle above the zygomaticus minor, and joins with the levator labii superioris alæque nasi. When this exists, as Soemmerring observes, it abducts the eyelids.

2. LEVATOR PALPEBRÆ SUPERIORIS,

Arises from the upper part of the foramen opticum of the sphenoid bone, through which the optic nerve passes, above the levator oculi, near the trochlearis muscle.

Inserted, by a broad thin tendon, into the cartilage that supports the upper eyelid, named *tarsus*.

Use. To open the eye, by drawing the eyelid upward; which it does completely, by being fixed to the tarsus, pulling it below the eyebrow, and within the orbit.

Aperiens palpebram rectus, Douglas.

MUSCLES OF THE EYEBALL.

THE muscles which move the globe of the eye are six, viz.
Four *straight* and two *oblique*.

The four straight muscles very much resemble each other;
all

Arising, by a narrow beginning, a little tendinous and fleshy, from the bottom of the orbit around the foramen opticum of the sphenoid bone, where the optic nerve enters, so that they may be taken out adhering to this nerve; and all having strong fleshy bellies.

Inserted at the forepart of the globe of the eye into the anterior part of the tunica sclerotica, and under the tunica adnata, at opposite sides, which indicates both their names and *Use*; so that they scarcely require any further description, but to name them singly.

1. LEVATOR OCULI,

Arises from the upper part of the foramen opticum of the sphenoid bone, below the levator palpebræ superioris; and runs forward to be

Inserted into the superior and forepart of the tunica sclerotica, by a broad thin tendon.

Use. To raise up the globe of the eye.

Atollens, Albinus and Soemmerring.

Elevator, Douglas.

2. DEPRESSOR OCULI,

Arises from the inferior part of the foramen opticum.

Inserted opposite to the former.

Use. To pull the globe of the eye down.

Deprimens, Albinus.

3. ADDUCTOR OCULI,

Arises, as the former, between the obliquus superior and depressor, being, from its situation, the shortest.

Inserted opposite to the inner angle.

Use. To turn the eye toward the nose.

4. ADDUCTOR OCULI,

Arises from the bony partition between the foramen opticum and lacerum, being the longest from its situation; and is

Inserted into the globe opposite to the outer canthus.

Use. To move the globe outward.

The oblique muscles are two :

1. OBLIQUUS SUPERIOR, SEU TROCHLEARIS,

Arises, like the straight muscles, from the edge of the foramen opticum at the bottom of the orbit, between the levator and adductor oculi; thence runs straight along the pars plana of the ethmoid bone to the upper part of the orbit, where a cartilaginous trochlea is fixed to the inside of the internal angular process of the os frontis, through which its tendon passes, and runs a little downward and outward, enclosed in a loose membranous sheath.

Inserted, by a broad thin tendon, into the tunica sclerotica, about half-way between the insertion of the levator oculi and optic nerve.

Use. To roll the globe of the eye, and turn the pupil downward and outward, so that the upper side of the globe is turned inward, the inferior part to the outside of the orbit, and the whole globe drawn forward toward the inner canthus.

Obliquus major, Winslow.

2. OBLIQUES INFERIOR,

Arises, by a narrow beginning, from the outer edge, of the orbital process of the superior maxillary bone, near its juncture with the os unguis ; and running obliquely outward, is

Inserted into the sclerotica, in the space between the abductor and optic nerve, by a broad thin tendon.

Use. To draw the globe of the eye forward, inward, and downward ; and, contrary to the superior, to turn the pupil upward, toward the inner extremity of the eyebrow ; at the same time, the external part of the globe is turned toward the inferior side, and the internal rolls toward the upper part.

Obliquus minor, Winslow.

MUSCLE OF THE NOSE.

THERE is only one muscle on each side that can be called proper to the nose, though it is affected by several muscles of the face.

COMPRESSOR NARIS,

Arises, by a narrow beginning, from the root of the ala nasi externally, where part of the levator labii superioris alæque nasi is connected to it ; it spreads into a number of thin disgregated fibres, which run up along the cartilage in an oblique manner toward the dorsum of the nose, where it joins with its fellow, and is

Inserted slightly into the anterior extremity of the os nasi and nasal process of the superior maxillary bone, where it meets with some of the fibres descending from the occipito-frontalis muscle.

Use. To compress the ala toward the septum nasi, particularly when we want to smell acutely; but, if the fibres of the frontal muscle which adhere to it act, the upper part of this thin muscle assists to pull the ala outward. It also corrugates the skin of the nose, and assists in expressing certain passions.

Rinæus, vel nasalis, Douglas.

MUSCLES OF THE MOUTH AND LIPS.

THE mouth has ten pair of muscles, which are inserted into the lips, and a common one formed by the termination of these, viz. four *above*, four *below*, three *outward*, and the common muscle surrounding the mouth.

The four above are,

1. LEVATOR ANGULI ORIS,

Arises, thin and fleshy, from the hollow of the superior maxillary bone, between the root of the socket of the first dens molaris and the foramen infra-orbitarium.

Inserted into the angle of the mouth and under lip, where it joins with its antagonist.

Use. To draw the corner of the mouth upward, and make that part of the cheek opposite to the chin prominent, as in smiling.

Elevator labiorum communis, Douglas.

Caninus, Winslow.

2. LEVATOR LABII SUPERIORIS ALÆQUE NASI,

Arises by two distinct origins ; the first, broad and fleshy, from the external part of the orbital process of the superior maxillary bone which forms the lower part of the orbit, immediately above the foramen infra orbitarium ; the second portion arises from the nasal process of the superior maxillary bone, where it joins the os frontis at the inner canthus, descending along the edge of the groove for the lachrymal sac. The first and shortest portion is

Inserted into the upper lip and orbicularis labiorum ; the second and longest, into the upper lip and outer part of the ala nasi.

Use. To raise the upper-lip toward the orbit, and a little outward ; the second portion serves to draw the skin of the nose upward and outward, by which the nostril is dilated.

Elevator labii superioris proprius. Douglas.

Incisivus lateralis, First portion ; *Pyramidalis*, Second portion ; Winslow.

3. NASALIS LABII SUPERIORIS.

Arises, tendinous from the tip and septum of the nose, enlarges, and descends obliquely outward till it is

Inserted into the orbicularis oris.

Use. To bring closer the angles of the mouth, and to depress the tip and septum of the nose.

Innes avoids the description of this muscle, but for insufficient reasons.

4. DEPRESSOR LABII SUPERIORIS ALÆQUE NASI,

Arises, thin and fleshy, from the os maxillare superius, immediately above the joining of the gums with the two dentes incisivi, and the dens caninus ; from thence it runs up under part of the levator labii superioris alæque nasi.

Inserted into the upper lip and root of the ala nasi.

Use. To draw the upper lip and ala nasi downward and backward.

Depressor alæ nasi, Albinus, and Soemmerring.

Incisivus medius, Winslow.

Depressor labii superioris proprius, Douglas.

The three below are,

1. DEPRESSOR ANGULI ORIS,

Arises, broad and fleshy, from the lower edge of the maxilla inferior, at the side of the chin, being firmly connected to that part of the platysma myoides, which runs over the maxilla to the angle of the mouth, to the depressor labii inferioris within, and to the skin and fat without, gradually turning narrower; and is

Inserted into the angle of the mouth, joining with the zygomaticus major and levator anguli oris.

Use. To pull down the corner of the mouth.

Triangularis, Winslow.

Depressor labiorum communis, Douglas.

2. DEPRESSOR LABII INFERIORIS,

Arises, broad and fleshy, intermixed with fat, from the inferior part of the lower jaw next the chin; runs obliquely upward; and is

Inserted into the edge of the under lip, extends along one half of the lip, and is lost in its red part.

Use. To pull the under lip and the skin of the side of the chin downward, and a little outward.

Quadratus, Winslow.

Depressor labii inferioris proprius, Douglas.

3. LEVATOR LABII INFERIORIS.

Arises, from the lower jaw, at the roots of the alveoli of two dentes incisivi and of the caninus; is

Inserted into the under-lip and skin of the chin.

Use. To pull the parts into which it is inserted upward.

Levator menti, Albinus, and Soemmerring.

Incisivus inferior, Winslow.

Elevator labii inferioris proprius, Douglas.

The three outward are,

1. BUCCINATOR,

Arises, tendinous and fleshy, from the lower jaw, as far back as the last dens molaris and forepart of the root of the coronoid process; fleshy from the upper jaw, between the last dens molaris and pterygoid process of the sphenoid bone; from the extremity of which it arises tendinous, being continued between both jaws to the constrictor pharyngis superior, with which it joins; thence proceeding with straight fibres, and adhering close to the membrane that lines the mouth, it is

Inserted into the angle of the mouth within the orbicularis oris.

Use. To draw the angle of the mouth backward and outward, and to contract its cavity, by pressing the cheek inward, by which the food is thrust between the teeth.

Retractor anguli oris, Albinus.

2. ZYGOMATICUS MAJOR,

Arises, fleshy, from the os malæ, near the zygomatic suture.

Inserted into the angle of the mouth, appearing to be lost in the depressor anguli oris and orbicularis oris.

Use. To draw the corner of the mouth and under-lip toward the origin of the muscle, and make the cheek prominent, as in laughing.

Zygomaticus, Douglas.

3. ZYGOMATICUS MINOR,

Arises from the upper prominent part of the os malæ, above the origin of the former muscle; and descending obliquely downward and forward, is

Inserted into the upper lip, near the corner of the mouth, along with the levator anguli oris.

Use. To draw the corner of the mouth obliquely outward, and upward, toward the external canthus of the eye.

The common muscle is the

ORBICULARIS ORIS,

The muscle is, in a great measure, formed by the muscles that move the lips; the fibres of the superior descending, those of the inferior ascending, and decussating each other about the corner of the mouth, run along the lip to join those of the opposite side, so that the fleshy fibres appear to surround the mouth like a sphincter.

Use. To shut the mouth, by contracting and drawing both lips together, and to counteract all the muscles that assist in forming it.

Sphincter labiorum, Douglas.

Semi-orbicularis, Winslow.

Constrictor oris, Cowper.

 ANOMALUS MAXILLÆ SUPERIORIS,

This muscle is situated beneath the levator labii superioris alæque nasi, and owing to the attachment of both its ends to the immoveable os superius maxillare, it can only act upon the vessels or the nerves. It

Arises from the upper part of the fossa of the cuspidatus of the upper jaw, and is

Inserted into the os maxillare superius below the origin of the first portion of the levator labii superioris alæque nasi.—Some times, adhering to the depressor labii superioris alæque nasi, it is inserted tendinous into the os maxillare superius about the middle height of the margin of the osseous foramen of the nose.

This muscle is altogether neglected by Innes.

 MUSCLES OF THE LOWER JAW.

THE lower jaw has four pair of muscles for its elevation or lateral motions, viz. two, which are seen on the side of the face, and two concealed by the angle of the jaw.

1. TEMPORALIS,

Arises, fleshy, from a semicircular ridge of the lower and lateral part of the parietal bone, from all the pars squamosa of the temporal bone, from the external angular process of the os frontis, from the temporal process of the sphenoid bone, and from an aponeurosis which covers it: from these different origins the fibres descend like radii toward the jugum, under which they pass; and are

Inserted, by a strong tendon, into the upper part of the coro.

noid process of the lower jaw ; in the duplicature of which tendon this process is enclosed as in a sheath, being continued down all its forepart to near the last dens-molaris.

Use. To pull the lower jaw upward, and press it against the upper, at the same time drawing it a little backward.

N. B. This muscle is covered by a tendinous membrane, called its *aponeurosis*, which arises from the bones that give origin to the upper and semicircular part of the muscle ; and descending over it, is inserted into all the jugum, and the adjoining part of the os frontis.

The use of this membrane is to give room for the origin of a greater number of fleshy fibres, to fortify the muscle in its action, and to serve as a defence to it.

Crotaphite muscle, Winslow.

2. MASSETER,

Arises, by strong, tendinous, and fleshy fibres, which run in different directions, from the superior maxillary bone, where it joins the os malæ, and from the inferior and interior part of the zygoma, its whole length, as far back as the tubercle before the socket for the condyle of the lower jaw ; the external fibres slanting backward, and the internal forward.

Inserted into the angle of the lower jaw, and from that upward to near the top of its coronoid process.

Use. To pull the lower to the upper jaw, and by means of its oblique decussation, a little forward and backward.

3. PTERYGOIDEUS INTERNUS,

Arises, tendinous and fleshy, from the inner and upper part of the internal plate of the pterygoid process, filling all the space between the two plates ; and from the pterygoid process of the os palati between these plates.

Inserted into the angle of the lower jaw internally.

Use. To draw the jaw upward, and obliquely toward the opposite side.

Pterygoideus major, Winslow.

4. PTERYGOSDEUS EXTERNUS,

Arises from the outer side of the external plate of the pterygoid process of the sphenoid bone, from part of the tuberosity of the os maxillare adjoining to it, and from the root of the temporal process of the sphenoid bone.

Inserted into a cavity in the neck of the condyloid process of the lower jaw ; some of its fibres are inserted into the ligament that connects the moveable cartilage and that process to each other.

Use. To pull the lower jaw forward, and to the opposite side ; and to pull the ligament from the joint, that it may not be pinched during these motions : when both external pterygoid muscles act, the fore-teeth of the under-jaw are pushed forward beyond those of the upper jaw.

Pterygoideus minor, Winslow.

THE MUSCLES WHICH APPEAR ABOUT THE ANTERIOR PART OF THE NECK.

ON the side of the neck are two muscles or layers.

1. MUSCULUS CUTANEUS,
VULGO,
PLATYSMA MYOIDES,

Arises, by a number of slender disgregated fleshy fibres, from the cellular substance that covers the upper parts of the deltoid and pectoral muscles ; in their ascent they all unite to form a thin muscle, which runs obliquely upward along the side of the neck, adhering to the skin.

Inserted into the lower jaw, between its angle and the origin of the depressor anguli oris, to which it is firmly connected, and but slightly to the skin that covers the inferior part of the masseter muscle and parotid glands.

Use. To assist the depressor anguli oris in drawing the skin of the cheek downward; and when the mouth is fixed, it draws all that part of the skin, to which it is connected, below the lower jaw, upward.

Platysma myoides, Galen.

Musculus cutaneus, Winslow.

Quadratus genæ, vel Latissimus colli, Douglas.

Latissimus colli, Albinus, and Soemmerring.

2. STERNO-CLEIDO-MASTOISDEUS,

Arises by two distinct origins; the anterior, tendinous and a little fleshy, from the top of the sternum near its junction with the clavicle; the posterior, fleshy, from the upper and anterior part of the clavicle; both unite a little above the anterior articulation of the clavicle, to form one muscle, which runs obliquely upward and outward, to be

Inserted, by a thick strong tendon, into the mastoid process, which it surrounds; and gradually turning thinner, is inserted as far back as the lambdoid suture.

Use. To turn the head on one side, and bend it forward.

Sterno-mastoideus and *Cleido-mastoideus*, Albinus, and Soemmerring.

Mastoideus, Douglas.

MUSCLES SITUATED BETWEEN THE LOWER JAW AND OS HYOIDES.

THERE are are four layers before, and two muscles at the side.

The four layers are,

1. DIGASTRICUS,

Arises, by a fleshy belly, intermixed with tendinous fibres, from the first and deepest of the fossæ at the root of the mastoid process of the temporal bone, and soon becomes tendinous; runs downward and forward: the tendon passes generally through the stylo-hyoideus muscle; then it is fixed by a ligament to the os hyoideus; and having received from that bone an addition of tendinous and muscular fibres, runs obliquely forward, turns fleshy again, and is

Inserted, by this anterior belly, into a rough sinuosity at the inferior and anterior edge of that part of the lower jaw called the chin.

Use. To open the mouth, by pulling the lower jaw downward, and backward; and when the jaws are shut, to raise the larynx, and consequently the pharynx, upward, as in deglutition.

Biventer maxillæ inferioris, Albinus, and Soemmerring.

2. MYLO-HYOIDEUS,

Arises, fleshy, from all the inside of the lower jaw, between the last dens molaris and the middle of the chin, where it joins with its fellow.

Inserted into the lower edge of the basis of the os hyoides, and joins with its fellow.

Use. To pull the os hyoides forward, upward, and to a side.

Transversus Mandibulæ, Soemmerring.

3. GENIO-HYOIDEUS,

Arises, tendinous, from a rough protuberance in the middle of the lower jaw internally, or inside of the chin.

Inserted into the basis of the os hyoides.

Use. To draw this bone forward to the chin.

4. GENIO-HYO-GLOSSUS,

Arises, tendinous, from a rough protuberance in the inside of the middle of the lower jaw ; its fibres run, like a fan, forward, upward, and backward ; and are

Inserted into the tip, middle, and root of the tongue, and base of the os hyoides, near its cornu.

Use. According to the direction of its fibres, to draw the tip of the tongue backward into the mouth, the middle downward, and to render its dorsum concave ; to draw its root and os hyoides forward, and to thrust the tongue out of the mouth.

Genioglossus, Soemmerring.

The two muscles at the sides are,

1. HYO-GLOSSUS,

Arises, broad and fleshy, from the base, cornu, and appendix of the os hyoides ; the fibres run upward and outward, to be

Inserted into the side of the tongue, near the stylo-glossus.

Use. To pull the tongue inward and downward.

Basio-cerato-chondro-glossus, Albinus.

Cerato-glossus, Douglas.

2. LINGUALIS.

Arises from the root of the tongue laterally ; runs forward between the hyo-glossus and genio-glossus, to be

Inserted into the tip of the tongue, along with part of the stylo-glossus.

Use. To contract the substance of the tongue, and bring it backward.

Previous to the description of the muscles of the larynx and pharynx, it will be absolutely necessary to explain the structure of these parts.

THE LARYNX

Forms the protuberance in the upper and anterior part of the neck, called vulgarly *pomum Adami*, which is generally larger in men than in women.

It is chiefly made up of five cartilages ; the names of which are these : the Thyroid, which is anterior and largest ; cricoid, which is inferior ; two arytenoid, which are posterior and smallest ; and the epiglottis, which is above all the rest. These are connected by ligaments, and have muscles, glands, membranes, &c. belonging to them.

The *Thyroid Cartilage* is large, broad, and folded in such a manner as to have a longitudinal convexity on the foreside, and two lateral portions which may be termed *wings*. 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 we name the *cornua of the thyroid 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.

The *Cricoid 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, and distinguished 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 trachea is connected ; so that the cricoid may be looked upon as the upper extremity of the trachea.

The posterior portion of the cricoid 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 arytenoid cartilages, and the two inferior, for the articulation of the inferior cornua or appendices of the thyroid cartilage.

The *Arytenoid Cartilages* are two small, equal, similar bodies, which joined together resemble the spout of an ewer ; and they are situated on the top of the cricoid. 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 cricoid.

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.

The *Epiglottis* is an elastic cartilage, somewhat of the figure of the tongue, narrow and thick 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 thyroid cartilage; 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 small holes, which are hid by the membranes that cover its two sides.

Ligaments of the larynx. The thyroid cartilage is connected to the cricoid by several short strong ligaments, round the articulations of the two inferior cornua with the lateral articular surfaces of the cricoid. 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 thyroid 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 arytenoid cartilages.

The cricoid cartilage is tied to the lower part of the thyroid 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, 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 cricoid.

Glottis. The cartilaginee arytenoideæ are connected to the cricoides by ligaments, which surround their articulations with the top of that cartilage. Anteriorly the basis of each arytenoid 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 thyroid. At their insertions in the thyroid, these two ligaments touch each other; but a small space is left

between them, where they are fixed in the two arytenoids; and they seem likewise to have a small adhesion to the top of the cricoid. 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 thyroid. 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 arytenoid, 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.

