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SYSTEM

OF

ANATOMY.

A

COMPENDIOUS SYSTEM

OF

ANATOMY.

IN SIX PARTS.

I. OSTEOLOGY.
II. OF THE MUSCLES, &c.
III. OF THE ABDOMEN.
IV. OF THE THORAX.
V. OF THE BRAIN AND NERVES.
VI. OF THE SENSES.

FROM THE ENCYCLOPÆDIA.

Illustrated with Twelve large Copperplates.

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1805.

CONTENTS.

SYSTEM

OF

ANATOMY.

ANATOMY,

THE art of dissecting, or artificially separating and taking to pieces, the different parts of the human body, in order to an exact discovery of their situation, structure, and œconomy.—The word is Greek, ανατομη; derived from ανατεμνω, to dissect, or separate by cutting.

INTRODUCTION.

1. *History of Anatomy.*

THIS art seems to have been very ancient; though, for a long time, known only in an imperfect manner.—The first men who lived must have soon acquired some notions of the structure of their own bodies, particularly of the external parts, and of some even of the internal, such as bones, joints, and sinews, which are exposed to the examination of the senses in living bodies.

This rude knowledge must have been gradually improved, by the accidents to which the body is exposed, by the necessities of life, and by the various customs, ceremonies, and superstitions, of different nations. Thus, the observance of bodies killed by violence, attention to wounded men, and to many diseases, the various ways of putting criminals to death, the funeral ceremonies, and a variety of such things, must have shown men every day more and more of themselves; especially as curiosity and self-love would here urge them powerfully to observation and reflection.

The brute-creation having such an affinity to man in outward form, motions, senses, and ways of life; the generation of the species, and the effect of death upon the body, being observed to be so nearly the same in both; the conclusion was not only obvious, but unavoidable, that their bodies were formed nearly upon the same model. And the opportunities of examining the bodies of brutes were so easily procured, indeed so necessarily occurred in the common business of life, that the huntsman in making use of his prey, the priest in sacrificing, the augur in divination, and, above all, the butcher, or those who might out of curiosity attend upon his operations, must have been daily adding to the little stock of anatomical knowledge. Accordingly we find, in fact, that the South-sea islanders, who have been left to their own observation and reasoning, without the assistance of letters, have yet a considerable share of rude or wild anatomical and physiological knowledge. Dr. Hunter informs us, that when Omai was in his museum with Mr. Banks, though he could not explain himself intelligibly, they plainly saw that he knew the principal parts of the body, and something likewise of their uses; and manifested a great curiosity or desire of having the functions of the internal parts of the body explained to him, particularly the relative functions of the two sexes, which with him seemed to be the most interesting object of the human mind.

We may further imagine, that the philosophers of the most early ages, that is, the men of curiosity, observation, experience and reflection, could not overlook an instance of natural organization, which was so interesting, and at the same time so wonderful, more especially such of them as applied to the study and cure of diseases. We know that physic was a branch of philosophy till the age of Hippocrates.

Thus the art must have been circumstanced in its beginning. We shall next see from the testimony of historians and other writers, how it actually appeared as an art, from the time that writing was introduced among men; how it was improved and conveyed down to us through a long series of ages.

Civilization and improvements of every kind, would naturally begin in fertile countries and healthful climates, where there would be leisure for reflection, and an appetite for amusement. Accordingly, writing, and many other useful and ornamental inventions and arts, appear to have been cultivated in the eastern parts of Asia long before the earliest times that are treated of by the Greek or other European writers; and that the arts and learning of those eastern people were in subsequent times gradually communicated to adjacent countries, especially by the medium of traffic. The customs, superstitions, and climate of eastern countries, however, appear to have been as unfavourable to practical anatomy, as they were inviting to the study of astronomy, geometry, poetry, and all the softer arts of peace.

Animal bodies there, run so quickly into nauseous putrefaction, that the early inhabitants must have avoided such offensive employments, as anatomical inquiries, like their posterity at this day. And, in fact, it does not appear, by the writings of the Grecians, or Jews, or Phœnicians, or of other eastern countries, that anatomy was particularly cultivated by any of those eastern nations. In tracing it backwards to its infancy, we cannot go farther into antiquity than the times of the Grecian philosophers. As an art in the state of some cultivation, it may be said to have been brought forth and bred up among them as a branch of natural knowledge.