The two ligaments which connect the epiglottis to the notch of the thyroid cartilage, and to the basis of the os hyoides, and a third which ties the basis of the os hyoides to the notch of the thyroid, 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 arytenoid cartilages, all the way to their points or cornua. It has also a membranous ligament, 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 irre-

gular 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.

It is scarcely necessary to add, that the larynx constitutes part of the organ of speech.

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 the veins and arteries, which pass to and from the head, 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 pterygoideæ, and by the neighbouring portion of both pterygoid 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 an angle or point, toward the jugular fossulæ of the basis cranii. Afterward 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 cricoid 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 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.

The upper, and, in some measure, the middle portion of the pharynx, in the opinion of M. Santorini, is useful in modifying the voice; while the lower, and in part also the middle portion, serve chiefly in deglutition.

MUSCLES SITUATED BETWEEN THE OS HYOIDES AND TRUNK.

THESE may be divided into two layers.

The first layer consists of two muscles.

1. STERNO-HYOIDEUS,

Arises, thin and fleshy, from the cartilaginous extremity of the first rib, the upper and inner part of the sternum, and from the clavicle where it joins with the sternum.

Inserted into the base of the os hyoides.

Use. To pull the os hyoides downward.

2. OMO-HYOIDEUS,

Arises, broad, thin, and fleshy, from the superior costa of the scapula, near the simlunar nitch, and from the ligament that runs across it; thence ascending obliquely, it becomes tendinous below the sterno-cleidomastoid muscle; and, growing fleshy again, is

Inserted into the base of the os hyoides, between its cornu and the insertion of the sterno-hyoideus.

Use. To pull the os hyoides obliquely downward.

Coraco-hyoideus, Albinus and Douglas.

The second layer consists of four muscles.

1. STERNO-THYROIDEUS,

Arises, fleshy, from the whole edge of the uppermost bone of the sternum internally, opposite to the cartilage of the first rib, from which it receives a small part of its origin.

Inserted into the surface of the rough line at the external part of the inferior edge of the thyroid cartilage.

Use. To draw the larynx downward.

Sterno-thyreoides, Soemmerring.

2. THYREO-HYOIDEUS,

Arises from the rough line, opposite to the former.

Inserted into part of the basis, and almost all the cornu of the os hyoides.

Use. To pull the os hyoides downward, or the thyroid cartilage upward.

Thyro-hyoideus vel Hyo-thyroideus, Winslow.

Hyothyreoideus, Soemmerring.

3. MUSCULUS GLANDULÆ THYROIDÆ,

Arises from the inferior margin of the body of the os hyoides, and, crossing the thyroid cartilage, is

Inserted into the middle part of the thyroid gland.

Use. To pull that gland toward the os hyoides.

This muscle is altogether omitted by Innes.

4. CRICO-THYROIDEUS.

Arises from the side and forepart of the cricoid cartilage, running obliquely upward.

Inserted by two portions ; the first, into the lower part of the thyroid cartilage ; the second, into its inferior cornu.

Use. To pull forward and depress the thyroid, or to elevate and draw backward the cricoid cartilage.

Cricothyreoideus, and *Dilator Glottidis Prior*, Soemmerring.

MUSCLES SITUATED BETWEEN THE LOWER JAW
AND OS HYOIDES Laterally.

THEY are five in number. Three proceed from the styloid process of the temporal bone, from which they have half of their names; and two from the pterygoid process of the sphenoid bone.

The three from the styloid process are,

1. STYLO-GLOSSUS.

Arises tendinous and fleshy, from the styloid process, and from a ligament that connects that process to the angle of the lower jaw.

Inserted into the root of the tongue, runs along its side, and is insensibly lost near its tip.

Use. To draw the tongue laterally and backward.

2. STYLO-HYOIDEUS.

Arises by a round tendon, from the middle and inferior part of the styloid process.

Inserted into the os hyoides at the junction of the base and cornu.

Use. To pull the os hyoides to one side, and a little upward.

N. B. Its fleshy belly is generally perforated by the tendon of the digastric muscle, on one or both sides. There is often another accompanying it, called *stylo-hyoideus alter*; which has the same origin, but not as Innes says, the same insertion; for it is fixed into the appendix of the os hyoides.

3. STYLO-PHARANGEUS,

Arises, fleshy, from the root of the styloid process.

Insertea into the side of the pharynx and back part of the thyroid cartilage.

Use. To dilate and raise the pharynx and thyroid cartilage upward.

The two from the pterygoid process are,

1. CIRCUMFLEXUS, OR TENSOR PALATI,

Arises from the spinous process of the sphenoid bone, behind the foramen ovale, which transmits the third branch of the fifth pair of nerves, and from the Eustachian tube, not far from its osseous part: it then runs down along the pterygoideus internus, passes over the hook of the internal plate of the pterygoid process by a round tendon, which soon spreads into a broad membrane.

Inserted into the velum pendulum palati, and the semilunar edge of the os palati, and extends as far as the suture which joins the two bones. Generally some of its posterior fibres join with the constrictor pharyngis superior, and palato-pharyngeus.

Use. To stretch the velum, to draw it downward, and to a side toward the hook. It has little effect upon the tube, being chiefly connected to its osseous part.

Circumflexus palati, Albinus, and Soemmerring.

Spheno-salpingo-staphilinus, seu *Staphilinus externus*, Winslow.

Musculus tubæ novus, Valsalva; vel *Palato-salpingeus*, Douglas.

2. LEVATOR PALATI,

Arises, tendinous and fleshy, 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.

Inserted into the whole length of the velum pendulum palati, as far as the root of the uvula, and unites with its fellow,

Use. To draw the velum upward and backward, so as to shut the passage from the fauces into the mouth and nose.

Levator palati mollis, Albinus, and Soemmerring.

Petro-salpingo-staphilinus, vel *Salpingo-staphilinus internus*, vulgo, Winslow.

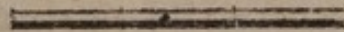
Salpingo-staphilinus, Valsalva. *Petrigo-staphilinus externus*, vulgo, Douglas.

Spheno-staphilinus, Cowper.

Previous to the description of the muscles situated about the passage into the throat, it will be necessary to mention the principal parts to which they are connected.

Upon looking into any person's mouth, when wide opened, we see a soft curtain hanging from the palate-bones, named *velum pendulum palati*. In the middle of which we likewise observe a papilla projecting from the velum, named *uvula*, or *pap of the throat*. From each side of the uvula, at its root, two arches, or columns, are sent down; the anterior to the root of the tongue, the posterior to the pharynx. Between these arches, on each side, the cellular glands called *amygdalæ* are situated.

The common opening behing the anterior arch may be named *fauces*, or *top of the throat*, from which there are six passages, viz. two upward, being one to each nostril: two at the sides, or one to each ear, called the *Eustachian tubes*: two downward; the anterior is the passage through the *glottis* and *larynx*, into the *trachea*, which terminates in the lungs; the posterior is the largest, named *pharynx*, or *top of the œsophagus*, which leads to the stomach.



MUSCLES SITUATED ABOUT THE ENTRY TO THE FAUCES.

THERE are two on each side, and a single one in the middle.

The two on each side are,

1. CONSTRICTOR ISTHMI FACIUM.

Arises, by a slender beginning from the side of the tongue, near its root; from thence running upward, within the anterior arch, before the amygdala, it is

Inserted into the middle of the velum pendulum palati, at the root of the uvula anteriorly, being connected with its fellow, and with the beginning of the palato-pharyngeus.

Use. To draw the velum toward the root of the tongue, which it raises at the same time, and, with its fellow, contracts the passage between the two arches, by which it shuts the opening into the fauces.

Glosso-staphilinus, Winslow and Douglas.

2. PALATO-PHARYNGEUS,

Arises, by a broad beginning, from the middle of the velum pendulum palati, at the root of the uvula posteriorly, and from the tendinous expansion of the circumflexus palati. The fibres are collected within the posterior arch behind the amagdala, and run backward to the top and lateral part of the pharynx, where the fibres are scattered, and mix with those of the stylopharyngeus.

Inserted into the edge of the upper and back part of the thyroid cartilage; some of its fibres being lost between the membrane of the pharynx and the two inferior constrictors.

Use. Draws the uvula and velum downward and backward; and at the same time pulls the thyroid cartilage and pharynx upward, and shortens it; with the constrictor superior and tongue, it assists in shutting the passage into the nostrils; and, in swallowing, it thrusts the food from the fauces into the pharynx.

Thyro-staphilinus, Douglas.

Thyro-pharyngo-staphilinus, Winslow.

SALPINEO-PHARYNGEUS of Albinus is composed of a few Fibres of this Muscle, which

Arise from the anterior and lower part of the cartilaginous extremity of the Eustachian tube ; and are

Inserted into the inner part of the last mentioned muscle.

Use. To assist the former, and to dilate the mouth of the tube.

The one in the middle is the

AZYGO SUVULÆ.

Arises, fleshy, from the extremity of the suture which joins the palate-bones, runs down the whole length of the velum and uvula, resembling a small earth-worm, and adhering to the tendons of the circumflexi.

Inserted into the tip of the uvula.

Use. Raises the uvula upward and forward, and shortens it.

Palato-staphilinus, Douglas.

Staphilinus, or *Epistaphilinus*, Winslow.

Musculus uvulæ, Soemmerring.

MUSCLES SITUATED ON THE POSTERIOR PART OF THE PHARYNX.

OF these there are three pair.

1. CONSTRICTOR PHARYNGIS INFERIOR,

Arises from the side of the thyroid cartilage, near the attachment of the sterno-hyoideus and thyreo-hyoideus muscles ; and from the cricoid cartilage, near the crico-thyroideus. This muscle is the largest of the three, and is

Inserted into the white line, where it joins with its fellow ;

the superior fibres running obliquely upward, covering nearly one half of the middle constrictor; and terminating in a point; the inferior fibres running more transversely, and covering the beginning of the œsophagus.

Use. To compress that part of the pharynx which it covers, and to raise it with the larynx a little upward.

Thyro-pharyngeus, Crico-pharyngeus, Douglas.

2. CONSTRICTOR PHARYNGIS MEDIUS,

Arises from the appendix of the os hyoides, from the cornu of that bone, and from the ligament which connects it to the thyroid cartilage; the fibres of the superior part running obliquely upward, and, covering a considerable part of the superior constrictor, terminate in a point.

Inserted into the middle of the cuneiform process of the os occipitis, before the foramen magnum, and joined to its fellow at a white line in the middle back part of the pharynx. The fibres at the middle part run more transversely than those above or below.

Use. To compress that part of the pharynx which it covers, and to draw it and the os hyoides upward.

Hyo-pharyngeus, Syndesmo-pharyngeus, Douglas.

3. CONSTRICTOR PHARYNGIS SUPERIOR,

Arises, above, from the cuneiform process of the os occipitis, before the foramen magnum, near the holes where the ninth pair of nerves passes out; lower down, from the pterygoid process of the sphenoid bone; from the upper and under jaw, near the roots of the last dentes molares; and between the jaws, it is continued with the buccinator muscle; and with some fibres from the root of the tongue and from the palate.

Inserted into a white line in the middle of the pharynx, where it joins with its fellow, and is covered by the constrictor medius.

Use. To compress the upper part of the pharynx, and draw it forward and upward.

Cephalo-pharyngeus, Pterygo-pharyngeus, Mylo-pharyngeus, Glosso-pharyngeus, Douglas.

MUSCLES SITUATED ABOUT THE GLOTTIS.

THEY consist generally of four or five pairs of small muscles, and a single one.

1. CRICO-ARYTÆNOIDEUS POSTICUS,

Arises, fleshy, from the back part of the cricoid cartilage, and is

Inserted into the posterior part of the base of the arytenoid cartilage.

Use. To open the rima glottidis a little, and, by pulling back the arytenoid cartilage, to stretch the ligament so as to make it tense.

Dilatator glottidis posterior, Soemmerring.

2. CRICO-ARYTÆNOIDEUS LATERALIS.

Arises, fleshy, from the cricoid cartilage, laterally, where it is covered by part of the thyroid, and is

Inserted into the side of the base of the arytenoid cartilage near the former.

Use. To open the rima glottidis, by pulling the ligaments from each other.

3. THYREO-ARYTÆNOIDEUS MAJOR.

Arises from the under and back part of the middle of the thy-

roid cartilage ; and, running backward and a little upward, along the side of the glottis, is

Inserted into the arytenoid cartilage, higher up and farther forward than the crico-arytænoideus lateralis.

Use. To pull the arytenoid cartilage forward nearer to the middle of the thyroid, and consequently to shorten and relax the ligament of the larynx or glottis vera.

4. THYREO-ARYTÆNOIDEUS MINOR.

Arises from the thyroid cartilage near its incisura cordiformis, and ascends to be

Inserted into the arytenoid cartilage.

Use. The same as that of the former.

This muscle is omitted by Innes.

5. ARYTÆNOIDEUS OBLIQUUS.

Arises from the base of one arytenoid cartilage ; and, crossing its fellow, is

Inserted near the tip of the other arytenoid cartilage.

Use. When both act, they pull the arytenoid cartilages toward each other.

N. B. Very often one of these is wanting.

Arytænoideus minor, Douglas.

The single muscle is the

ARYTÆNOIDEUS TRANSVERSUS.

Arises from the side of one arytenoid cartilage, from near its articulation with the cricoid to near its tip. The fibres run straight across, and are

Inserted, in the same manner, into the other arytenoid cartilage.

Use. To shut the rima glottidis, by bringing these two cartilages, with the ligaments, nearer one another.

Arytænoideus major, Douglas.

Besides these, there are a few disgregated muscular fibres on each side; which, from their general direction, are named,

1. THYREO-EPIGLOTTIDEUS MAJOR,

Arises, by a few pale disgregated fibres from the thyroid cartilage; and is

Inserted into the epiglottis laterally.

Use. To draw the epiglottis obliquely downward, or, when both act, directly downward; and, at the same time, it expands that soft cartilage.

Thyreoepiglotticus major, Soemmerring.

2. THYREO-EPIGLOTTIDEUS MINOR.

Arises just above the former, and is

Inserted into the side of the epiglottis above its root.

Use. To assist the former.

Thyreoepiglotticus minor, Soemmerring.

This muscle is omitted by Innes.

3. ARYTÆNO-EPIGLOTTIDEUS.

Arises, by a number of small fibres, from the lateral and upper part of the arytenoid cartilage; and, running along the outer side of the external rima, is

Inserted into the epiglottis along with the former.

Use. To pull that side of the epiglottis toward the external rima; or, when both act, to pull it close upon the glottis. It is counteracted by the elasticity of the epiglottis.

MUSCLES SITUATED ON THE ANTERIOR PART OF THE ABDOMEN.

THEY consist of three broad layers on each side of the belly ; always a long one, and generally also a short one, on each side of the linea alba.

The three layers are,

1. OBLIQUUS DESCENDENS EXTERNUS,

Arises, by eight heads, from the lower edges of an equal number of inferior ribs, at a little distance from their cartilages : it always intermixes, in a serrated manner, with portions of the serratus major anticus ; and generally coheres to the pectoralis major, intercostals, and latissimus dorsi ; which last covers the edge of a portion of it extended from the last rib to the spine of the os ilium. From these origins the fibres run down obliquely forward, and terminate in a thin broad tendon, whose fibres are continued in the same direction.

Inserted into the whole length of the *linea alba*, which is formed by the tendinous fibres of the two oblique and transverse muscles, interlaced with those of the opposite side, the whole way from the cartilago ensiformis to the os pubis ; becomes thicker toward the lower part of the abdomen, and is perforated in the middle by the umbilicus. On the outside of the rectus muscle, the tendon of the external oblique appears whiter than elsewhere, by its being there connected with the tendons of the internal oblique and transverse muscles ; so that this part has been called *Linea semilunaris*, from its curved shape. The under part of the tendon divides into two columns, which leaves an oval space between them, named the *ring* of the external oblique muscle, for the passage of the spermatic cord in the male, or round ligament of the womb in the female : the anterior superior column passes over the cartilage between the ossa

pubis and is fixed to the opposite os pubis ; the other is fixed to the os pubis of the same side. It is also inserted, tendinous and fleshy, into the middle of the spine of the ilium.

From that part, which is named its *anterior superior spinous process*, it is stretched tendinous to the os pubis, and is named *Poupart's* or *Fallopian's* ligament. From this ligament it sends a tendinous layer, which is lost in the membranous fascia of the thigh.

Use. Supports and compresses the peritonæum and abdomen ; assists in the evacuations of fæces and urine, and likewise in the exclusion of the foetus ; thrusts the diaphragm upward, and draws down the ribs in expiration ; bends the body obliquely when the ribs are fixed, and raises the pelvis obliquely.

Obliquus externus abdominis, Albinus, and Soemmerring.

Obliquus descendens, Douglas.

2. OBLIQUUS ASCENDENS INTERNUS,

Arises from the spine of the ilium, the whole length between the posterior and superior anterior spinous process ; from the os sacrum and the three undermost lumbar vertebræ, by a tendon common to it and to the serratus posticus inferior ; from Poupart's ligament, at the middle of which it sends off the beginning of the cremaster muscle : the spermatic cord in the male, or round ligament of the womb in the female, passes under its thin edge, except a few detached fibres.

Inserted into the cartilago ensiformis, into the cartilages of the seventh and those of all the false ribs ; but, at the upper part, it is extremely thin, resembling a cellular membrane, and only becomes fleshy at the cartilage of the tenth rib. Here its tendon divides into two layers ; the anterior layer, with a great portion of the inferior part of the posterior layer, joins the tendon of the external oblique, and runs over the rectus to be inserted into the whole length of the linea alba. The posterior layer joins the tendon of the transversalis muscle as low as half-way between the umbilicus and os pubis ; but, below this place, only a few fibres of the posterior layer are seen, and the rest of

it passes before the rectus muscle, and is inserted into the linea alba; so that the whole tendon of the external oblique muscle, with the anterior layer of the internal oblique, passes before the rectus muscle; and the whole posterior layer of the internal oblique, together with the whole tendon of the transversalis muscle, excepting at the inferior part, pass behind the rectus, and are inserted into the linea alba. At its undermost part it is inserted into the forepart of the os pubis.

Use. To assist the former; but it bends the trunk in the reverse direction.

Obliquus internus abdominis, Albinus, Winslow, and Soemmerring.

Obliquus ascendens, Douglas.

3. TRANSVERSALIS.

Arises tendinous, but soon becoming fleshy from the inner or back part of the cartilages of the seven lower ribs, where some of its fibres are continued with those of the diaphragm and the intercostal muscles; by a broad thin tendon, connected to the transverse processes of the last vertebra of the back, and the four superior vertebræ of the loins: fleshy, from the whole spine of the os ilium internally, and from the tendon of the external oblique muscle, where it intermixes with some fibres of the internal oblique.

Inserted into the cartilago ensiformis, and into the whole length of the linea alba, excepting its lowermost part.

Use. To support and compress the abdominal bowels; and it is so particularly well adapted for the latter purpose, that it might be called the *proper constrictor* of the abdomen.

Transversus abdominis, Albinus, and Soemmerring.

The long muscle in the middle is named,

RECTUS ABDOMINIS.

Arises, by two heads, from the ligament of the cartilage which joins the two ossa pubis to each other; runs upward the whole

length of, and parallel to, the linea alba, growing broader and thinner as it ascends.

Inserted into the cartilages of the three inferior true ribs, and often intermixes with some fibres of the pectoral muscle.

It is generally divided by three tendinous intersections; the first is at the umbilicus, the second where it runs over the cartilage of the seventh rib, the third in the middle between these; and there is commonly a half intersection below the umbilicus: these seldom penetrate through the whole thickness of the muscle; they adhere firmly to the anterior part of the sheath; but very slightly to the posterior layer.

Use. To compress the forepart, but more particularly the lower part of the belly; to bend the trunk forward, or to raise the pelvis. By its tendinous intersections, it is enabled to contract at any of the intermediate spaces; and, by its connection with the tendons of the other muscles, it is prevented from changing place, and from rising into a prominent form when in action.

The short muscle in the middle is named

PYRAMIDALIS.

Arises along with the rectus; and, running upward within the same sheath, is

Inserted, by an acute termination, near half-way between the os pubis and umbilicus, into the linea alba and inner edge of the rectus muscle.

As it is frequently wanting in both sides, without any incon-
veniency, its

Use seems to be, to assist the inferior part of the rectus.

MUSCLES ABOUT THE MALE ORGANS OF GENERATION.

THE *testicles* are said to have a thin muscle common to both, and have one proper to each.

The supposed common muscle is called the

DARTOS.

This appears to be no more than a condensation of the cellular membrane lining the scrotum; yet the skin here is capable of being corrugated and relaxed in a greater degree than in other places.

The muscle proper to each testicle is the

CREMASTER.

Arises from the internal oblique, where a few fibres of that muscle intermix with the transversalis, near the junction of the os ilium and pubis, over which part it passes, after having pierced the ring of the external oblique; and then it descends upon the spermatic cord.

Inserted into the tunica vaginalis of the testicle, upon which it spreads, and is insensibly lost.

Use. To suspend and draw up the testicle, and to compress it in the act of coition.

The penis has five pairs of muscles,

1. ERECTOR PENIS.

Arises, tendinous and fleshy, from the tuberosity of the os ischium, and runs upward, embracing the whole crus of the penis.

Inserted into the strong tendinous membrane that covers the corpora cavernosa penis, near as far up as the union of these bodies.

Use. To compress the crus penis, by which the blood is pushed from it into the forepart of the corpora cavernosa; and the penis is by that means more completely distended. The erectores seem likewise to keep the penis in its proper direction.

Ischio cavernosus, Winslow.

Ischio cavernosus sive Erector Penis, Soemmerring.

2. ACCELERATOR URINÆ, SEU EJACULATOR SEMINIS.

Arises, fleshy, from the sphincter ani and membranous part of the urethra; and tendinous from the crus, near as far forward as the beginning of the corpus cavernosum penis; the inferior fibres run more transversely, and the superior descend in an oblique direction.

Inserted into a line in the middle of the bulb, where it joins with its fellow, by which the bulb is completely enclosed.

Use. To drive the urine or semen forward; and, by grasping the bulb of the urethra, to push the blood toward its corpus cavernosum and the glans, by which they are distended.

Bulbo-cavernosus, Winslow.

3. COMPRESSOR PROSTATÆ.

Arises above the levator ani, from the internal part of the os pubis, between the lower part of the symphysis and the upper part of the foramen ovale.

It surrounds the prostate, and is lost between it and the rectum.

Use. To compress the inferior part of the prostate.

This muscle is omitted by Innes. It often seems to be a part of the levator ani.

4. TRANSVERSUS PERINEI,

Arises from the tough fatty membrane that covers the tube-

rosity of the os ischium; thence it runs transversely inward, and is

Inserted into the accelerator urinæ, and into that part of the sphincter ani which covers the bulb.

Use. To dilate the bulb, and draw the perineum and verge of the anus a little outward and backward.

Transversalis urethræ, Winslow.

Transversus perinei, Albinus.

Levator parvus, seu *externus*, Douglas.

5. TRANSVERSUS PERINEI ALTER.

Arises behind the former, runs more obliquely forward, and is

Inserted into that part of the accelerator urinæ which covers the anterior part of the bulb of the urethra.

Use. To assist the former.

Inferior protate, Winslow.

MUSCLES OF THE ANUS.

THE *anus* has two single muscles, and one pair.

The single muscles are

1. SPHINCTER ANI EXTERNUS.

Arises from the skin and fat that surround the verge of the anus on both sides, near as far out as the tuber of the os ischium; the fibres are gradually collected into an oval form, and surround the extremity of the rectum.

Inserted, before, by a narrow point, into the perineum, acceleratores urinæ, and transversus perinei; behind, by an acute termination, into the extremity of the os coccygis.

Use. Shuts the passage through the anus into the rectum ; and pulls down the bulb of the urethra, by which it assists in dejecting the urine and semen.

Sphincter cutaneus, Winslow.

2. SPHINCTER ANI INTERNUS.

A thick and strong fleshy ring, which, surrounded by the sphincter externus, encloses the commencement of the anus.

It may properly enough be considered that part of the circular fibres of the rectum, which surround its extremity, but, at the same time it ought undoubtedly to be reckoned a distinct muscle.

LEVATOR ANI,

Arises from the os pubis within the pelvis, as far up as the upper edge of the foramen thyroideum, and joining of the os pubis with the os ischium ; from the thin tendinous membrane that covers the obdurator internus and coccygeus muscles ; from the spinous process of the os ischium ; and its fibres run down like rays from a circumference to a centre.

Inserted into the sphincter ani, acceleratores urinæ, and anterior part of the two last bones of the os coccygis ; surrounds the extremity of the rectum, neck of the bladder, prostate gland, and part of the vesiculæ seminales ; so that its fibres behind and below the os coccygis joining it with its fellow, they together very much resemble the shape of a funnel.

Use. To draw the rectum upward after the evacuation of the fæces, and to assist in shutting it ; to sustain the contents of the pelvis, and to help in ejecting the semen, urine, and contents of the rectum ; and, perhaps, by pressing upon the veins, to contribute greatly to the erection of the penis.

MUSCLES OF THE FEMALE ORGANS OF GENERATION.

THE *clitoris* has one pair,

ERECTOR CLITORIDIS.

Arises from the crus of the os ischium internally, and in its ascent covers the crus of the clitoris as far up as the os pubis.

Inserted into the upper part of the crus and body of the clitoris.

Use. Draws the clitoris downward and backward; and may serve to make the body of the clitoris more tense, by squeezing the blood into it from its crus.

First muscle of the clitoris, Douglas.

The *vagina* has one pair,

SPHINCTER VAGINÆ.

Arises from the sphincter ani, and from the posterior side of the vagina, near the perineum; thence it runs up to the side of the vagina, near its external orifice, opposite to the nymphæ, and covers the corpus cavernosum vaginæ.

Inserted into the crus and body, or union of the crura clitoridis.

Use. Contracts the mouth of the vagina, and compresses its corpus cavernosum.

Constrictor cunni, Albinus, and Soemmerring.

Second muscle of the clitoris, Douglas.

The urethra has one muscle.

DEPRESSOR URETHRÆ.

Extends transversely from one crus of the pubis to the other, involving the urethra.—Its name indicates its use.

This muscle is omitted by Innes.

The perineum has two pairs.

1. TRANSVERSUS PERINEI,

Arises, as in the male, from the fatty cellular membrane which covers the tuberosity of the os ischium.

Inserted into the upper part of the sphincter ani, and into a white hardish tough substance in the perineum, between the lower part of the pudendum and anus.

Use. To sustain and keep the perineum in its proper place.

2. TRANSVERSUS PERINEI ALTER,

Arises as the former, but is

Inserted into the side of the vagina.

Use. To assist the former.

The anus, as in the male, has two single muscles, and one pair.

1. SPHINCTER ANI EXTERNUS,

Arises, as in the male, from the skin and fat surrounding the extremity of the rectum.

Inserted, above, into the white tough substance of the perineum; and below, into the point of the os coccygis.

Use. To shut the passage into the rectum; and, by pulling

down the perineum, to assist in contracting the mouth of the vagina.

2. SPHINCTER ANI INTERNUS.

It exactly resembles that of the male.

LEVATOR ANI,

Arises, as in the male, within the pelvis, and descends along the inferior part of the vagina and rectum.

Inserted into the perineum, sphincter ani, extremity of the vagina, and rectum.

Use. To raise the extremity of the rectum upward, to contract the inferior part of the rectum, and to assist in contracting and supporting the vagina; and, perhaps, by pressing on the veins, to contribute to the distention of the cells of the clitoris and corpus cavernosum of the vagina.

MUSCLES SITUATED WITHIN THE PELVIS.

OF these there are three pairs.

1. OBTURATOR INTERNUS,

Arises from more than one half of the internal circumference of the foramen thyroideum, formed by the os pubis and ischium: its inside is covered by a portion of the levator ani; and appears to be divided into a number of fasciculi, which unite and form a roundish tendon, that passes out of the pelvis, between the posterior sacro ischiatic ligament and tuberosity of the os ischium: where it passes over the capsular ligament of the

thigh bone, it is enclosed, as in a sheath, by the gemini muscles.

Inserted, by a round tendon, into the large pit at the root of the trochanter major.

Use. To roll the os femoris obliquely outward.

Marsupialis, seu *Obturator internus*, Douglas.

N. B. The insertion of this muscle should not be prosecuted, until the muscles of the thigh, to which it belongs, are dissected.

2. COCCYGEUS.

Arises, tendinous and fleshy, from the spinous process of the os ischium, and covers the inside of the posterior sacro-ischiatic ligament ; from this narrow beginning, it gradually increases, to form a thin fleshy belly, interspersed with tendinous fibres.

Inserted into the extremity of the os sacrum, and near the whole length of the os coccygis laterally.

Use. To support and move the os coccygis forward, and to tie it more firmly to the sacrum.

3. CURVATOR COCCYGIS.

Arises from the internal, lateral and inferior part of the last bone of the sacrum, and from the internal and lateral part of the first bone of the os coccygis ; and is

Inserted into the second, third, but principally into the fourth bone of the coccyx, having first joined its fellow.

Use. To curve the coccyx.

This muscle is omitted by Innes.

*MUSCLES SITUATED WITHIN THE CAVITY OF THE
ABDOMEN.*

THESE consist of a single muscle, and four pairs.

DIAPHRAGMA.

This broad thin muscle, which makes a complete septum between the thorax and abdomen, is concave below and convex above ; the middle of it on each side reaching as high within the thorax of the skeleton as the fourth rib, and is commonly divided into two portions.

1. THE SUPERIOR, OR GREATER MUSCLE OF THE
DIAPHRAGM,

Arises, by distinct fleshy fibres, from the cartilago ensiformis, from the cartilages of the seventh, and of all the inferior ribs on both sides. The fibres from the cartilago ensiformis, and from the seventh and eighth ribs, run obliquely upward and backward ; from the ninth and tenth, transversely inward and upward ; and from the eleventh and twelfth, obliquely upward. From these different origins the fibres run, like radii from the circumference to the centre of a circle ; and are

Inserted into a cordiform tendon, of a considerable breadth, which is situated in the middle of a diaphragm ; and in which, therefore, the fibres from opposite sides are interlaced. Toward the right side the tendon is perforated, by a triangular hole, for the passage of the vena cava inferior ; and to the upper convex part of it the pericardium and mediastinum are connected.

2. THE INFERIOR, LESSER MUSCLE, OR APPENDIX OF THE
DIAPHRAGM,

Arises from the second, third, and fourth lumbar vertebræ, by eight heads ; of which two in the middle, commonly called its

crura, are the longest, and begin tendinous. Between the *crura*, the aorta and thoracic duct pass; and, on the outside of these, the great sympathetic nerves and branches of the vena azygos perforate the shorter heads. The muscular fibres run obliquely upward and forward, and form in the middle two fleshy columns, which decussate and leave an oval space between them for the passage of the œsophagus and eighth pair of nerves.

Inserted, by strong fleshy fibres, into the posterior part of the middle tendon.

Use. The diaphragm is the principal agent in respiration, particularly in inspiration: for when it is in action, the fibres, from their different attachments, endeavour to bring themselves into a plane toward the middle tendon, by which the cavity of the thorax is enlarged, particularly at the sides, where the lungs are chiefly situated; and as the lungs must always be contiguous to the inside of the thorax and upper side of the diaphragm, the air rushes into them, in order to fill up the increased space. This muscle is assisted by the two rows of intercostals, which elevate the ribs, and the cavity of the thorax is more enlarged. In time of violent exercise, or whatever cause drives the blood with unusual celerity towards the lungs, the pectoral muscles, the serrati antici majores, the serrati postici superiores, and scaleni muscles, are brought into action. And in laborious inspiration, the muscles which arise from the upper part of the thorax, when the parts into which they are inserted are fixed, likewise assist. In expiration, the diaphragm is relaxed and pushed up by the pressure of the abdominal muscles upon the viscera of the abdomen; and at the same time that they press it upward, they also, together with the sternocostales and serrati postici inferiores, pull down the ribs, and are assisted in a powerful manner by the elasticity of the cartilages that join the ribs to the sternum; by which the cavity of the thorax is diminished, and the air suddenly pushed out of the lungs: and, in laborious expiration, the quadrati lumborum, sacrolumbales, and longissimi dorsi, concur in pulling down the ribs.

The four pairs are,

1. QUADRATUS LUMBORUM,

Arises, pretty broad, tendinous and fleshy, from the posterior part of the spine of the os ilium.

Inserted into the transverse processes of all the vertebræ of the loins, into the last rib near the spine, and by a small tendon into the side of the last vertebra of the back.

Use. To move the loins to one side, pull down the last rib, and when both act, to bend the loins forward.

Quadratus, seu *Lumbaris externus*, Winslow.

2. PSOAS PARVUS,

Arise, fleshy, from the sides of the two upper vertebræ of the loins, and sends off a small long tendon, which ends thin and flat, and is

Inserted into the brim of the pelvis, at the junction of the os ilium and pubis.

Use. To assist the psoas magnus in bending the loins forward; and, in certain positions, to assist in raising the pelvis.

N. B. This muscle is very often wanting.

Psoas minor, Soemmerring.

3. PSOAS MAGNUS,

Arises, fleshy, from the side of the body, and transverse process of the last vertebra of the back; and, in the same manner, from all those of the loins, by as many distinct slips.

Inserted, tendinous, into the trochanter minor of the os femoris; and fleshy into that bone, a little below the same trochanter.

Use. To bend the thigh forward; or, when the inferior extremity is fixed, to assist in bending the body.

Psoas, seu *Lumbaris inturnus*, Winslow.

Psoas major, Soemmerring.

4. ILIACUS INTERNUS,

Arises, fleshy, from the transverse process of the last vertebra of the loins, from all the inner lip of the spine of the os ilium, from the edge of that bone between its anterior superior spinous process and the acetabulum, and from most of the hollow part of the ilium. It joins with the psoas magnus, where it begins to become tendinous; and is

Inserted along with it.

Use. To assist the psoas in bending the thigh, and to bring it directly forward.

N. B. The insertion of the two last muscles should not be prosecuted till the muscles of the thigh are dissected.

MUSCLES SITUATED ON THE ANTERIOR PART OF THE THORAX.

THESE may be divided into two layers. The first layer consists of one muscle, named

PECTORALIS MAJOR,

Arises from the cartilaginous extremities of the fifth and sixth ribs, where it always intermixes with the external oblique muscle of the abdomen; from almost the whole length of the sternum, and from near half of the anterior part of the clavicle: the fibres run toward the axilla in a folding manner.

Inserted, by two broad tendons, which cross each other at the upper and inner part of the os humeri, above the insertion of the deltoid muscle, and outer side of the groove for lodging the tendon of the long head of the biceps.

Use. To move the arm forward, and obliquely upward, toward the sternum.

Pectoralis, Albinus.

The second layer consists of three muscles :

1. SUBCLAVIUS,

Arises tendinous from the cartilage that joins the first rib to the sternum.

Inserted, after becoming fleshy, into the inferior part of the clavicle, which it occupies from within an inch or so of the sternum, as far outward as to its connection, by ligament, with the coracoid process of the scapula.

Use. To pull the clavicle downward and forward.

2. PECTORALIS MINOR,

Arises, tendinous and fleshy, from the upper edge of the third, fourth, and fifth ribs, near where they join with their cartilages.

Inserted, tendinous, into the coracoid process of the scapula ; but soon grows fleshy and broad.

Use. To bring the scapula forward and downward, or to raise the ribs upward.

Serratus anticus, Albinus.

Serratus minor anticus, Douglas.

3. SERRATUS MAGNUS,

Arises from the nine superior ribs, by an equal number of fleshy digitations, resembling the teeth of a saw.

Inserted, fleshy, into the whole base of the scapula internally, between the insertion of the rhomboid and the origin of the subscapularis muscles, being folded about the two angles of the scapula.

Use. To move the scapula forward ; and, when the scapula is forcibly raised, to draw upward the ribs.

Serratus major anticus, Douglas.

*MUSCLES SITUATED BETWEEN THE RIBS AND
WITHIN THE THORAX.*

BETWEEN the ribs, on each side, there are eleven double rows of muscles, which are therefore named *intercostals*. These decussate each other like the strokes of the letter X.

1. INTERCOSTALES EXTERNI,

Arise from the inferior acute edge of each superior rib, and run obliquely forward, the whole length from the spine to near the joining of the ribs with their cartilages ; from which, to the sternum, there is only a thin membrane covering the internal intercostals.

Inserted into the upper obtuse edge of each inferior rib, as far back as the spine, into which the posterior portion is fixed.

INTERCOSTALES INTERNI,

Arise in the same manner as the external : but they begin at the sternum, and run obliquely backward, as far as the angle of the rib ; and from that to the spine they are wanting.

Inserted in the same manner as the external.

Use. By means of these muscles, the ribs are equally raised upward during inspiration. Their fibres being oblique, give them a greater power of bringing the ribs near each other, than could be performed by straight ones. But, by the obliquity of the fibres, they are almost brought contiguous : and as the fixed points of the ribs are before and behind, if the external had been continued forward to the sternum, and the internal backward to the spine, it would have hindered their motion, which is greatest in the middle, though the obliquity of the ribs renders it less perceptible ; and, instead of raising the fibres fixed to the sternum and spine, would have depressed the ribs.

N. B. The portions of the external intercostals which arise from the transverse processes of the vertebræ where the ribs are

fixed to them, and other portions that pass over one rib and terminate in the next below it, Albinus calls *LEVATORES COSTARUM LONGIORES, ET BREVIORES*.

The portions of the internal that pass over one rib, and are inserted into the next below it, Douglas calls *COSTARUM DEPRESSORES PROPRII*.

These portions of both rows assist in raising the ribs in the same manner as the rest of the intercostals.

Supra costales, and *Infra costales*, Winslow.

The muscles within the thorax are one pair, viz.

TRIANGULARIS, OR STERNO-COSTALIS,

Arises, fleshy, and a little tendinous, from all the length of the cartilago ensiformis laterally, and from the edge of the lower half of the middle bone of the sternum, from whence its fibres ascend obliquely upward and outward.

Inserted, generally by three triangular terminations, into the lower edge of the cartilages of the third, fourth, and fifth ribs, near where these join with the ribs.

Use. To depress these cartilages, and the extremities of the ribs; and consequently to assist in contracting the cavity of the thorax.

This muscle often varies; and is sometimes inserted into the cartilage of the second rib, sometimes into the cartilage of the sixth rib.

MUSCLES SITUATED ON THE ANTERIOR PART OF THE NECK CLOSE TO THE VERTEBRÆ.

THESE consist of one layer formed by four muscles.

1. LONGUS COLLI,

Arises, tendinous and fleshy, from the bodies of the three superior vertebræ of the back laterally; and from the the transverse process of the third, fourth, fifth, and sixth vertebræ of the neck, near their roots.

Inserted into the forepart of the bodies of all the vertebræ of the neck, by as many small tendons, which are covered with flesh.

Use. To bend the neck gradually forward, and to one side.

2. RECTUS CAPITIS INTERNUS MAJOR,

Arises, from the anterior points of the transverse processés of the third, fourth, fifth, and sixth vertebræ of the neck, by four distinct beginnings.

Inserted into the cuneiform process of the os-occipitis, a little before the condyloid process.

Use. To bend the head forward.

Rectus anterior longus, Winslow.

Rectus capitis anticus Major, Soemmerring.