The æra of philosophy, as it was called, began with Thales the Milesian being declared by a very general consent of the people, the most wise of all the Grecians, 480 years before Christ. The philosophers of his school, which was called the Ionian, cultivated principally natural knowledge. Socrates, the seventh in succession of their great teachers, introduced the study of morals, and was thence said to bring down philosophy from heaven, to make men truly wise and happy.

In the writings of his scholar and successor Plato, we see that the philosophers had carefully considered the human body, both in its organization and functions; and though they had not arrived at the knowledge of the more minute and intricate parts, which required the successive labour and attention of many ages, they had made up very noble and comprehensive ideas of the subject in general. The anatomical descriptions of Xenophon and Plato have had the honour of being quoted by Longinus (§xxxii.) as specimens of sublime writing; and the extract from Plato is still more remarkable for its containing the rudiments of the circulation of the blood. "The heart (says Plato) is the centre or knot of the blood-vessels; the spring or fountain of the blood which is carried impetuously round; the blood is the *pabulum* or food of the flesh; and, for the purpose of nourishment, the body is laid out into canals, like those which are drawn through gardens, that the blood may be conveyed, as from a fountain, to every part of the pervious body."

Hippocrates was nearly contemporary with the great philosophers of whom we have been speaking, about 400 years before the Christian æra. He is said to have separated the profession of philosophy and physic, and to have been the first who applied to physic alone as the business of his life. He is likewise generally supposed to be the first who wrote upon anatomy. We know of nothing that was written expressly upon the subject before; and the first anatomical dissection which has been recorded, was made by his friend Democritus of Abdera.

If, however, we read the works of Hippocrates with impartiality, and apply his accounts of the parts to what we now know of the human body, we must allow his descriptions to be imperfect, incorrect, sometimes extravagant, and often unintelligible, that of the bones only excepted. He seems to have studied these with more success than the other parts, and tells us that he had an opportunity of seeing an human skeleton.

From Hippocrates to Galen, who flourished towards the end of the second century, in the decline of the Roman empire, that is, in the space of 600 years, anatomy was greatly improved; the philosophers still considering it as a most curious and interesting branch of natural knowledge, and the physicians, as a principal foundation of their art. Both of them, in that interval of time, contributed daily to the common stock, by more accurate and extended observations, and by the lights of improving philosophy.

As these two great men had applied very particularly to the study of animal bodies, they not only made great improvements, especially in physiology, but raised the credit of natural knowledge, and spread it as wide as Alexander's empire.

Few of Aristotle's writings were made public in his lifetime. He affected to say that they would be unintelligible to those who had not heard them explained at his lectures: and, except the use which Theophrastus made of them, they were lost to the public for above 130 years after the death of Theophrastus; and at last came out defective from bad preservation, and corrupted by men, who, without proper qualifications, presumed to correct and supply what was lost.

From the time of Theophrastus, the study of natural knowledge at Athens was for ever on the decline; and the reputation of the Lycæum and Academy was almost confined to the studies which are subservient to oratory and public speaking.

The other great institution for Grecian education, was at Alexandria in Egypt. The first Ptolemies, both from their love of literature, and to give true and permanent dignity to their empire, and to Alexander's favourite city, set up a grand school in the palace itself, with a museum and library, which, we may say, has been the most famed in the world. Anatomy, among other sciences, was publicly taught; and the two distinguished anatomists were Erasistratus the pupil and friend of Theophrastus, and Herophilus. Their voluminous works are all lost; but they are quoted by Galen almost in every page. These professors were probably the first who were authorised to dissect human bodies; a peculiarity which marks strongly the philosophical magnanimity of the first Ptolemy, and fixes a great æra in the history of anatomy. And it was, no doubt, from this particular advantage which the Alexandrians had above all others, that their school not only gained, but for many centuries preserved, the first reputation for medical education. Ammianus Marcellinus, who lived about 650 years after the schools were set up, says, they were so famous in his time, that it was enough to secure credit to any physician, if he could say he had studied at Alexandria.

Herophilus has been said to have anatomized 700 bodies. We must allow for exaggeration. Nay, it was said, that both he and Erasistratus made it a common practice to open living bodies, that they might discover the more secret springs of life. But this, no doubt was only a vulgar opinion, rising from the prejudices of mankind; and accordingly, without any good reason, such tales have been told of modern anatomists, and have been believed by the vulgar.