3. RECTUS CAPITIS INTERNUS MINOR,

Arises, fleshy, from the forepart of the body of the first vertebra of the neck, opposite to the superior oblique process.

Inserted near the root of the condyloid process of the os occipitis, under, and a little farther outward than, the former muscle.

Use. To nod the head forward.

Rectus anterior brevis, Winslow.

Rectus capitis anticus Minor, Soemmerring.

4. RECTUS CAPITIS LATERALIS,

Arises, fleshy, from the anterior part of the point of the transverse process of the first vertebra of the neck.

Inserted into the os occipitis, opposite to the foramen stylomastoideum of the temporal bone.

Use. To bend the head a little to one side.

Transversalis anticus primus, Winslow.

MUSCLES SITUATED ON THE POSTERIOR PART OF THE TRUNK.

THESE may be divided into four layers, and a single pair.

The first layer consists of two muscles, which cover almost the whole posterior part of the trunk.

1. TRAPEZIUS SEU CUCULARIS,

Arises, by a strong round tendon, from the lower part of the protuberance in the middle of the os occipitis behind ; and, by a thin membranous tendon, which covers part of the splenius and complexus muscles, from the rough curved line that extends from the protuberance toward the mastoid process of the temporal bone ; runs down along the nape of the neck, where it seems to arise from its fellow, and covers the spinous processes of the superior vertebræ of the neck ; but rises from the spinous processes of the two inferior, and from the spinous processes of all the vertebræ of the back ; adhering, tendinous, to its fellow, the whole length of its origin.

Inserted, fleshy, into the posterior half of the clavicle ; tendinous and fleshy, into the acromion, and into almost all the spine of the scapula.

Use. Moves the scapula according to the three different directions of its fibres ; for the upper descending fibres draw it obliquely upward, the middle transverse straight fibres draw it directly backward, and the inferior ascending fibres draw it obliquely downward and backward.

N. B. Where it is inseparably united to its fellow in the nape of the neck, it is named *Ligamentum Nuchæ* or *Colli*.

2. LATISSIMUS DORSI,

Arises, by a broad thin tendon, from the posterior part of the spine of the os ilium, from all the spinous processes of the os sacrum and vertebræ of the loins, and from the seven inferior ones of the vertebræ of the back; also, tendinous and fleshy, from the extremities of the three or four inferior ribs, a little beyond their cartilages, by as many distinct slips. The inferior fibres ascend obliquely, and the superior run transversely, over the inferior angle of the scapula, toward the axilla, where they are all collected, twisted, and folded.

Inserted, by a strong thin tendon, into the inner edge of the groove for lodging the tendon of the long head of the biceps.

Use. To pull the arm backward and downward, and to roll the os humeri.

N. B. The insertion of this muscle should not be prosecuted till the muscles of the os humeri, to which it belongs, are dissected.

The second layer consists of three pair, two on the back, and one on the neck.

On the back,

1. SERRATUS POSTICUS INFERIOR,

Arises, by a broad thin tendon, in common with that of the latissimus dorsi, from the spinal processes of the two inferior vertebræ of the back, and from the three superior of the loins.

Inserted into the lower edges of the four inferior ribs, at a little distance from their cartilages, by as many distinct fleshy lips.

Use. To depress the ribs into which it is inserted.

2. RHOMBOIDEUS.

This muscle is divided into two portions.

1. *Rhomboideus major*, arise, tendinous, from the spinous processes of the five superior vertebræ of the back.

Inserted into all the basis of the scapula below its spine.

Use. To draw the scapula obliquely upward, and directly inward.

2. *Rhomboideus minor*, arises, tendinous, from the spinous processes of the three inferior vertebræ of the neck, and from the ligamentum nuchæ.

Inserted into the base of the scapula, opposite to its spine.

Use. To assist the former.

On the neck,

3. SPLENIUS.

Arises, tendinous, from the four superior spinous processes of the vertebræ of the back; tendinous and fleshy, from the five inferior of the neck, and adheres firmly to the ligamentum nuchæ. At the third vertebra of the neck, the splenii recede from each other, so that part of the complexus muscle is seen.

Inserted, by as many tendons, into the five superior transverse processes of the vertebræ of the neck; and tendinous and fleshy, into the posterior part of the mastoid process, and into the os occipitis, where it joins with the root of that process.

Use. To bring the head and upper vertebræ of the neck backward laterally: and, when both act, to pull the head directly backward.

N. B. Albinus divides this muscle into two; viz. That portion which arises from the five inferior spinous processes of the neck, and is inserted into the mastoid process and os occipitis, he calls *splenius capitis*; and that portion which arises from the third and fourth of the back, and is inserted into the five

superior transverse processes of the neck, is called by him *splenius colli*, and by Soemmerring, *splenius cervicis*.

The single pair,

SERRATUS SUPERIOR POSTICUS.

Arises, by a broad thin tendon, from the spinous processes of the three last vertebræ of the neck, and the two uppermost of the back.

Inserted into the second, third, fourth, and fifth ribs, by as many fleshy lips.

Use. To elevate the ribs, and dilate the thorax.

The third layer consists of three pair on the back, and three on the neck.

On the back,

1. SPINALIS DORSI,

Arises from the spinous processes of the two uppermost vertebræ of the loins, and the three inferior of the back by as many tendons.

Inserted into the spinous processes of the nine uppermost vertebræ of the back, except the first, by as many tendons.

Use. To erect and fix the vertebræ, and to assist in raising the spine.

2. LONGISSIMUS DORSI.

Arises, tendinous without, and fleshy within, from the side, and all the spinous processes of the os sacrum; from the posterior spine of the os ilium; from all the spinous processes; and from the roots of the transverse processes of the vertebræ of the loins.

Inserted into all the transverse processes of the vertebræ of the back, chiefly by small double tendons; also, by a tendinous

and fleshy slip, into the lower edge of all the ribs, except the two inferior, at a little distance from their tubercles.

Use. To extend the vertebræ, and to raise and keep the trunk of the body erect.

N.B. From the upper part of this muscle there runs up a round fleshy portion which joins with the cervicalis descendens.

3. SACRO LUMBALIS.

Arises, in common with the longissimus dorsi.

Inserted into all the ribs, where they begin to be curved forward, by as many long and thin tendons; and,

From the upper part of the six or eight lower ribs, arise as many bundles of thin fleshy fibres, which soon terminate in the inner side of this muscle, and are named *musculi ad sacro-lumbalem accessorii*.

Use. To pull the ribs down, and assist to erect the trunk of the body.

N.B. There is a fleshy slip which runs from the upper part of this muscle into the fourth, fifth, and sixth transverse processes of the vertebræ of the neck, by three distinct tendons: it is named *cervicalis descendens*, and by Soemmerring, *descendens cervicis*; and its use is to turn the neck obliquely backward, and to one side.

This and the preceding are also called by Soemmerring, *Lum-cocostalis seu erector dorsi*.

On the neck,

1. COMPLEXUS.

Arises from the transverse processes of the seven superior vertebræ of the back, and four inferior of the neck, by as many distinct tendinous origins; in its ascent it receives a fleshy slip from the spinous process of the first vertebræ of the back: from

these different origins it runs upward, and is every where intermixed with tendinous fibres.

Inserted, tendinous and fleshy, into the inferior edge of the protuberance in the middle of the os occipitis, and into a part of the curved line that runs forward from that protuberance.

Use. To draw the head backward, and to one side; and, when both act, to draw the head directly backward.

N. B. The long portion of this muscle that is situated next the spinous processes, lies more loose, and has a roundish tendon in the middle of it; for which reason Albinus and Soemmerring call it *biventer cervicis*.

2. TRACHELO-MASTOIDEUS,

Arises from the transverse processes of the three uppermost vertebræ of the back, and from the five lowermost of the neck, where it is connected to the transversalis cervicis, by as many thin tendons, which unite into a belly, and run up under the splenius.

Inserted into the middle of the posterior side of the mastoid process, by a thin tendon.

Use. To assist the complexus; but it pulls the head more to a side.

Complexus minor, seu Mastoideus lateralis, Winslow.

Trachelo-mastoideus, seu Capitis par tertium Fallopii, Douglas.

3. LEVATOR ANGULI SCAPULÆ,

Arises, tendinous and fleshy, from the transverse processes of the five superior vertebræ of the neck, by as many distinct slips, which soon unite to form a muscle that runs downward and outward.

Inserted, fleshy, into the superior angle of the scapula.

Use. To pull the scapula upward, and a little forward.

Levator anguli scapulæ, Soemmerring.

Ungularis, vel Levator proprius, Winslow.

Levator seu Musculus patientiæ, Douglas.

The fourth layer consists of two pair on the back, two on the posterior part of the neck, four small pair situated immediately below the posterior part of the occiput, and three on the side of the neck.

On the back,

1. SEMI-SPINALIS DORSI,

Arises, from the transverse processes of the seventh, eighth, ninth, and tenth vertebræ of the back, by as many distinct tendons, which soon grow fleshy, and then become tendinous again; and are

Inserted into the spinous processes of all the vertebræ of the back above the eighth, and into the two lowermost of the neck, by as many tendons.

Use. To extend the spine obliquely backward.

Semi-spinalis externus, seu Transverso spinalis dorsi, Winslow.

1. MULTIFIDUS SPINÆ,

Arises from the side and spinous processes of the os sacrum, and from the posterior part of the os ilium, where it joins with the sacrum; from all the oblique and transverse processes of the vertebræ of the loins; from all the transverse processes of the vertebræ of the back, and from those of the neck, except the three first, by as many distinct tendons, which soon grow fleshy, run in an oblique direction, and are

Inserted, by distinct tendons, into all the spinous processes of the vertebræ of the loins, of the back, and of the neck, except the first.

Use. When the different portions of this muscle act on one side, they extend the back obliquely, or move it laterally; but, if they act together on both sides, extend the vertebræ backward.

Transverso-spinalis lumborum, veterib. Sacer.

Semi-spinalis internus, sive *Transverso-spinalis dorsi*.

Semi-spinalis, sive *Transverso spinalis colli*, *Pars interna*, Winslow.

Transversalis lumborum, vulgo *Sacer*.

Transversalis dorsi. *Transversalis colli*. Douglas.

On the posterior part of the neck,

1. SEMI-SPINALIS COLLI,

Arises, from the transverse processes of the uppermost six vertebræ of the back, by as many distinct tendons, ascending obliquely under the complexus.

Inserted into the spinous processes of all the vertebræ of the neck, except the first and the last.

Use. To extend the neck obliquely backward.

Semi-spinalis, sive *Transverso-spinalis colli*, Winslow.

Spinalis cervicis, Albinus, and Soemmerring.

Spinalis, Douglas.

2. TRANSVERSALIS COLLI,

Arises from the transverse processes of the five uppermost vertebræ of the back, by as many tendinous and fleshy origins; runs between the trachelo-mastoideus, and splenius colli and cervicalis descendens.

Inserted into the transverse processes of all the cervical vertebræ, except the first and the last.

Use. To turn the neck obliquely backward, and a little to one side.

Transversus cervicis, Soemmerring.

Below the posterior part of the occiput,

1. RECTUS CAPITIS POSTICUS MAJOR,

Arises, fleshy, from the external part of the spinous process

of the second vertebra of the neck ; and grows broader in its ascent, which is not sraight, but obliquely outward.

Inserted, tendinous and fleshy, into the os occipitis, near the rectus capitis lateralis, and the insertion of the obliquus capitis superior.

Use. To pull the head backward, and to assist a little in its rotation.

Rectus major, Winslow and Douglas.

2. RECTUS CAPITIS POSTICUS MINOR,

Arises, by a narrow beginning, close by its fellow, from a little protuberance in the middle of the back part of the first vertebra of the neck, its outer edge being covered by the rectus major.

Inserted, pretty broad, into the sides of a dimple in the os occipitis, near its foramen magnum.

Use. To assist the rectus major in moving the head backward.

Obliquus minor, Winslow and Douglas.

3. OBLIQUUS CAPITIS SUPERIOR,

Arises from the transverse process of the first vertebra of the neck.

Inserted, tendinous and fleshy, into the os occipitis behind the back part of the mastoid process of the temporal bone, and under the insertion of the complexus muscle.

Use. To draw the head backward.

Obliquus major, Winslow.

Obliquus superior, Douglas.

4. OBLIQUUS CAPITIS INFERIOR,

Arises, fleshy, from the spinous process of the second vertebra of the neck, its whole length ; and, forming a thick fleshy belly, is

Inserted into the transverse process of the first vertebra of the neck.

Use. To give a rotatory motion to the head.

On the side of the neck,

1. SCALENUS ANTICUS,

Arises from the fourth, fifth, and sixth transverse processes of the first vertebra of the neck, by as many tendons.

Inserted, tendinous and fleshy, into the upper side of the first rib, near its cartilage.

Scalenus prior, Albinus.

Anterior portion of the first scalenus, Winslow.

First scalenus, Douglas.

2. SCALENUS MEDIUS,

Arises, from all the transverse processes of the vertebræ of the neck, by as many strong tendons; the nerves to the superior extremity pass between it and the former.

Inserted into the upper and outer part of the first rib, from its root, to within the distance of an inch from its cartilage.

Posterior portion of the first scalenus, Winslow.

Second scalenus, Douglas.

2. SCALENUS POSTICUS,

Arises from the fifth and sixth transverse processes of the vertebræ of the neck.

Inserted into the upper edge of the second rib, not far from the spine.

Use of the three scaleni: to bend the neck to one side; or, when the neck is fixed, to elevate the ribs, and to dilate the thorax.

Posterior portion of the second scalenus, Winslow.

Third scalenus, Douglas.

Albinus and Soemmerring enumerate five scaleni.

There are a number of small muscles situated between the spinous and transverse processes of contiguous vertebræ, which are accordingly named,

1. INTERSPINALES COLLI,

The space between the spinous processes of the vertebræ of the neck, most of which are bifurcated, is filled up with fleshy portions ; which

Arise, double, from the spinous process of the inferior vertebræ of the neck ; and ascend to be

Inserted, in the same manner, into the spinous process of the superior vertebra. They are five in number.

Use. To draw these processes nearer to each other.

Interspinales cervicis, Soemmerring.

2. INTERTRANSVERSALES COLLI,

They begin from the transverse process of the first vertebra of the back, and fill up the spaces between the transverse processes of the vertebræ of the neck, which are likewise bifurcated ; and, consequently, there are six distinct double muscles, the anterior of which may be called *Priores*, and the posterior *Posteriores*.

Arise from the inferior transverse process of each vertebra of the neck, and first of the back, and are

Inserted into the superior transverse processes.

Use. To draw these processes toward each other, and turn the neck a little to one side.

Intertransversi colli priores et posteriores, Soemmerring.

3, 4, 5. INTERSPINALES DORSI ET LUMBORUM, AND THE INTERTRANSVERSALES DORSI,

Are rather small tendons than muscles, serving to connect the spinal and transverse processes.

6. INTERTRANSVERSALES LUMBORUM,

Are four distinct small bundles of flesh, which fill up the spaces between the transverse processes of the vertebræ of the loins, and serve to draw them toward each other.

Intertransversi lumborum, Soemmerring.

MUSCLES OF THE SUPERIOR EXTREMITIES.

THESE may be divided into the muscles that are situated on the scapula, on the os humeri, on the cubit or fore-arm, and on the hand.

Muscles situated on the scapula.

These are called *muscles* of the *os humeri*; and are three behind, one along its inferior costa, two before, and one beneath it.

Behind,

1. SUPRASPINATUS,

Arises, fleshy, from all that part of the base of the scapula that is above its spine; also from the spine and superior costa; passes under the acromion, and adheres to the capsular ligament of the os humeri.

Inserted, tendinous, into that part of the large proptuberance on the head of the os humeri, that is next the groove for lodging the tendon of the long head of the biceps.

Use. To raise the arm upward; and, at the same time, to pull the capsular ligament from between the bones, that it may not be pinched.

2. INFRASPINATUS,

Arises, fleshy, from all that part of the base of the scapula that is between its spine and inferior angle; from the spine as far as the cervix of the scapula. The fibres ascend and descend obliquely toward a tendon in the middle of the muscle, which runs forward, and adheres to the capsular ligament.

Inserted, by a thick and short tendon, into the upper and

middle part of the large protuberance on the head of the os humeri.

Use. To roll the humerus outward ; to assist in raising, and in supporting it when raised ; and to pull the ligament from between the bones.

N. B. These two muscles are covered with a tendinous membrane, from which a number of their fleshy fibres arise. It serves besides to strengthen their actions, and keeps them from swelling too much outwardly in action.

3. TERES MINOR,

Arises, fleshy, from the round edge of the inferior costa of the scapula, and runs forwards along the inferior edge of the infraspinatus muscle, and adheres to the ligament.

Inserted, tendinous, into the back part of the large protuberance on the head of the os humeri, a little behind and below the termination of the last-named muscle.

Use. To roll the humerus outward ; to draw the humerus backward ; and to prevent the ligament from being pinched between the bones.

Along the inferior costa of the scapula,

TERES MAJOR,

Arises, fleshy, from the inferior angle of the scapula, and from all that portion of its inferior costa that is rough and thicker than the rest ; its fleshy fibres are continued over part of the infraspinatus muscle, to which they firmly adhere.

Inserted, by a broad, short, and thin tendon, into the ridge at the inner side of the groove for lodging the tendon of the long head of the biceps, along with the latissimus dorsi.

Use. To roll the humerus inwards, and to draw it backward and downward.

The two before the scapula.

1. DELTOIDES,

Arises, fleshy, from all the posterior part of the clavicle that the pectoralis major does not possess; tendinous and fleshy, from the acromion, and lower margin of almost the whole spine of the scapula opposite to the insertion of the cucullaris muscle; from these origins it runs in three different directions, i. e. from the clavicle outward and downward; from the spine of the scapula outward, forward, and downward; and from the acromion straight downward; and is composed of a number of fasciculi, which form a strong fleshy muscle that covers the anterior part of the joint of the os humeri.

Inserted, tendinous, into a rough protuberance in the outer side of the os humeri, near its middle, where the fibres of this muscle intermix with some part of the brachialis externus.

Use. To pull the arm directly outward and upward, and a little forward or backward, according to the different directions of its fibres.

2. CORACO-BRACHIALIS,

Arises, tendinous and fleshy, from the forepart of the coracoid process of the scapula; adhering, in its descent, to the short head of the biceps.

Inserted, tendinous and fleshy, about the middle of the internal part of the os humeri, near the origin of the third head of the triceps, called *brachialis externus*, where it sends down a thin tendinous expansion to the internal condyle of the os humeri.

Use. To raise the arm upwards and forwards.

N. B. There passes a nerve through this muscle, called *Musculo cutaneus*.

The one beneath the scapula,

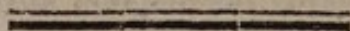
SUBSCAPULARIS,

Arises, fleshy, from all the base of the scapula internally, and

from its superior and inferior costæ, being composed of a number of tendinous and fleshy fasciculi, which make prints on the bone; they all join together, fill up the hollow of the scapula, and pass over the joint, adhering to the capsular ligament.

Inserted, tendinous, into the upper part of the internal protuberance at the head of the os humeri.

Use. To roll the humerus inward, and to draw it to the side of the body; and to prevent the capsular ligament from being pinched.



MUSCLES SITUATED ON THE OS HUMERI.

THESE are called

Muscles of the Cubit or Fore-arm.

They consist of two before, and two behind.

Before,

1. BICEPS FLEXOR CUBITI,

Arises, by two heads. The first and outermost, called *longus*, begins tendinous from the upper edge of the glenoid cavity of the scapula; passes over the head of the os humeri within the joint; and, in its descent without the joint, is enclosed in a groove near the head of the os humeri, by a membranous ligament that proceeds from the capsular ligament and adjacent tendons. The second, or innermost head, called *brevis*, arises, tendinous and fleshy, from the coracoid process of the scapula, in common with the coraco-brachialis muscle. A little below the middle of the forepart of the os humeri, these heads unite.

Inserted, by a strong roundish tendon, into the tubercle on the upper end of the radius internally.

Use. To *supinate* the hand, to *bend* the fore-arm, and to *extend* the arm.

N. B. At the bending of the elbow, where it begins to grow tendinous, it sends off an aponeurosis, which covers all the muscles on the inside of the fore-arm, and joins with another tendinous membrane, which is sent off from the triceps extensor cubiti, and covers all the muscles on the outside of the fore-arm, and a number of the fibres, from opposite sides, decussate each other. It serves to strengthen the muscles, by keeping them from swelling too much outwardly, when in action; and a number of their fleshy fibres take their origin from it.

Biceps brachii, Albinus, and Soemmerring.

Coraco-radialis, seu *biceps*, Winslow.

Biceps internus, Douglas.

2. BRACHIALIS INTERNUS,

Arises, fleshy, from the middle of the os humeri, at each side of the insertion of the deltoid muscle, covering all the inferior and forepart of this bone, runs over the joint, and adheres firmly to the ligament.

Inserted, by a strong short tendon, into the coronoid process of the ulna.

Use. To bend the fore arm, and to prevent the capsular ligament of the joint from being pinched.

Brachialis, Winslow.

Behind,

1. TRICEPS EXTENSOR CUBITI.

Arises, by three heads; the first called *longus*, pretty broad and tendinous, from the inferior costa of the scapula, near its cervix. The second head, called *brevis*, arises by an acute, tendinous, and fleshy beginning, from the back part of the os humeri, a little below its head, outwardly. The third, called *brachialis externus*, arises by an acute beginning, from the back part of the os humeri. These three heads unite lower than the

insertion of the *teres major*, and cover the whole posterior part of the humerus, from which they receive addition in their descent.

Inserted into the upper and external part of the process of the ulna, called *olecranon*, and partly into the condyles of the os humeri, adhering firmly to the ligament.

Use. To extend the fore-arm, and to bend the arm.

Anconeus major, *Anconeus externus*, and *Anconeus internus*, Winslow.

Biceps externus, and *Brachialis externus*, Douglas.

3. ANCONEUS.

Arises, tendinous, from the posterior part of the external condyle of the os humeri; it soon grows fleshy, and is continued from the third head of the triceps.

Inserted, fleshy, and thin, into a ridge on the outer and posterior edge of the ulna, being continued some way below the olecranon, and covered with a tendinous membrane.

Use. To assist in extending the fore-arm.

Anconeus minor, Winslow.

Anconeus, vel *Cubitalis Riolani*. Douglas.

MUSCLES SITUATED ON THE CUBIT OR FORE-ARM.

THESE may be divided into three classes; *first*, flexors and extensors of the whole hand; *second*, flexors and extensors of the fingers; and *third*, supinators and pronators, or those that roll the radius on the ulna.

First class consists of three flexors, and three extensors.

Flexors:

1. PALMARIS LONGUS,

Arises, tendinous, from the internal condyle of the os humeri,

soon grows fleshy, and after a short progress, sends off a long slender tendon.

Inserted into the ligamentum carpi annulare, and into a tendinous membrane that is expanded on the palm of the hand, named *aponeurosis palmaris*; which, above, begins at the transverse or annular ligament of the wrist, and below, is fixed to the roots of the fingers.

Use. To bend the wrist, to stretch the membrane that is expanded on the palm, and in some measure, to pronate the radius.

Ulnaris gracilis, Winslow.

N. B. This muscle is sometimes wanting; but the aponeurosis palmaris is always to be found, and a small muscle named

PALMARIS BREVIS,

Arises from the ligamentum carpi annulare, and tendinous membrane that is expanded on the palm of the hand.

Inserted, by small bundles of fleshy fibres, into the skin and fat that covers the abductor minimi digiti, and into the os pisiforme.

Use. To assist in contracting the palm of the hand.

Palmaris cutaneus, Winslow.

2. FLEXOR CARPI RADIALIS,

Arises, tendinous and fleshy, from the internal condyle of the os humeri, and from the anterior part of the upper end of the ulna, where it firmly adheres to the pronator radii teres.

Inserted, by a flat tendon, into the fore and upper part of the metacarpal bone that sustains the fore-finger, after running through a fossa in the os trapezium.

Use. To bend the wrist, and to assist in bending the elbow joint, and in pronation.

Radialis internus, Albinus, Winslow, and Soemmerring.

3. FLEXOR CARPI ULNARIS,

Arises, tendinous, from the internal condyle of the os humeri. It has likewise a small fleshy beginning from the outer side of the olecranon; between which and the condyle the ulnar nerve passes to the fore-arm; and a number of its fleshy fibres arise from the tendinous membrane which covers the fore-arm.

Inserted, by a short strong tendon, into the os pisiforme; at a little distance from its insertion, a small ligament is sent off to the metacarpal bone that sustains the little finger.

Use. To assist the former in bending the arm, to draw the hand toward the side of the little finger, and to assist in pronating it.

Ulnaris internus, Albinus, Winslow, and Soemmerring.

Extensors :

1. EXTENSOR CARPI RADIALIS LONGIOR,

Arises, broad, thin, and fleshy, immediately below the supinator radii longus, from the lower part of the external ridge of the os humeri, above its external condyle.

Inserted, by a round tendon, into the posterior and upper part of the metacarpal bone that sustains the forefinger.

Use. To extend and bring the hand backward; and, under certain circumstances, to bend the elbow joint, and to pronate, or to supinate the hand.

Radialis externus longior, Albinus, and Soemmerring.

Radialis externus primus, Winslow.

2. EXTENSOR CARPI RADIALIS BREVIOR,

Arises, tendinous, from the external condyle of the os humeri, and from the ligament that connects the radius to it, and runs along the outside of the radius.

Inserted, by a round tendon, into the upper and back part of the metacarpal bone that sustains the middle finger.

Use. To assist the last-mentioned muscle, and also to pull the hand toward the thumb side; but not as the former to bend the elbow joint.

Radialis externus brevior, Albinus, and Soemmerring.

Radialis secundus, Winslow.

EXTENSOR CARPI ULNARIS,

Arises, tendinous, from the external condyle of the os humeri; and, in its progress, fleshy from the middle of the ulna, where it passes over it. Its round tendon is enclosed by a membranous sheath, in a groove which is situated at the extremity of the ulna.

Inserted, by its round tendon, into the posterior and upper part of the metacarpal bone that sustains the little-finger.

Use. To assist the former in extending the hand, to pull it toward the little finger side, and, under certain circumstances, to pronate it.

Ulnaris externus, Albinus, Winslow, and Soemmerring.

Second Class.

The flexors and extensors of the four fingers are, two long, and one small flexor to each finger, and one extensor.

1. FLEXOR SUBLIMIS PERFORATUS,

Arises, tendinous and fleshy, from the internal condyle of the os humeri; tendinous from the coronoid process of the ulna, near the edge of the cavity that receives the head of the radius; fleshy from the tubercle of the radius; and membranous and fleshy from the middle of the forepart of the radius, where the flexor pollicis longus arises. Its fleshy belly sends off four round tendons before it passes under the ligament of the wrist.

Inserted into the anterior and upper part of the second bone of each finger, being, near the extremity of the first bone, divided for the passage of the perforans.

Use. To bend the second joint or phalanx of the fingers, to

bend the first, the wrist, and the elbow joint, and to assist in pronation.

Sublimus, Albinus.

Perforatus, Douglas, and Soemmerring.

2. FLEXOR PROFUNDUS PERFORANS,

Arises, fleshy, from the external side, and upper part of the ulna, for some way downward, and from a large share of the interosseous ligament. It splits into four tendons, a little before it passes under the ligamentum carpi annulare; and these pass through the slits in the tendons of the flexor sublimis.

Inserted into the fore and upper part of the third or last bone of all the four fingers.

Use. To bend the last joint of the fingers, and also to assist the former.

Profundus, Albinus.

Perforans, Douglas, and Soemmerring.

The four small flexors are named

LUMBRICALES.

Arise, thin and fleshy, from the outside of the tendons of the flexor profundus, a little above the lower edge of the ligamentum carpi annulare.

Inserted, by long slender tendons, into the outer sides of the broad tendons of the interossei muscles, about the middle of the first joint, then they wind round the fingers, and are inserted into the base of the third bone of each.

Use. To increase the flexion of the fingers while the long flexors are in full action, by bending the first joint; but to extend the second and third, and to pull the fingers to the outside.

Extensors :

EXTENSOR DIGITORUM COMMUNIS,

Arises, by an acute, tendinous, and fleshy beginning, from the external condyle of the os humeri, where it adheres to the supinator radii brevis. Before it passes under the ligamentum carpi annulare externum, it splits into four tendons; some of which may be divided into several smaller; and about the fore-part of the metacarpal bones they remit tendinous filaments to each other.

Inserted into the posterior part of all the bones of the four fingers, by a tendinous expansion.

Use. To extend all the joints of the fingers, the wrist and the elbow joint.

Third Class,

Consists of four muscles, viz. two *supinators*, and two *pronators*.

Supinators :

1. SUPINATOR RADII LONGUS,

Arises, by an acute and fleshy origin, from the external ridge of the os humeri, above the external condyle, near as far up as the middle of that bone.

Inserted into the outer-side of the inferior extremity of the radius.

Use. To pronate, under certain circumstances, as well as to supinate the hand, and also to bend the elbow joint.

Supinator longus, Albinus, Winslow, and Douglas.

Brachioradialis, Soemmerring.

2. SUPINATOR RADII BREVIS,

Arises, tendinous, from the external condyle of the os humeri; tendinous and fleshy, from the external and upper part of the ulna, and adheres firmly to the ligament that joins these two bones.

Inserted into the head, neck, and tubercle of the radius, near the insertion of the biceps, and ridge running from that downward and outward.

Use. To roll the radius outward, and so bring the hand supine, probably also to assist in giving the last bend to the elbow joint.

Pronators:

1. PRONATOR RADII TERES,

Arises, fleshy, from the internal condyle of the os humeri, and tendinous from the coronoid process of the ulna.

Inserted, thin, tendinous, and fleshy, into the middle of the posterior part of the radius.

Use. To roll the radius, together with the hand, inward.

2. PRONATOR RADII QUADRATUS,

Arises, broad, tendinous, and fleshy, from the lower and inner part of the ulna; the fibres run transversely, to be

Inserted into the lower and anterior part of the radius, opposite to its origin.

Use. To turn the radius, together with the hand, inward, and to bend the elbow joint.

MUSCLES SITUATED ON THE HAND CHIEFLY.

THESE may be divided into four classes, viz. muscles of the thumb, fore-finger, little-finger, and metacarpal-bones.

Muscles of the Thumb.

These consist of *three flexors, three extensors, one abductor, and one adductor.*

Flexors :**1. FLEXOR LONGUS POLLICIS MANUS.**

Arises, by an acute fleshy beginning, from the upper part of the radius, immediately below its tubercle, and is continued down for some space on the forepart of this bone. It has likewise generally another origin from the internal condyle of the os humeri, which forms a distinct fleshy slip that terminates near the upper part of the origin from the radius.

Inserted into the last joint of the thumb, after having passed its tendon under the ligament of the wrist.

Use. To bend the last joint of the thumb, and also the wrist joint.

Flexor tertii internodii, Douglas.

2. FLEXOR BREVIS POLLICIS MANUS,

Arises from the os trapezoides, magnum, and unciforme of the carpus, and is divided into two portions by the tendon of the flexor pollicis longus.

Inserted into the ossa sesamoidea and first bone of the thumb.

Use. To bend the first joint of the thumb.

Flexor secundi internodii, Douglas.

3. FLEXOR OSSIS METACARPI POLLICIS, OR OPPONENS
POLLICIS,

Arises, fleshy, from the os trapezium and ligamentum carpi annulare, lying under the abductor pollicis.

Inserted, tendinous and fleshy, into the under and anterior part of the metacarpal bone of the thumb.

Use. To bring the thumb inward, opposite to the other fingers.

Flexor primi internodii, Douglas.

Extensors:

1. EXTENSOR OSSIS METACARPI POLLICIS MANUS,

Arises, fleshy, from the middle and posterior part of the ulna, immediately below the insertion of the anconæus muscle, from the posterior part of the middle of the radius, and from the interosseous ligament.

Inserted, generally by two tendons, into the os trapezium, and upper back part of the metacarpal bone of the thumb, and often joins with the abductor pollicis.

Use. To extend the metacarpal bone of the thumb outwardly, to extend the carpus, and to turn it somewhat inward.

Abductor longus pollicis manus, Albinus and Soemmerring.

Extensor primi internodii, Douglas.

2. EXTENSOR PRIMI INTERNODII,

Arises, fleshy, from the posterior part of the ulna near the former muscle, and from the interosseous ligament.

Inserted, tendinous, into the posterior part of the first bone of the thumb; and part of it may be traced as far as the second bone.

Use. To extend the metacarpal and first bone of the thumb

obliquely outward, and to extend the carpus and turn it somewhat inward.

Extensor minor pollicis manus, Albinus, and Soemmerring.

This and the preceding muscle is called

Extensor pollicis primus, Winslow.

Extensor secundi internodii, Douglas.

3. EXTENSOR SECUNDI INTERNODII,

Arises, by an acute, tendinous, and fleshy beginning, from the middle back part of the ulna, and from the interosseous ligament; its tendon runs through a small groove at the inner and back part of the lower end of the radius.

Inserted into the last bone of the thumb.

Use. To extend the thumb obliquely backward, and to extend the wrist and turn it inward.

Extensor major pollicis manus, Albinus, and Soemmerring.

Extensor pollicis secundus, Winslow.

Extensor tertii internodii, Douglas.

ABDUCTOR POLLICIS MANUS.

Arises, by a broad tendinous and fleshy beginning, from the ligamentum carpi annulare, and from the os trapezium.

Inserted, tendinous, into the outer side of the root of the first bone of the thumb.

Use. To draw the thumb from the fingers.

N. B. Albinus names the inner portion of this muscle *Abductor brevis alter*.

Abductor, Thenar Riolani, Douglas.

Abductores Breves Pollicis, Exterior et Interior, Soemmerring.

ADDUCTOR POLLICIS MANUS.

Arises, fleshy, from almost the whole length of the metacarpal bone that sustains the middle finger; from thence its fibres are collected together.

Inserted, tendinous, into the inner part of the root of the first bone.

Use. To pull the thumb toward the fingers.

Adductor ad minimum digitum, Douglas.

Fore-finger :

INDICATOR.

Arises, by an acute fleshy beginning, from the middle of the posterior part of the ulna ; its tendon passes under the same ligament with the extensor digitorum communis, with part of which it is

Inserted into the posterior part of the fore-finger.

Use. To assist that portion of the extensor communis going to the fore-finger, and to pull it slightly toward the middle finger.

Extensor secundi internodii indicis proprius, vulgo indicator, Douglas.

ABDUCTOR INDICIS MANUS.

Arises, from the os trapezium, and from the superior part and inner side of the metacarpal bone of the thumb.

Inserted, by a short tendon, into the outer and back part of the first bone of the fore-finger.

Use. To bring the fore-finger toward the thumb, or the thumb toward the fore-finger.

Semi-interosseous, Winslow.

Little-finger :

ABDUCTOR MINIMI DIGITI MANUS,

Arises, fleshy, from the os pisiforme, and from that part of the ligamentum carpi annulare next it.

Inserted, tendinous, into the inner side of the upper end of the upper end of the first bone of the little finger.

Use. To draw this finger from the rest, to bend the first and to extend the other joints.

Hypothenar minor, Winslow.

Extensor tertii internodii minimi digiti, Douglas.

ADDUCTOR METACARPI MINIMI DIGITIS MANUS,

Arises, fleshy, from the thin edge of the os unciforme, and from that part of the ligament of the wrist next it.

Inserted, tendinous, into the inner side and anterior part of the metacarpal bone of this finger.

Use. To bend and bring the metacarpal bone of this finger toward the rest.

Metacarpeus, Winslow.

Flexor primi internodii minimi digiti, Douglas.

FLEXOR PARVUS MINIMI DIGITI,

Arises, fleshy, from the outer side of the os unciforme, and from the ligament of the wrist which joins with that bone.

Inserted, by a roundish tendon into the inner and anterior part of the upper end of the first bone of this finger.

Use. To bend the first, but to extend the other joints of the little finger, and to assist the adductor.

Abductor minimi digiti, *Hypothenar Riolani*, Douglas.

Flexor proprius minimi digiti, Soemmerring.

Between the metacarpal bones, there are *four internal* and *three external* muscles named *interossei*.

Interossei interni :

1. PRIOR INDICIS,

Arises, tendinous and fleshy, from the upper and outer part of the metacarpal bone that sustains the fore-finger.

Inserted into the outside of that part of the tendinous expan-

sion from the *extensor digitorum communis*, which covers the posterior part of the fore-finger.

Use. To draw the fore-finger inward toward the thumb, to bend its first joint, and to extend the rest.

Extensor tertii internodii indicis, Douglas.

2. POSTERIOR INDICIS,

Arises, tendinous and fleshy, from the root and inner part of the metacarpal bone that sustains the fore-finger.

Inserted into the inner side of the tendinous expansion which is sent off from the *extensor digitorum communis*, along the posterior part of the fore-finger.

Use. To draw the fore-finger outward, to bend its first joint and to extend the others.

First interosseous, Douglas.

3. PRIOR ANNULARIS,

Arises, from the root of the outside of the metacarpal bone that sustains the ring-finger.

Inserted into the outside of the tendinous expansion of the *extensor digitorum communis* which covers the ring-finger.

Use. To pull the ring finger toward the thumb, to bend its first and to extend its other joints.

Fourth interosseus, Douglas.

4. INTEROSSEUS AURICULARIS,

Arises from the root and outer side of the metacarpal bone of the little finger; and is

Inserted into the outside of the tendinous expansion of the *extensor digitorum communis*, which covers the posterior part of the little finger.

Use. To draw the little finger outwards, to bend its first joint and to extend the rest.

Sixth interosseus, Douglas.

Interossei externi, seu bicipites :

1. PRIOR MEDII,

Arises, by two origins, from the roots of the metacarpal bones that sustain the fore and middle fingers externally, and next each other : runs along the outside of the middle-finger ; and, being conspicuous on both sides of the hand, is

Inserted into the outside of the tendinous expansion from the extensor digitorum communis, which covers the posterior part of the middle finger.

Use. To draw the middle finger inward, to bend its first joint, and to extend the others.

Second Interosseus, Douglas.

2. POSTERIOR MEDII,

Arises, by two origins, from the roots of the metacarpal bones, next each other, that sustain the middle and ring fingers.

Inserted into the inside of the tendinous expansion from the extensor digitorum communis, which runs along the posterior part of the middle-finger.

Use. To draw the middle finger outward, to bend its first, and to extend its other joints.

Third interosseus, Douglas.

3. POSTERIOR ANNULARIS,

Arises, by two origins, from the roots of the metacarpal bones that sustain the ring and little fingers next each other.

Inserted into the inside of the tendinous expansion of the extensor digitorum communis, which runs along the posterior part of the ring finger.

Use. To draw the ring finger inward, to bend its first joint, and to extend the rest.

Fifth interosseus, Douglas.

N. B. The internal interossei are only conspicuous on the palm of the hand ; but the external are apparent on both the palm and back of the hand.

MUSCLES OF THE INFERIOR EXTREMITIES.

THESE may be divided into the muscles *situated on the outside of the pelvis, on the thigh, on the leg, and on the foot.*

Muscles on the outside of the *pelvis*, which are called *muscles of the thigh.*

These are composed of *one layer before and three layers behind.*

The layer before consists of five muscles :

- | | |
|----------------------|----------------------------------|
| 1. PSOAS MAGNUS. | } These were formerly described. |
| 2. ILIACUS INTERNUS. | |

3. PECTINALIS.

Arises, broad and fleshy, from the upper and anterior part of the os pubis or pectinis, immediately above the foramen thyroideum.