Among the Romans, though it is probable they had physicians and surgeons from the foundation of the city, yet we have no account of any of these applying themselves to anatomy for a very long time. Archagathus was the first Greek physician established in Rome, and he was banished the city on account of the severity of his operations.—Asclepiades, who flourished in Rome 101 years after Archagathus, in the time of Pompey, attained such a high reputation as to be ranked in the same class with Hippocrates. He seemed to have some notion of the air in respiration acting by its weight; and in accounting for digestion, he supposed the food to be no farther changed than by a comminution into extremely small parts, which being distributed to the several parts of the body, is assimilated to the nature of each. One Cassius, commonly thought to be a disciple of Asclepiades, accounted for the right side of the body becoming paralytic on hurting the left side of the brain, in the same manner as has been done by the moderns, viz. by the crossing of the nerves from the right to the left side of the brain.

From the time of Asclepiades to the second century, physicians seem to have been greatly encouraged at Rome; and, in the writings of Celsus, Rufus, Pliny, Cœlius, Aurelianus, and Aræteus, we find several anatomical observations, but mostly very superficial and inaccurate. Towards the end of the second century lived Claudius Gallenus Pergamus, whose name is so well known in the medical world. He applied himself particularly to the study of anatomy, and did more in that way than all that went before him. He seems, however, to have been at a great loss for human subjects to operate upon; and therefore his descriptions of the parts are mostly taken from brute animals. His works contain the fullest history of anatomists, and the most complete system of the science, to be met with any where before him, or for several centuries after; so that a number of passages in them were reckoned absolutely unintelligible for many ages, until explained by the discoveries of succeeding anatomists.

About the end of the fourth century, Nimesius bishop of Emissa wrote a treatise on the nature of man, in which it is said were contained two celebrated modern discoveries; the one, the uses of the bile, boasted of by Sylvius de la Boe; and the other, the circulation of the blood. This last, however, is proved by Dr. Friend, in his history of physic, p. 229. to be falsely ascribed to this author.

The Roman empire beginning now to be oppressed by the barbarians, and sunk in gross superstition, learning of all kinds decreased; and when the empire was totally overwhelmed by those barbarous nations, every appearance of science was almost extinguished in Europe. The only remains of it were among the Arabians in Spain and in Asia.—The Saracens who came into Spain, destroyed at first all the Greek books which the Vandals had spared: but though their government was in a constant struggle and fluctuation during 800 years before they were driven out, they received a taste for learning from their countrymen of the east; several of their princes encouraged liberal studies; public schools were set up at Cordova, Toledo, and other towns, and translations of the Greeks into the Arabic were universally in the hands of their teachers.

Thus was the learning of the Grecians transferred to the Arabians. But though they had so good a foundation to build upon, this art was never improved while they were masters of the world: for they were satisfied with commenting upon Galen; and seem to have made no dissection of human bodies.

Abdollaliph, who was himself a teacher of anatomy, a man eminent in his time (at and before 1203) for his learning and curiosity; a great traveller, who had been bred at Bagdad, and had seen many of the great cities and principal places for study in the Saracen empire; who had a favourable opinion of original observation, in opposition to book-learning; who boldly corrected some of Galen's errors, and was persuaded that many more might be detected; this man, we say, never made or saw, or seemed to think of a human dissection. He discovered Galen's errors in the osteology, by going to burying-grounds, with his students and others, where he examined and demonstrated the bones; he earnestly recommended that method of study, in preference even to the reading of Galen, and thought that many farther improvements might be made; yet he seemed not to have an idea that a fresh subject might be dissected with that view.

Perhaps the Jewish tenets, which the Mahometans adopted, about uncleanliness and pollution, might prevent their handling dead bodies; or their opinion of what was supposed to pass between an angel and the dead person, might make them think disturbing the dead highly sacrilegious. Such, however, as Arabian learning was, for many ages together there was hardly any other in all the western countries of Europe. It was introduced by the establishment of the Saracens in Spain in 711, and kept its ground till the restoration of learning in the end of the 15th century. The state of anatomy in Europe, in the times of Arabian influence, may be seen by reading a very short system of anatomy drawn up by Mundinus, in the year 1315. It was extracted principally from what the Arabians had preserved of Galen's doctrine; and, rude as it is, in that age, it was judged to be so masterly a performance, that it was ordered by a public decree, that it should be read in all the schools of Italy; and it actually continued to be almost the only book which was read upon the subject for above 200 years. Cortesius gives him the credit of being the great restorer of anatomy, and the first who dissected human bodies among the moderns.

A general prejudice against dissection, however, prevailed till the 16th century. The emperor Charles V. ordered a consultation to be held by the divines of Salamanca, in order to determine whether or not it was lawful in point of conscience to dissect a dead body. In Muscovy, till very lately, both anatomy and the use of skeletons were forbidden, the first as inhuman, and the latter as subservient to witchcraft.