Inserted into the anterior and upper part of the linea aspera of the os femoris, a little below the trochanter minor, by a flat and short tendon.

Use. To bring the thigh upward and inward, and to give it a degree of rotation outward.

Pectineus, Albinus, and Soemmerring.

4. TRICEPS ADDUCTOR FEMORIS,

Under this appellation are comprehended three distinct muscles :

1. ADDUCTOR LONGUS FEMORIS,

Arises, by a pretty strong roundish tendon, from the upper

and anterior part of the of os pubis, and ligament of its synchondrosis. on the inner-side of the pectinalis.

Inserted, tendinous, near the middle of the posterior part of the linea aspera, being continued for some way down.

Adductor femoris primus, Douglas.

Triceps minus, Winslow.

2. ADDUCTOR BREVIS FEMORIS.

Arises, tendinous, from the os pubis near its joining with the opposite os pubis below and behind the former.

Inserted, tendinous and fleshy, into the inner and upper part of the linea aspera, from a little below the trochanter minor, to the beginning of the insertion of the adductor longus.

Adductor femoris secundus, Douglas.

Triceps secundus, Winslow.

3. ADDUCTOR MAGNUS FEMORIS,

Arises, a little lower down than the former, near the symphysis of the ossa pubis; tendinous and fleshy, from the tuberosity of the os ischium; the fibres run outward and downward.

Inserted, into almost the whole length of the linea aspera; into a ridge above the internal condyle of the os femoris; and, by a roundish long tendon, into the upper part of that condyle, a little above which the femoral artery takes a spinal turn towards the ham, passing between this muscle and the bone.

Use of these three muscles or triceps. To bring the thigh inward and upward, according to the different directions of their fibres; and, in some degree, to roll the thigh outward.

Adductor femoris tertius, and

Adductor femoris quartus, Douglas.

Triceps tertius, Winslow.

5. OBTURATOR EXTERNUS,

Arises, fleshy, from the lower forepart of the os pubis, and

forepart of the inner crus of the ischium; surrounds the foramen thyroideum; a number of its fibres, arising from the membrane which fills up that foramen, are collected like rays toward a centre, and pass outward around the root of the back part of the cervix of the os femoris.

Inserted, by a strong tendon, into the cavity at the inner and back part of the root of the trochanter major, adhering in its course to the capsular ligament of the thigh-bone.

Use. To roll the thigh-bone obliquely outward, and to prevent the capsular ligament from being pinched.

Behind:

First Layer.

GLUTEUS MAXIMUS,

Arises, fleshy, from the posterior part of the spine of the os ilium, a little higher up than the joining of the ilium with the os sacrum, from the whole external side of the os sacrum, below the posterior spinous process of the os ilium; from the posterior sacro-ischiatic ligament, over which part of the inferior edge of this muscle hangs in a folded manner; from the os coccygis. All the fleshy fibres run obliquely forward, and a little downward, to form a thick broad muscle, which is divided into a number of strong fasciculi. The upper part of it covers almost the whole of the trochanter major, between which and the tendon of this muscle there is a large bursa mucosa, and where it is inseparably joined to the broad tendon of the *tensor vaginæ femoris*.

Inserted, by a strong, thick, and broad tendon into the upper and outer part of the linea aspera, which is continued from the trochanter major, for some way downward.

Use. To extend the thigh, by pulling it directly backward, and a little outward.

Gluteus magnus, Albinus, and Soemmerring.

Gluteus major, Cowper.

Second Layer.

GLUTEUS MEDIUS,

Arises, fleshy, from the anterior superior spinous process of the os ilium, and from all the outer edge of the spine of the ilium, except its posterior part, where it arises from the dorsum of that bone.

Inserted, by a broad tendon, into the outer and posterior part of the trochanter major.

Use. To draw the thigh-bone outward, and a little backward; to roll the thigh-bone outward, especially when it is bended.

N. B. The anterior and upper part of this muscle is covered by a tendinous membrane, from which a number of its fleshy fibres arise, and which joins with the broad tendons of the gluteus maximus, tensor vaginæ femoris, and latissimus dorsi.

Third Layer consists of four Muscles.

1. GLUTEUS MINIMUS.

Arises, fleshy, from a ridge that is continued from the superior anterior spinous process of the os ilium, and from the middle of the dorsum of that bone, as far back as its great nitch.

Inserted, by a strong tendon, into the fore and upper part of the trochanter major.

Use. To assist the former in pulling the thigh outward and backward, and in rolling it.

Gluteus minor, Albinus, and Soemmerring.

2. PYRIFORMIS,

Arises, within the pelvis, by three tendinous and fleshy origins, from the second, third, and fourth pieces of the os sacrum; thence growing gradually narrower, it passes out of the pelvis along with the posterior crural nerve, below the nitch in

the postesior part of the os ilium, where it receives a few fleshy fibres.

Inserted, by a roundish tendon, into the upper part of the cavity at the inner side of the root of the trochanter major.

Use. To move the thigh a little upward, and roll it outward,
Pyriformis, seu iliacus externus, Douglas.

3. GEMINI.

Arises, by two distinct origins ; the superior from the spinous process, and the inferior from the tuberosity of the os ischium ; also, from the posterior sacro-ischiatic ligament. They are both united by a tendinous and fleshy membrane, and form a purse for the tendon of the obturator internus muscle, which was formerly described.

Inserted, tendinous and fleshy, into the cavity at the inner side of the root of the trochanter major, on each side of the tendon of the obturator internus, to which they firmly adhere.

Use. To roll the thigh outward, and to preserve the tendon of the obturator internus from being hurt by the hardness of that part of the ischium over which it passes ; also, to hinder it from starting out of its place, while the muscle is in action.

Gemelli, Winslow.

4. QUADRATUS FEMORIS,

Arises, tendinous and fleshy, from the outside of the tuberosity of the os ischium ; and running transversely, is

Inserted, fleshy, into a rough ridge, continued from the root of the large trochanter to the root of the small one.

Use. To roll the thigh outward.

MUSCLES SITUATED ON THE THIGH.

THESE are called *muscles* of the *leg*; and consist of *one*, on the *outside*; *two*, on the *inside*; *four* *before*; and, *four* *behind*.

Previous to the description of the muscles that are situated on the thigh and leg, it is necessary to take notice of a broad tendinous fascia or sheath, which is sent off from the back and from the tendons of the glutei and adjacent muscles.

It is a strong thick membrane on the outside of the thigh and leg; but, toward the inside of both, it gradually turns thinner, and has rather the appearance of cellular substance, than a tendinous membrane. A little below the trochanter major, it is firmly fixed to the linea aspera; and, farther down, to that part of the head of the tibia that is next the fibula; where it sends off the tendinous expansion along the outside of the leg.

It serves to strengthen the action of the muscles, by keeping them firm in their proper places while in action, particularly the tendons that pass over the joints, where this membrane is thickest, and it gives origin to a number of the fleshy fibres of the muscles.

Outside,

TENSOR VAGINÆ FEMORIS.

Arises, by a narrow, tendinous, and fleshy beginning, from the external part of the anterior superior spinous process of the os ilium.

Inserted, a little below the trochanter major, into the inner side of the membranous fascia which covers the outside of the thigh.

Use. To stretch the membranous fascia, to assist in the abduction of the thigh, and somewhat in its rotation inward.

Musculus aponeurosis, vel Fasciæ latae, Winslow.

Inside,

1. SARTORIUS,

Arises, tendinous, from the anterior superior spinous process of the os ilium, soon grows fleshy, runs down for some space upon the rectus, and going obliquely inward, it passes over the vastus internus, and, about the middle of the os femoris, over part of the triceps, it runs down farther between the tendon of the adductor magnus and that of the gracilis muscle.

Inserted, by a broad and thin tendon, into the inner side of the tibia, near the inferior part of its tubercle.

Use. To elevate the thigh and turn it outward, to bend the leg obliquely inward, or to bring one leg across the other.

2. GRACILIS,

Arises, by a thin tendon, from the os pubis near the symphysis of these two bones; soon grows fleshy; and, descending by the inside of the thigh, is

Inserted, tendinous, into the tibia under the sartorius.

Use. To bring the thighs together, and one leg across the other, and to bend the knee.

Gracilis internus, sive *Rectus internus*, Winslow.

Before,

1. RECTUS.

Arises, fleshy, from the inferior anterior spinous process of the os ilium, and tendinous from the dorsum of the ilium, a little above the acetabulum; runs down over the anterior part of the cervix of the os femoris, the fibres not being straight, but running down like the plumage of a feather obliquely outward and inward, from a tendon in the middle.

Inserted, tendinous, into the upper part of the patella, from which a thin tendon runs down, on the forepart of this bone, to terminate in a thick strong ligament, which is sent off from the

inferior part of the patella, and inserted into the tubercle of the tibia.

Use. To bend the thigh, and to extend the leg in a powerful manner, by the intervention of the patella, like a pulley.

Rectus, sive Gracilis anterior, Winslow.

2. VASTUS EXTERNUS,

Arises, broad, tendinous, and fleshy, from the root of the trochanter major, and upper part of the linea aspera, its origin being continued from near the insertion of the gluteus minimus, the whole length of the linea aspera, by fleshy fibres which run obliquely forward to a middle tendon, where they terminate.

Inserted into a large share of the upper part of the patella; and part of it ends in an aponeurosis, which is continued down to the leg, and, in its passage, is firmly fixed to the head of the tibia.

Use. To turn the thigh outward, and to extend the leg.

3. VASTUS INTERNUS,

Arises, tendinous and fleshy, from between the forepart of the os femoris and root of the trochanter minor, and from almost all the inside of the linea aspera, by fibres running obliquely forward and downward.

Inserted, tendinous, into the upper and inside of the patella, continuing fleshy lower than the vastus externus. Part of it likewise ends in an aponeurosis continued down to the leg, and fixed in its passage to the upper part of the tibia.

Use. To extend the leg.

4. CRURALIS,

Arises, fleshy, from between the two trochanters of the os femoris, but nearer the minor, and firmly adhering to most of the forepart of the os femoris, and connected to both vasti muscles.

Inserted, tendinous, into the upper part of the patella, behind the rectus.

Use. To assist in the extension of the leg.

N. B. These four muscles *before*, being inserted into the patella, have the same effect upon the leg, as if they were immediately inserted into it, by means of the strong tendon, or rather ligament, which is sent off from the inferior part of the patella to the tibia.

Behind,

1. SEMITENDINOUS,

Arises, tendinous and fleshy, in common with the long head of the biceps, from the posterior part of the tuberosity of the os ischium; and sending down a long roundish tendon, which ending flat, is

Inserted into the inside of the ridge of the tibia, a little below its tubercle.

Use. To bend the leg backward, and a little inward.

Seminervosus, Winslow, and Douglas.

2. SEMINEMBRANOSUS,

Arises, tendinous, from the upper and posterior part of the tuberosity of the os ischium, sends down a broad flat tendon, which ends in a fleshy belly, and, in its descent, runs at first on the forepart of the biceps, and, lower, between it and the semitendinosus.

Inserted, tendinous, into the inner and back part of the head of the tibia.

Use. To bend the leg, and bring it directly backward.

N. B. The two last form what is called the *inner hamstring*.

3. BICEPS FLEXOR CRURIS,

Arises, by two distinct heads. The first, called *longus*, arises,

in common with the semitendinosus, from the upper and posterior part of the tuberosity of the os ischium. The second, called *brevis*, arises from the linea aspera, a little below the termination of the gluteus maximus, by a fleshy acute beginning, which soon grows broader as it descends to join with the first head, a little above the external condyle of the os femoris.

Inserted by a strong tendon, into the upper part of the head of the fibula.

Use. To extend the thigh, and to bend the leg.

Biceps cruris, Albinus.

Biceps femoris, Soemmerring.

Biceps, Winslow, and Douglas.

N. B. This muscle forms what is called the *outer hamstring*; and between it and the inner, the nervus popliteus, and arteria, and vena poplitea, are situated.

4. POPLITEUS,

Arises, by a round tendon, from the lower and back part of the external condyle of the os femoris; then runs over the ligament that involves the joint, firmly adhering to it, and part of the semilunar cartilage. As it runs over the joint, it becomes fleshy, and the fibres run obliquely inward, being covered with a thin tendinous membrane.

Inserted, broad, thin, and fleshy, into a ridge at the upper and internal edge of the tibia, a little below its head.

Use. To assist in bending the leg, and to prevent the capsular ligament from being pinched. After the leg is bent, this muscle serves to roll it inward.

MUSCLES SITUATED ON THE LEG.

THESE are called *Muscles* of the *Foot*; and may be divided into two classes, viz. 1. *Extensors* and *Flexors* of the *Foot*.
2. *Common Extensors* and *Flexors* of the *Toes*.

First Class.

Extensors.

These consist of three :

1. GASTROCNEMIUS EXTERNUS SEU GEMELLUS,

Arises, by two distinct heads. The first head arises from the upper and back part of the internal condyle of the os femoris, and from that bone, a little above its condyle, by two distinct tendinous origins. The second head arises tendinous from the upper and back part of the external condyle of the os femoris. A little below the joint, their fleshy bellies unite in a middle tendon; and, below the middle of the tibia, it sends off a broad thin tendon, which joins a little above the extremity of the tibia with the tendon of the following.

2. SOLEUS, SEU GASTROCNEMIUS INTERNUS,

Arises by two origins. The first is from the upper and back part of the head of the fibula, continuing to receive many of its fleshy fibres from the posterior part of that bone for some space below its head. The other origin begins from the posterior and upper part of the middle of the tibia; and runs inward along the inferior edge of the popliteus toward the inner part of the tibia, from which it receives fleshy fibres for some way down. The flesh of this muscle, covered by the tendon of the gemellus, runs down near as far as the extremity of the tibia; a little above

which the tendons of both gastrocnemii unite, and form a strong round chord, which is called *tendo Achillis*.

Inserted into the upper and posterior part of the os calcis ; by the projection of which the tendo Achillis is at a considerable distance from the tibia.

Use. To extend the foot, by bringing it backward and downward.—The Gastrocnemius also bends the knee.

Gemelleus and *Soleus*, Albinus.

Gastrocnemii and *Soleus*, Winslow.

Extensor tarsi suralis, vel *Extensor magnus*, Douglas.

Muculus suræ, Soemmerring.

3. PLANTARIS,

Arises, thin and fleshy, from the upper and back part of the root of the external condyle of the os femoris, near the inferior extremity of that bone, adhering to the ligament that involves the joint in its descent. It passes along the second origin of the soleus, and under the gemellus, where it sends off a long, slender, thin tendon, which comes from between the great extensors, where they join tendons ; then runs down by the inside of the tendo Achillis.

Inserted into the inside of the posterior part of the os calcis, below the tendo Achillis.

Use. To assist the former, and to pull the capsular ligament of the knee from between the bones. It seems likewise to assist in rolling the foot inward.

Tibialis gracilis, vulgo *Plantaris*, Winslow.

Extensor tarsi minor, vulgo *Plantaris*, Douglas.

N. B. This muscle, though seldom, has been found wanting on both sides.

Flexors :

These consists of four ; two that belong to the tibia, and two to the fibula.

1. TIBIALIS ANTICUS,

Arises, tendinous and fleshy, from the middle of that process of the tibia, to which the fibula is connected above; then it runs down fleshy on the outside of the tibia; from which, and the upper part of the interosseous ligament, it receives a number of distinct fleshy fibres; near the extremity of the tibia, it sends off a strong round tendon, which passes under part of the ligamentum tarsi annulare near the malleolus internus.

Inserted, tendinous, into the inside of the os cuneiforme internum, and posterior end of the metatarsal bone that sustains the great toe.

Use. To bend the foot, by drawing it upward, and, at the same time, to turn the toes inward.

2. TIBIALIS POSTICUS,

Arises, by a narrow fleshy beginning, from the fore and upper part of the tibia, just under the process which joins it to the fibula; then passing through a perforation in the upper part of the interosseous ligament, it continues its origin from the back part of the fibula next the tibia, and from near one half of the upper part of the last-named bone; as also, from the interosseous ligament, the fibres running toward a middle tendon, which passes in a groove behind the malleolus internus.

Inserted, tendinous, into the upper and inner part of the os naviculare, being further continued to the os cuneiforme internum and medium; besides, it gives some tendinous filaments to the os calcis, os cuboides, and to the root of the metatarsal bone that sustains the middle toe.

Use. To extend the foot, and to turn the toes inward.

3. PERONEUS LONGUS,

Arises, tendinous and fleshy, from the forepart of the head of the perone, or fibula, the fibres running straight down; also from the upper and external part of the fibula, where it begins

to rise into a round edge ; as also, from the hollow between that and its anterior edge, as far down as to reach within a hand-breadth of the ancle, by a number of fleshy fibres, which run outward toward a tendon, which passes through a channel at the outer ancle, in the back part of the inferior extremity of the fibula ; then, being reflected to the sinuosity of the os calcis, it runs along a groove in the os cuboides, above the muscle in the sole of the foot.

Inserted, tendinous, into the outside os the root of the metatarsal bone that sustains the great toe, and by some tendinous fibres in the os cuneiforme internum.

Use. To move the foot outward, and to extend it a little.

Peroneus maximus, vulgo *Peroneus posterior*, Winslow.

Peroneus primus, seu *Posticus*, Douglas.

4. PERONEUS BREVIS.

Arises, by an acute fleshy beginning, from above the middle of the external part of the fibula ; from the outer side of the anterior spine of this bone ; as also, from its round edge externally, the fibres running obliquely outward toward a tendon on its external side which passes through the groove at the outer ancle, being there included under the same ligament with that of the preceding muscle ; and a little further, it runs through a particular one of its own.

Inserted, tendinous, into the root and external part of the metatarsal bone that sustains the little toe.

Use. To assist the former in pulling the foot outward, and extending it a little.

Peroneus medius, vulgo *Peroneus anticus*, Winslow.

Peroneus secundus, seu *Anticus*, Douglas.

Second Class.

Common Extensors.

These consist of two.

1. EXTENSOR LONGUS DIGITORUM PEDIS,

Arises, tendinous and fleshy, from the upper and outer part of the head of the tibia, and from the head of the fibula, where it joins with the tibia, and from the interosseous ligament; also from the tendinous fascia, which covers the upper and outside of the leg by a number of fleshy fibres; and tendinous and fleshy, from the anterior spine of the fibula, almost its whole length, where it is inseparable from the *peroneus tertius*. It splits into four round tendons, under the ligamentum tarsi annulare.

Inserted, by a flat tendon, into the root of the first joint of each of the four small toes; and is expanded over the upper side of the toes, as far as the root of the last joint.

Use. To bend the ankle joint, and extend all the joints of the four small toes.

Extensor longus, Douglas.

N. B. A portion of this muscle, which

Arises, from the middle of the fibula, continues down to near its inferior extremity, and sends its fleshy fibres forward to a tendon, which passes under the annular ligament, and is

Inserted into the root of the metatarsal bone that sustains the little toe: it is called by Albinus *Peroneus tertius*; and by others, the *Nonus Vesalii*.

Use. To assist in bending the foot.

2. EXTENSOR BREVIS DIGITORUM PEDIS.

Arises, fleshy and tendinous, from the fore and upper part of the os calcis; and soon forms a fleshy belly, divisible into four portions, which sends off an equal number of tendons that pass over the upper part of the foot, under the tendons of the former.

Inserted, by four slender tendons, into the tendinous expansion from the extensor longus, which covers the small toes, except the little one ; also into the tendinous expansion from the extensor pollicis, that covers the upper part of the great toe.

Use. To extend the toes.

Extensor brevis, Douglas.

Flexors.

These may be reckoned three.

1. FLEXOR BREVIS DIGITORUM PEDIS, SUBLIMIS PERFORATUS.

Arises, by a narrow fleshy beginning, from the inferior and posterior part of a protuberance of the os calcis, between the abductors of the great and little toes ; soon forms a thick fleshy belly, which sends off four tendons that split for the passage of the flexor longus.

Inserted into the second phalanx of the four lesser toes. The tendon of the little toe is often wanting.

Use. To bend the second joint of the toes.

Perforatus, seu *Sublimis*, Douglas.

2. FLEXOR LONGUS DIGITORUM PEDIS, PROFUNDUS PERFORANS.

Arises, by an acute tendon, which soon becomes fleshy, from the back part of the tibia, some way below its head, near the entry of the medullary artery ; which beginning, is continued down the inner edge of this bone by short fleshy fibres, ending in its tendon ; also by tendinous and fleshy fibres, from the outer edge of the tibia ; and between this double order of fibres the tibialis posticus muscle lies enclosed. Having passed under the annular ligaments, it then passes through a sinuosity at the inside of the os calcis ; and, about the middle of the sole of the foot, divides into four tendons, which pass through the slits of

the perforatus ; and, just before its division, it receives a considerable tendon from that of the flexor pollicis longus.

Inserted into the extremity of the last joint of the four lesser toes.

Use. To extend the ancle joint, to turn the foot inward and bend the toes.

This muscle is assisted by the

**FLEXOR DIGITORUM ACCESSORIUS, SEU MASSA CARNEA
JACOBI SYLVII.**

Arises, by a thin fleshy origin, from most part of the sinusity at the inside of the os calcis, which is continued forward for some space on the same bone ; also by a thin tendinous beginning, from before the tuberosity of the os calcis externally ; and, soon becoming all fleshy, is

Inserted into the tendon of the flexor longus, just at its division into four tendons.

Use. To assist the flexor longus.

3. LUMBRICALES PEDIS,

Arise, by four tendinous and fleshy beginnings, from the tendon of the flexor profundus, just before its division, near the insertion of the massa carnea.

Inserted, by four slender tendons, into the inside of the first joint of the four lesser toes, and are lost in the tendinous expansion that is sent from the extensors to cover the upper part of the toes.

Use. To draw the toes inward, to bend their first joint and to extend the rest.

**MUSCLES WHICH ARE CHIEFLY SITUATED ON
THE FOOT.**

THESE may be divided into the *muscles* of the *great toe*, of the *little toe*, and of the *metatarsal bones*.

Muscles of the great toe.

These are five :

1. EXTENSOR PROPRIUS POLLICIS PEDIS,

Arises, by an acute, tendinous, and fleshy beginning, some way below the head and anterior part of the fibula, along which it runs to near its lower extremity, connecting to it by a number of fleshy fibres, which descend obliquely toward a tendon.

Inserted, tendinous, into the posterior part of the first and last joint of the great toe.

Use. To bend the ankle joint and to extend the great toe.

Extensor longus, Douglas.

Extensor proprius Hallucis, Soemmerring.

2. FLEXOR LONGUS POLLICIS PEDIS,

Arises, by an acute, tendinous, and fleshy beginning, from the posterior part of the fibula, some way below its head, being continued down the same bone, almost to its inferior extremity, by a double order of oblique fleshy fibres ; its tendon passes under an annular ligament at the inner ankle.

Inserted into the last joint of the great toe, and generally sends a small tendon to the os calcis.

Use. To bend the last joint of this toe.

Flexor longus, Douglas.

Flexor longus Hallucis, Soemmerring.

3. FLEXOR BREVIS POLLICIS PEDIS,

Arises, tendinous, from the under and forepart of the os calcis, where it joins with the os cuboides, from the os cuneiforme externum, and is inseparably united with the abductor and adductor pollicis.

Inserted, into the external os sesamoideum and root of the first joint of the great toe.

Use. To bend the first joint.

Flexor Brevis Hallucis, Soemmerring.

4. ABDUCTOR POLLICIS PEDIS,

Arises, fleshy, from the inside of the root of the protuberance of the os calcis, where it forms the heel; and tendinous from the same bone, where it joins with the os naviculare.

Inserted, tendinous, into the internal os sesamoideum, and root of the first joint of the great toe.

Use. To pull the great toe from the rest, and turn it inward.

Thenar, Winslow.

Abductor Hallucis, Soemmerring.

5. ADDUCTOR POLLICIS PEDIS,

Arises, by a long thin tendon, from the os calcis, from the os cuboides, from the os cuneiforme externum, and from the root of the metatarsal bone of the second toe.

Inserted into the external os sesamoideum, and root of the metatarsal bone of the great toe.

Use. To bring this toe nearer the rest, and turn it outward.

Antithenar, Winslow.

Adductor Hallucis, Soemmerring.

Muscles of the little toe.

These, besides the common extensors and flexors, are two, viz.

1. ABDUCTOR MINIMI DIGITI PEDIS,

Arises, tendinous and fleshy, from the semicircular edge of a cavity on the inferior part of the protuberance of the os calcis, and from the root of the metatarsal bone of the little toe.

Inserted into the root of the first joint of the little toe externally.

Use. To draw the little toe outward from the rest.

Parathenar major, and *Metatarsseus*, Winslow.

2. FLEXOR BREVIS MINIMI DIGITI PEDIS,

Arises, tendinous from the os cuboides, near the sulcus or furrow for lodging the tendon of the peroneus longus; fleshy from the outside of the metatarsal bone that sustains this toe, below its protuberant part.

Inserted into the anterior extremity of the metatarsal bone, and root of the first joint of this toe.

Use. To bend this toe, and turn it outward.

Parathenar minor, Winslow.

Muscles from the metatarsal bones.

These are four external and three internal interossei, and one muscle which is common to all the metatarsal bones.

Interossei Pedis externi, Bicipites.

1. ABDUCTOR INDICIS PEDIS.

Arises, tendinous and fleshy, by two origins, from the root of the inside of the metatarsal bone of the fore toe, from the outside of the root of the metatarsal bone of the great toe, and from the os cuneiforme internum.

Inserted, tendinous, into the inside of the root of the first joint of the fore toe.

Use. To pull the fore toe inward from the rest of the small toes.

2. ADDUCTOR INDICIS PEDIS,

Arises, tendinous and fleshy, from the roots of the metatarsal bones of the fore and second toe.

Inserted, tendinous, into the outside of the root of the first joint of the fore toe.

Use. To pull the fore toe outward toward the rest.

3. ADDUCTOR MEDII DIGITI PEDIS.

Arises, tendinous and fleshy, from the roots of the metatarsal bones of the second and third toes.

Inserted, tendinous, into the outside of the root of the first joint of the second toe.

Use. To pull the second toe outward.

4. ADDUCTOR TERTII DIGITI PEDIS,

Arises, tendinous and fleshy, from the roots of the metatarsal bones of the third and little toe.

Inserted, tendinous, into the outside of the root of the first joint of the third toe.

Use. To pull the third toe outward.

Interossei Pedis interni.

1. ABDUCTOR MEDII DIGITI PEDIS.

Arises, tendinous and fleshy, from the inside of the root of the metatarsal bone of the middle toe internally.

Inserted, tendinous, into the inside of the root of the first joint of the middle toe.

Use. To pull the middle toe inward.

2. ABDUCTOR TERTII DIGITI PEDIS.

Arises, tendinous and fleshy, from the inside and inferior part of the root of the metatarsal bone of the third toe.

Inserted, tendinous, into the inside of the root of the first joint of the third toe.

Use. To pull the third toe inward.

3. ABDUCTOR MINIMI DIGITI PEDIS.

Arises, tendinous and fleshy, from the inside of the root of the metatarsal bone of the little toe.

Inserted, tendinous, into the inside of the root of the first joint of the little toe.

Use. To pull the little toe inward.

The muscle which brings the extremities of the metatarsal bones towards each other, is named

TRANSVERSALIS PEDIS.

Arises, tendinous, from the under part of the anterior extremity of the metatarsal bone of the great toe, and from the internal os sesamoideum of the first joint, adhering to the adductor pollicis.

Inserted, tendinous, into the under and outer part of the anterior extremity of the metatarsal bone of the little toe, and ligament of the next toe.

Use. To contract the foot, by bringing the great toe and the two outermost toes nearer each other.

Transversus Pedis, Soemmerring.

N. B. The muscles situated on the sole of the foot are covered by a strong tendinous aponeurosis, which is extended from the os calcis to the first joints of all the toes, and serves to preserve the subjacent parts from being compressed in standing and walking.

SECTION VII.

OF MUSCULAR MOTION.

BY the name of *muscular* or *moving fibres*, we call those bundles of reddish-coloured threads, which perform all the motions of the human body. When many of these fibres are collected together, and appear more evidently red, they are called *a muscle*. The extreme simplicity of the structure of these parts has been the cause of the obscurity that prevails in understanding how a small, soft, fleshy substance, can produce such strong and ample motions as we see in man, and particularly in the crustaceous insects.

In every muscle we meet with long soft threads or *fibres*, somewhat elastic, or extensible, and almost constantly disposed parallel with each other; and these, being surrounded with cellular substance, are by that fastened together into little bundles, called *lacertuli*, which are again tied together into larger bundles, by a more loose cellular net-work, which contains some fat; and betwixt these we constantly perceive membranous partitions and stripes of the cellular substance removing them farther from each other, till at last a number of them combined together in a posture either parallel or inclined, are surrounded with a more thin and dense cellular membrane, contiguous with that of their partitions; and this being again surrounded by a thicker plate of the cellular substance, externally parts the whole from the adjacent flesh, and gives it the denomination of a *single* or *entire muscle*. In every one of these threads there appears a lesser series of filaments, which, by oblique extremities, are cemented to others of the same kind, forming together a large fibre.

The generality of the muscles, but more especially those which are inserted into the bones, have other fibres fixed to them; but these are condensed into a more slender, hard, and shining substance, of a silver colour, which has the name of *tendon*.

That fleshy fibres truly change into such as are tendinous, says Dr. Haller, is evident from comparing a foetus, in which there are few tendons, with a child of some years growth, in which there are many more; and both with an adult, in which are the greatest number. But Dr. Wrisberg observes, in opposition to this, that many tendons are found in a foetus, which could not assume this nature by muscular action; as the tendo Achillis, aponeurosis plantaris, centrum diaphragmatis, &c. Besides, in various parts of the body there are tendons found without corresponding muscles.

Muscles which are not inserted into any of the bones, have commonly no tendons, as the sphincters and muscular membranes of the viscera and vessels. But those commonly end in long tendons, which are required to pass round the joints and heads of the bones, to be inserted in those extremities which are more moveable. In a foetus the muscles are evidently inserted into the periosteum only; but in adults, where the periosteum is more closely joined with the bone itself, the tendons, being confused with the periosteum, pass together with that even into the foveoli of the bone.

The tendinous fibres indeed often lie in a straight line with the fleshy ones, and are as it were a continuation of them. But in many parts of the body the fleshy fibres are obliquely inclined to the tendon, and adhere to it, as the tendon itself grows thicker in its progress by continually receiving new fibres. Other tendons lie in the middle betwixt two plates of fibres, forming an obtuse angle with one another, at irregular distances, in their descent. There are instances of numerous tendons pennated in different places formed into one muscle. There are also other methods by which the tendinous fibres are joined with the fleshy ones.

Within the cellular tunic that surrounds the fibres, the arteries and veins are subdivided into net-works, which commonly form right angles, run in company, and mostly contiguous with each other; and from the smaller of these vessels a vapour is exhaled into the thinner cellular substance, as the fat is also transfused into the thicker cellular substance; whence again they are both absorbed by the lymphatic vessels, which can be

distinctly seen both on the surface and in the substance of the muscles, as in the heart, &c.

The nerves of the muscles are still more evident. They are commonly very large; and enter them by so many branches, that some have considered the muscular fibres as formed by them. Several arguments are now offered against this opinion: one of the strongest is, that muscles in the limbs of animals do not shrink, although the nerves entering these muscles have been cut through for a considerable length of time. The nerves enter the muscles in a way somewhat similar to that of the arteries and veins; but it is impossible to trace them a great way among the fleshy fibres, for they at length deposite their harder covering, and become soft and disappear before they can be traced to their terminations.

The fabric of the least fibre, which is as the element of a muscle, being investigated by the microscope in a man and other animals, is found to be similar to that of the larger fibres, and they are all joined together by the intermediate cellular substance. The surface of these fibres, however, puts on a curious waved or zigzag appearance, as was formerly mentioned. This *Proschaska* thinks is nothing else than impressions made by the vessels and cellular substance, and perhaps by the nerves: but Dr. *Monro* has described and painted a similar appearance in the tendons and nerves; and is of opinion, that they are to be considered as folds or joints, serving to accommodate the parts to the different states of flexion and extension. In proof of this, he finds, that those parts have this appearance in their relaxed state, but lose it when they are much stretched.

With regard to the nature of the ultimate moving fibres, there have been many disputes. Some think they are solid; others, that they are hollow, formed of a series of vessels or rhomboidal chains communicating with each other.

The structure of the tendons agrees in some respects with, but differs in others from, that of the muscles. We observe their fibres regularly disposed, and separated by cellular substance and blood-vessels; and without doubt they have lymphatics and nerves: but the tendinous fibres are closer together than those of the muscles, the cellular substance which sepa-

rates them is finer, their red vessels fewer in number, and the nerves cannot be traced without difficulty into their substance.

It has been doubted whether the fibres of tendons are a continuation of the moving fibres, or of a different nature. Many, both ancients and moderns, have embraced the first opinion, others the second: but if we consider that the tendinous fibres are not irritable, have no contraction, that they differ little from those which constitute the ligaments, and that they degenerate sometimes into a substance truly cellular, we may probably be inclined to adopt the latter opinion.

According to Baron Haller, a muscle therefore is endowed with a threefold force. The dead one, in common to it with other animal fibres: another, which he has called the *vis insita*, and a third, called the *vis nervea*.

The *vis insita* is more proper to life, and the first hours after death, and disappears much sooner than the dead one. In most cases, it acts also by alternate oscillations; so that, being driven hither and thither, it sometimes contracts the muscle towards the middle: sometimes again it extends the muscle from the middle towards the extremities, and sometimes also it has a reiterated motion. Moreover, it is manifestly quicker, and performs the greatest motions. It is excited both by the pricking of an iron instrument, and in the hollow muscles by inflated air, by water, and every kind of acrimony, but most powerfully of all by a torrent of electrical or of galvanic matter. Lastly, it is proper to the muscular fibre, and is found in no other part of the human body with the qualities above mentioned. But we must give a more particular explication of its phenomena.

It is natural to every muscle to shorten itself, by drawing the extremities towards its belly or middle. But to discover the moving power of a muscle from the fabric which we have described, it will be of use to consider the appearances observable in the muscular contraction. Every muscle then becomes shorter and broader in its action. But this contraction of its length is various; in some more, in others less; and is very considerable, for example, in some of the sphincters, insomuch that they appear to be contracted more than one third of their extent.

fibre. Any other explanation would perhaps be hypothetic. As to nervous vesicles swelling by a quicker flux of the nervous spirits, they are inconsistent with anatomical truth, which demonstrates the least visible fibres to be cylindrical, and in no part vesicular; and likewise repugnant to the celerity with which muscular motion is performed, and with the bulk of a muscle being rather diminished than increased during its action. The inflation also of rhomboidal chains in the fibres is equally repugnant to their celerity, to inspection, and to anatomy; they would also occasion an immense waste of strength, and after all render the muscle but little shorter. The nerves besides want that irritable nature which is observed in the muscular fibre. Finally, it is by no means demonstrable, that the fibres, from so few nerves, can be so numerous, or distributed in so many different tranverse directions, with respect to the muscular threads, as those hypotheses require to be allowed. A complication of the nerves round the extremities of fibres, so as to contract them by their elasticity, is founded upon a false structure of the muscular fibre, supposing the nerves to be distributed, where filaments of the cellular substance only can be demonstrated. Moreover, the phenomena, of animals, which, having neither brain nor nerves, are yet very apt for motion, apparently demonstrate the intrinsic fabric of the muscles to be sufficient for their motion, without other assistance from the nerves. Other explanations, derived from spherules full of air in the blood, suppose a false nature of that fluid; namely, a repletion of it with elastic air, of which it has none. The animal spirits are not of the nature of an electric torrent.

That muscle then is contracted which in a given time receives more of the nervous impulse, whether that be occasioned by the will, or by some cause arising in the brain, or applied to the nerve.

But, though you may conjecture the soul to be the cause of the nervous motion, you cannot do the same with regard to that arising from the *vis insita*. The heart and intestines, also the organs of generation, are governed by a *vis insita*, and by stimuli. These powers do not arise from the will; nor are they lessened, or excited, or suppressed, or changed by the same.

No custom nor art can make these organs subject to the will, which have their motions from this power: nor can it be brought about, that they should obey the commands of the soul, like attendants on voluntary motion. It is so certain that motion is produced by the body alone, that we cannot even suspect any motion to arise from a spiritual cause, besides that which we see is occasioned by the will; and, even in that motion which is occasioned by the will, a stimulus will occasion the greatest exertions, when the mind is very unwilling.

There seems to be this difference between the muscles obeying the will, and those which are governed by a *vis insita*; namely, that the latter, being more irritable, are very easily excited into motion by a gentle stimulus; as for instance, the heart and intestines; which organs are most manifestly, greatly, and constantly, irritable. On the other hand, the muscles which obey the will, are neither endowed with so great nor so durable a power of this kind. Hence, they either stand in need of the power of the will, or a stronger stimulus; by which, indeed, when they are excited, even these are animated to motion against the will. Thus it happens, that in apoplexies, the muscles which obey the will languish, and become paralytic, as being destitute of all influx from the brain; while the vital muscles, having no occasion for the operation of the brain, continue to be excited into contraction by their stimuli, the heart by the blood, and the intestines by the air and aliments.

The strength of this action in the muscles is very considerable in all persons, but more especially in those who are phrenetic, and some who are called strong men; since frequently, with the use of a few muscles only, they will raise a weight equal to, or much greater than, that of the whole human body itself. For very slender muscles suffice to elevate 200 or 300 pounds. The muscles of the back will even sustain 3000. Notwithstanding this, we see, that much the greater part of the force or power exerted by a muscle is always lost without producing any visible effect. For all the muscles are inserted nearer the point or centre of motion, than the weights they are applied to; and therefore their action is weaker, in the same proportion as they move a shorter part of the lever than that to which the weight is applied. More-

over, in most of the bones, especially those of the limbs, the muscles are inserted at very acute angles; whence again the effect which a muscle exerts in action, is proportionably less as the sine of the angle intercepted betwixt the bone and the muscle is less than the whole sine. Again, the middle part of all muscular force is lost, because it may be reckoned as a cord extended, and drawing an opposite weight to its fixed point. Again, many of the muscles are seated in the angle of two bones, from one of which arising they move the other; and therefore, that bone being moved, they are bent, and of course, like an inflected cord, require a new force to extend them. Many of them pass over certain joints, each of which they bend in some degree, whereby a less part of their remaining force goes to bend the joint to which they are particularly destined. The fleshy fibres themselves of the muscles frequently intercept angles with the tendon in which they terminate; whence a great part of their force is lost, as much as is equal to the difference or deviation betwixt the sine of the angle of their insertion and the whole sine. Finally, the muscles move their opposed weights with the greatest velocity and expedition, so as not only to overcome the equilibrium, but likewise to add a considerable celerity to the weight.