In the beginning of the 15th century, learning revived considerably in Europe, and particularly physic, by means of copies of the Greek authors brought from the sack of Constantinople; after which the number of anatomists and anatomical books increased to a prodigious degree.—The Europeans becoming thus possessed of the ancient Greek fathers of medicine, were for a long time so much occupied in correcting the copies they could obtain, studying the meaning, and commenting upon them, that they attempted nothing of their own, especially in anatomy.

And here the late Dr. Hunter introduces into the annals of this art, a genius of the first rate, Leonardo da Vinci, who had been formerly overlooked, because he was of another profession, and because he published nothing upon the subject. He is considered by the Doctor as by far the best anatomist and physiologist of his time; and was certainly the first man we know of who introduced the practice of making anatomical drawings.

Vassere, in his lives of the painters, speaks of Leonardo thus, after telling us that he had composed a book of the anatomy of a horse, for his own study: "He afterwards applied himself with more diligence to the human anatomy; in which study he reciprocally received and communicated assistance to Marc. Antonio della Torre, an excellent philosopher, who then read lectures in Pavia, and wrote upon this subject; and who was the first, as I have heard, who began to illustrate medicine from the doctrine of Galen, and to give true light to anatomy, which till that time had been involved in clouds of darkness and ignorance. In this he availed himself exceedingly of the genius and labour of Leonardo, who made a book of studies, drawn with red chalk, and touched with a pen, with great diligence, of such subjects as he had himself dissected; where he made all the bones, and to those he joined, in their order, all the nerves, and covered them with the muscles. And concerning those, from part to part, he wrote remarks in letters of an ugly form, which are written by the left hand, backwards, and not to be understood but by those who know the method of reading them; for they are not to be read without a looking-glass. Of these papers of the human anatomy, there is a great part in the possession of M. Francesco da Melzo, a Milanese gentleman, who, in the time of Leonardo, was a most beautiful boy, and much beloved by him, as he is now a beautiful and genteel old man, who reads those writings, and carefully preserves them, as precious relicks, together with the portrait of Leonardo, of happy memory. It appears impossible that that divine spirit should reason so well upon the arteries, and muscles, and nerves, and veins; and with such diligence of every thing, &c. &c."

Those very drawings and the writings are happily found to be preserved in his Britannic Majesty's great collection of original drawings, where the Doctor was permitted to examine them; and his sentiments upon the occasion he thus expresses: "I expected to see little more than such designs in anatomy, as might be useful to a painter in his own profession; but I saw, and indeed with astonishment, that Leonardo had been a general and a deep student. When I consider what pains he has taken upon every part of the body, the superiority of his universal genius, his particular excellence in mechanics and hydraulics, and the attention with which such a man would examine and see objects which he was to draw, I am fully persuaded that Leonardo was the best anatomist at that time in the world. We must give the 15th century the credit of Leonardo's anatomical studies, as he was 55 years of age at the close of that century."

In the beginning of the 16th century, Achillinus and Benedictus, but particularly Berengarius and Massa, followed out the improvement of anatomy in Italy, where they taught it, and published upon the subject. These first improvers made some discoveries from their own dissections: but it is not surprising that they should have been diffident of themselves, and have followed Galen almost blindly, when his authority had been so long established, and when the enthusiasm for Greek authors was rising to such a pitch.

Soon after this, we may say about the year 1540, the great Vesalius appeared. He was studious, laborious, and ambitious. From Brussels, the place of his birth, he went to Louvain, and thence to Paris, where anatomy was not yet making a considerable figure, and then to Louvain to teach; from which place, very fortunately for his reputation, he was called to Italy, where he met with every opportunity that such a genius for anatomy could desire, that is, books, subjects, and excellent draughtsmen. He was equally laborious in reading the ancients, and in dissecting bodies. And in making the comparison, he could not but see, that there was great room for improvement, and that many of Galen's descriptions were erroneous. When he was but a young man, he published a noble system of anatomy, illustrated with a great number of elegant figures.—In this work he found so many occasions of correcting Galen, that his contemporaries, partial to antiquity, and jealous of his reputation, complained that he carried his turn for improvement and criticisms to licentiousness. The spirit of opposition and emulation was presently roused; and Sylvius in France, Columbus, Fallopius, and Eustachius in Italy, who were all in high anatomical reputation about the middle of this 16th century, endeavoured to defend Galen at the expense of Vesalius. In their disputes they made their appeals to the human body: and thus in a few years the art was greatly improved. And Vesalius being detected in the very fault which he condemned in Galen, to wit, describing from the dissections of brutes, and not of the human body, it exposed so fully that blunder of the older anatomists, that in succeeding times there has been little reason for such complaint.—Besides the above, he published several other anatomical treatises. He has been particularly serviceable by imposing names on the muscles, most of which are retained to this day. Formerly they were distinguished by numbers, which were differently applied by almost every author.