All these losses of power being computed, make it evident, that the force exerted by muscles in their contraction, is exceeding great beyond any mechanical ratio or proportion whatever; since the effect is scarce one sixtieth of the whole force exerted by the muscle, and yet only a small number of these muscles, weighing but a few pounds, are able not only to raise some thousands of pounds, but also with a considerable celerity. Nor is this to be reputed any defect of wisdom in the arrangements of nature: for all those losses of power were necessary toward a just symmetry or proportion of the parts, with the various motions and celerities required by the muscles to act in different directions; all which circumstances bear a relation to the mechanism of compound engines. But we may, however, conclude hence, that the action of the nervous or animal fluid is very powerful, since, in an engine so small, it can exert a force equal to some thousand pounds for a considerable time, or even

for many days together ; nor does this seem to be otherwise explicable, than by the incredible celerity by which this impulse obeys the command of the will. But how or whence it acquires such a velocity, is not in our power to say ; it is, at present, sufficient that we know the laws of its motion are such, that a given action of the will produces a new and determinate celerity in the nervous fluid.

The easy and sudden relaxions of muscles in their motion are assisted by the actions of their antagonist muscles. That is, in all parts of the body every muscle is counterpoised by some weight, elasticity, an opposite muscle, or a fluid acting against the cavity of a muscle, by which it is expelled. This cause, which is a *vis insita*, continually operates as long as the muscle acts ; and so soon as the additional celerity derived from the brain abates, it restores the limb or other part immediately to its former easy state, in which there is an equilibrium betwixt the muscle and its opposing cause. Whenever the antagonist power is removed from the muscle, there are none of them but must contract, extending their opposites, by which the distended nerves probably excite an uneasy sense, and cause a stronger endeavour toward recovering the equilibrium. Hence one of the flexor muscles being cut in two, the extensor operates even in a dead body ; and the reverse.

But there are other means, by which the motions of the muscles are rendered more safe, certain, and easy. The large long muscles, by which the greater motions of flexure are performed, being included in tendinous capsules or cases, drawn and tightened by other muscles, are thus secured and strengthened ; for so the muscle remains pressed against the bone, in a state of contraction, all the time that the limb is bent, and avoids a considerable loss of its power. But the long tendons, which are incurvated or extended over joints in their motion, are received and confined by peculiar bands, which retain them within their slippery channels, and keep them from slipping out under the skin ; which dislocation of the tendon, whenever it happens, is attended with a spasm of the muscle, severe pain, and loss of motion ; and in these sheaths a particular liquor is separated for the lubricating of the tendons. The same kind of

care we observe taken by nature in the case of muscles which perforate others in their course. In other parts, the tendons are either carried round certain eminences of the bone, in order that they may be inserted at greater angles into the bone which they move ; or else they are inserted into another bone, whence a different tendon descends under a larger angle into the bone to be moved. In other parts, the muscles which are derived from convenient situations, have their tendons carried round in a contrary direction by nature, so that they pass into the part to be moved as it were round a pulley. Nature has likewise surrounded the muscles on all sides with fat, which is spread also betwixt their bundles of fibres and the small fibres themselves which lie contiguous : which fat, being pressed out by the turgescence of the muscles and fibres, renders them soft, flexible, slippery, and fit for motion.

Moreover, the power and action of one muscle is determined by the co-operations or oppositions of others, which serve either to hold firm some part whence the muscle arises, or to bend it together with the muscle, or else to change its action from the perpendicular to the diagonal, by concurring to assist its force at the same time. The muscles also assist one another, even those which are separated at a considerable distance, the first keeping the bone firm which is not to be moved, out of which the second arise. Therefore, the action of no one muscle can be understood from considering it alone ; but all the others must likewise be brought into the consideration, which are either inserted into the muscle itself, or into any of the parts to which the said muscle adheres.

By these muscles, variously conspiring and opposing each other, are performed walking, standing, flexion, extension, deglutition, and all the other gestures and offices of the several parts in the living body. But by too much exercise or action, the muscles themselves grow hard and tendinous on all sides ; render the parts upon which they are incumbent cartilaginous, or else change those which are membranous into a bony nature ; increase the roughness, protuberances, and processes, of the bones which lie next to them, and excavate their flat parts, de-late their cells, and bend the bones toward these parts.

The muscle which the stimulus has ceased to irritate, or for the action of which the mind has no occasion, is relaxed, and grows soft ; its wrinkles are filled up, and grow plain ; its fibres are rendered longer, receding from the middle toward the fixed extremities ; and its swelling falls. Whatever is the cause of additional contraction is then taken away ; but that remains, without which the muscle never is, as long as it is alive. Nor is this the work of an antagonist muscle, although it may be assisted by it.

The three noted classes of animal powers, *elasticity*, *irritability*, and *sensibility*, Dr. Wrisberg observes, have been and are yet too much confounded, although it is no difficult task to distinguish these affections of the fibres from one another. The force and nature of elasticity, possessed by the fibres, which, only in different degrees, pervades all parts without exception, was fully known to Bellini, Baglivi, Stahl, Pacchioni, Juncker, &c. This power, known to Stahl's followers under the appellation of *tone*, has no similarity to irritability, sensibility, and vital power, so called. It does, however, either alone perform the actions of the animal and vegetable body, or adds strength and vigour to them : the former is manifest in the motion of the ribs and cartilages ; and the latter in the constriction of the uterus, vessels, and membranes. It by no means obeys the laws of life alone, but may endure long after death ; it is not destroyed completely but by putrefaction alone. During life it is diminished by various causes, and again restored by several remedies. Irritability, which Haller thought existed in the fibres of the muscles alone, in name indeed but not in reality, and which was known to Glisson, is a new genus of animal power ; nor does the word *ενεργειαν* of Hippocrates signify the same thing. It is almost proved, from the experiments of Lups, Haller, Fontana, Hoffman, and several others, that it is different from elasticity in its rise, duration, seat, causes, effect, and phenomena. We shall add a few remarks :

1. It is most powerful in the muscular fibres of the whole body, but not equally dispersed through all ; more powerful in the heart, muscles of respiration, and intestines ; becomes gradually weaker among the voluntary muscles, and perhaps, in a

trivial degree, in the vessels, membranes ; but always exists, as appears from the doubts offered by Whyte, De Haen, Van Doeveren, &c. to which Haller in part, and also the learned Cigna, have answered.

2. The phenomena of irritability, and the irritations themselves by which those are produced, are not always the same : for in some it advances in a regular track, so that almost from any irritation you will always observe a manifest irritability : this is almost the case in all the muscles. In many other parts you see the greatest inconstancy and a very irregular effect, as it will be one thing one day, another thing another day, now increased, now diminished, one time yield to, another time resist, the irritation : all which is evident in the skin, viscera, vessels, and iris.

3. That it is different from the faculty of feeling, and therefore by no means depends upon the nerves, appears partly from other reasons, partly from the irritability of vegetables. Though it is desirable to take into account some phenomena of the *dionæa muscipula*, according to Ellis's observations, or of the sensitive plant, or the antheræ of certain other plants, it would be wrong to compare this contractile power of some parts of vegetables with irritability ; for what makes the particular character of irritability, the internal tremor of the constituent parts, is wanting in all vegetables ; we see contraction and motion alone, which are also observable in other elastic bodies, where we suppose no irritability to exist. The faculty of feeling, depending solely upon the nerves, although it has been regarded as one and the same thing with irritability, has been more strongly opposed by Haller's opponents, De Haen, Whyte, Le Cat, Gerhard, &c. than irritability itself. But that sensibility of parts is to be referred both to the various quantity of the nerves, their situation and condition, according to Haller's and Castell's experiments, and to the various violence of irritation and nature of the irritating or offending body ; so that they may be at times more or less painful ; and, at others, as Haller thinks, they may be altogether insensible. I shall not repeat what has often been objected to, that a greater pain having preceded, absorbs a less pain following ; as we do not feel the taste of a drop

of wine if we have taken a very small quantity of rectified alcohol upon the tongue a little before. It cannot however be denied, that in inflammatory diseases, affections of the mind, and other causes, it may happen, that hurt parts may now feel, which, under any other condition, may seem to be insensible. The *vital power* of certain learned men of later times, as Vanden Bos, Bikker, Gaubius, Albinus, &c. rather seems compounded of all the animal powers comprehended together; which opinion, except in some minutiae, Boerhaave and Simpson have more exactly adopted.

As the doctrine delivered above, concerning the existence of a *vis insita* different from the *vis nervea*, has been the cause of considerable debate, and is at present called in question by several, particularly by Doctor Monro, we think it necessary to give a few objections as stated in his Observations on the Nervous System. The chief experiment, says the Doctor, which seems to have led Baron Haller to this opinion, is the well-known one, that the heart and other muscles, after being detached from the brain, continue to act spontaneously, or by stimuli may be roused into action for a considerable length of time; and when it cannot be alleged, says Haller, that the nervous fluid is by the mind, or otherwise, impelled into the muscle.

That in this instance, we cannot comprehend by what power the nervous fluid or energy can be put in motion, must, perhaps, be granted: but has Haller given a better explanation of the manner in which his supposed *vis insita* becomes active?

If it be as difficult to point out the cause of the action of the *vis insita* as that of the action of the *vis nervea*, the admission of that new power, instead of relieving, would add to our perplexity.

We should then have admitted, that two causes, of a different nature, were capable of producing exactly the same effect; which is not in general agreeable to the laws of nature.

We should find other consequences arise from such an hypothesis, which tend to weaken the credibility of it. For instance, if in a sound animal the *vis nervea* alone produces the contraction of the muscles, we will ask what purpose the *vis insita*

serves? If both operate, are we to suppose that the *vis nervea*, impelled by the mind or living principle, gives the order, which the *vis insita* executes, and that the nerves are the *internuntii*; and so admit two wise agents employed in every the most simple action? But instead of speculating further, let us learn the effects of experiments, and endeavour from these to draw plain conclusions.

1. When I poured a solution of opium in water under the skin of the leg of a frog, the muscles, to the surface of which it was applied, were very soon deprived of the power of contraction. In like manner, when I poured this solution into the cavity of the heart, by opening the *vena cava*, the heart was almost instantly deprived of its power of motion, whether the experiment was performed on it fixed in its place, or cut out of the body.

2. I opened the thorax of a living frog; and then tied or cut its aorta, so as to put a stop to the circulation of its blood.

I then opened the *vena cava*, and poured the solution of opium into the heart; and found, not only that this organ was instantly deprived of its powers of action, but that in a few minutes the most distant muscles of the limbs were extremely weakened. Yet this weakness was not owing to the want of circulation, for the frog could jump about for more than an hour after the heart was cut out.

In the first of these two experiments, we observe the supposed *vis insita* destroyed by the opium; in the latter, the *vis nervea*; for it is evident that the limbs were affected by the sympathy of the brain, and of the nervous system in general, with the nerves of the heart.

3. When the nerve of any muscle is first divided by a transverse section, and then burnt with a hot iron, or punctured with a needle, the muscle in which it terminates contracts violently, exactly in the same manner as when the irritation is applied to the fibres of the muscle. But when the hot iron, or needle, is confined to the nerve, Dr. Haller himself must have admitted, that the *vis nervea*, and not the *vis insita*, was excited. But here I would ask two questions.

First, Whether we do not as well understand how the vis nervea is excited when irritation is applied to the muscle as when it is applied to the trunk of the nerve, the impelling power of the mind seeming to be equally wanting in both cases?

Secondly, If it appears that irritation applied to the trunk of a nerve excites the vis nervea, why should we doubt that it can equally well excite it when applied to the small and very sensible branches and terminations of the nerve in the muscle?

As, therefore, it appears that the supposed vis insita is destroyed or excited by the same means as the vis nervea; nay, that when, by the application of opium to the heart of a frog, after the aorta is cut and the circulation interrupted, we have destroyed the vis insita, the vis nervea is so much extinguished, that the animal cannot act with the distant muscles of the limbs; and that these afterward grow very torpid, or lose much of their supposed vis insita; it seems clearly to follow, that there is no just ground for supposing that any other principle produces the contraction of a muscle.

These observations are ingenious, philosophical, and worthy of the name of Monro.

SECTION VIII.

OF THE BURSE MUCOSE.

THESE mucous bags serve the purpose of lubricating the tendons of the muscles.

SOEMMERRING has observed that they not only exist in the extremities, but may also be demonstrated in the trunk and in the head.

It is scarcely necessary to say more of them than that they are uniformly either situated wherever the tendon of one muscle passes over another, a bone, or any solid part, or they are placed between superficial tendons and the integuments.

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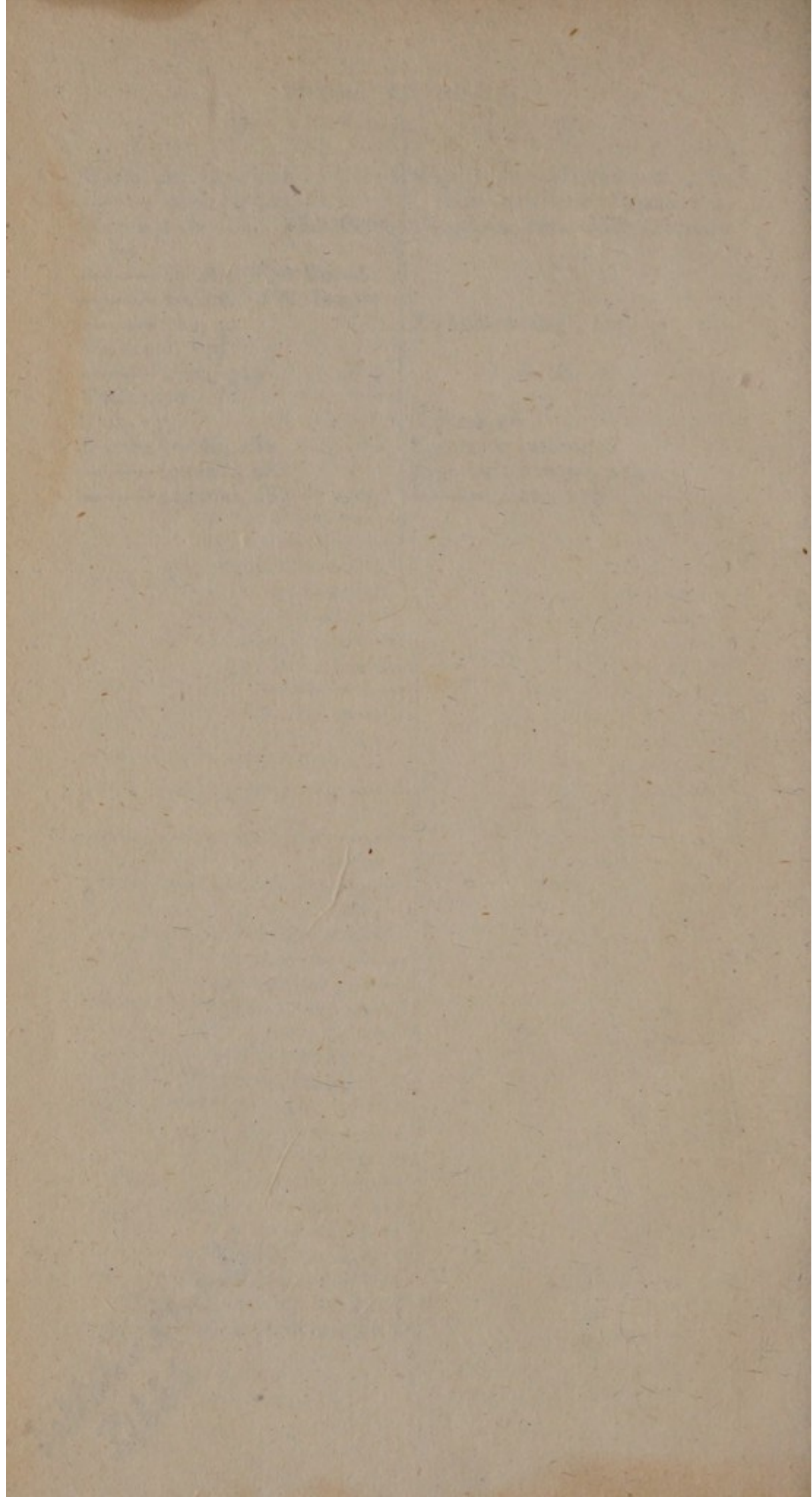
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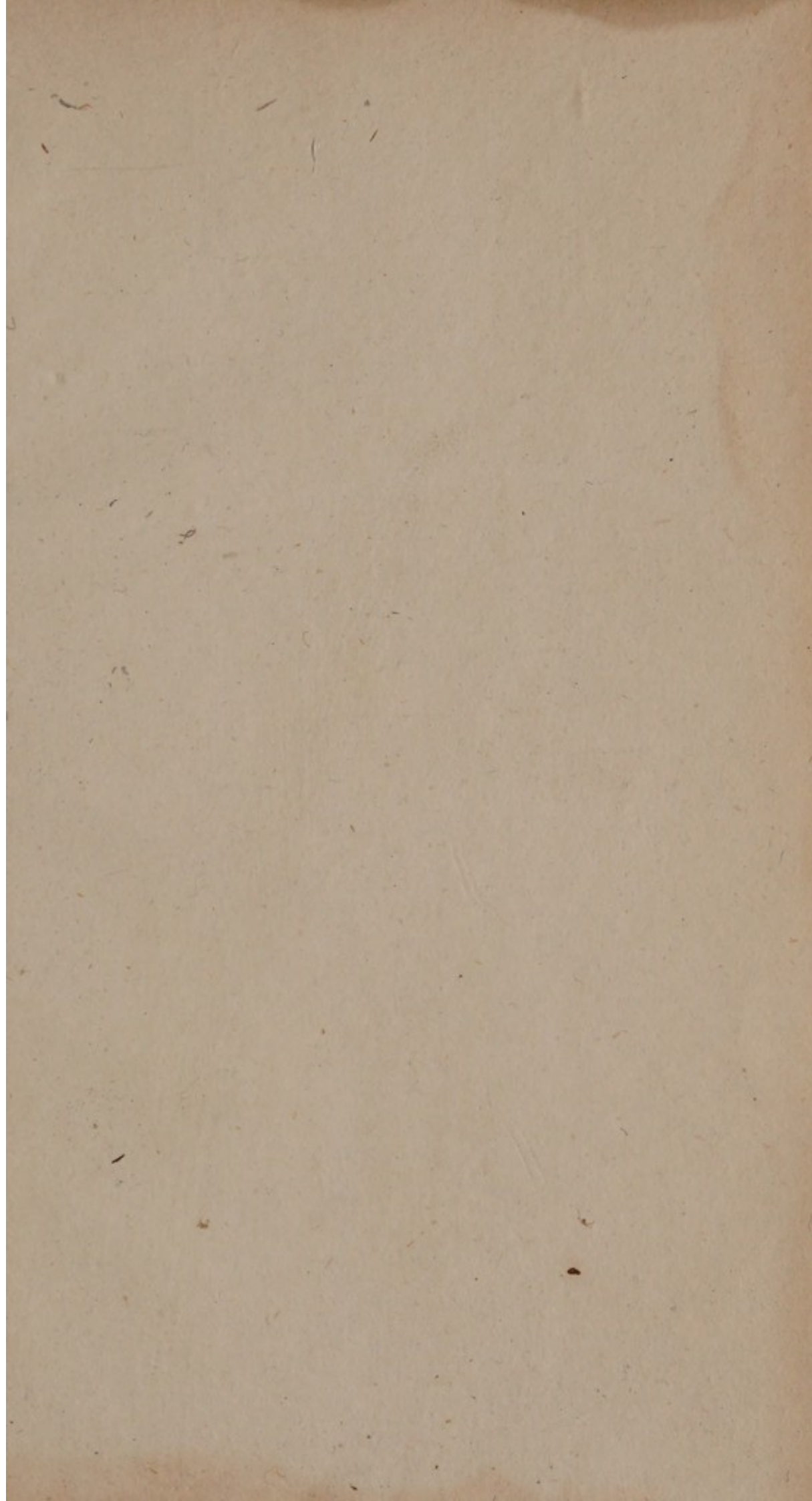
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Wellcome
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