In 1561, Gabriel Fallopius, professor of anatomy at Padua, published a treatise of anatomy under the title of *Observationes Anatomicæ.* This was designed as a supplement to Vesalius; many of whose descriptions he corrects, though he always makes mention of him in an honourable manner. Fallopius made many great discoveries, and his book is well worth the perusal of every anatomist.

In 1563, Bartholomæus Eustachius published his *Opuscula Anatomica* at Venice, which have ever since been justly admired for the exactness of the descriptions, and the discoveries contained in them. He published afterwards some other pieces, in which there is little of anatomy; but never published the great work he had promised, which was to be adorned with copperplates representing all the parts of the human body. These plates, after lying buried in an old cabinet for upwards of 150 years, were at last discovered and published in the year 1714, by Lancisi the pope's physician; who added a short explicatory text, because Eustachius's own writing could not be found.

From this time the study of anatomy gradually diffused itself over Europe; insomuch that for the last hundred years it has been daily improving by the labour of a number of professed anatomists almost in every country of Europe.

We may form a judgment about the state of anatomy even in Italy, in the beginning of the 17th century, from the information of Cortesius. He had been professor of anatomy at Bologna, and was then professor of medicine at Massana; where, though he had a great desire to improve himself in the art, and to finish a treatise which he had begun on practical anatomy, in 24 years he could twice only procure an opportunity of dissecting a human body, and then it was with difficulties and in hurry; whereas he had expected to have done so, he says, *once every year, according to the custom in the famous academies of Italy.*

In the very end of the 16th century, the great Harvey, as was the custom of the times, went to Italy to study medicine; for Italy was still the favourite seat of the arts: And in the very beginning of the 17th century, soon after Harvey's return to England, his master in anatomy, Fabricius ab Aquapendente, published an account of the valves in the veins, which he had discovered many years before, and no doubt taught in his lectures when Harvey attended him.

This discovery evidently affected the established doctrine of all ages, that the veins carried the blood from the liver to all parts of the body for nourishment. It set Harvey to work upon the use of the heart and vascular systems in animals; and in the course of some years he was so happy as to discover, and to prove beyond all possibility of doubt, *the circulation of the blood.* He taught his new doctrine in his lectures about the year 1616, and printed it in 1628.

It was by far the most important step that had been made in the knowledge of animal bodies in any age. It not only reflected useful lights upon what had been already found out in anatomy, but also pointed out the means of further investigation. And accordingly we see, that from Harvey to the present time, anatomy has been so much improved, that we may reasonably question if the ancients have been further outdone by the moderns in any other branch of knowledge. From one day to another there has been a constant succession of discoveries, relating either to the structure or functions of our body; and new anatomical processes, both of investigation and demonstration, have been daily invented. Many parts of the body, which were not known in Harvey's time, have since then been brought to light: and of those which were known, the internal composition and functions remained unexplained; and indeed must have remained unexplicable without the knowledge of the circulation.

Harvey's doctrine at first met with considerable opposition; but in the space of about 20 years it was so generally and so warmly embraced, that it was imagined every thing in physic would be explained. But time and experience have taught us, that we still are, and probably must long continue to be, very ignorant; and that in the study of the human body, and of its diseases, there will always be an extensive field for the exercise of sagacity.

After the discovery and knowledge of the circulation of the blood, the next question would naturally have been about the passage and route of the nutritious part of the food or chyle from the bowels to the blood-vessels: And, by good fortune, in a few years after Harvey had made his discovery, Asellius, an Italian physician, found out the lacteals, or vessels which carry the chyle from the intestines; and printed his account of them, with coloured prints, in the year 1627, the very year before Harvey's book came out.

For a number of years after these two publications, the anatomists in all parts of Europe were daily opening living dogs, either to see the lacteals or to observe the phenomena of the circulation. In making an experiment of this kind, Pecquet in France was fortunate enough to discover the thoracic duct, or common trunk of all the lacteals, which conveys the chyle into the subclavian vein. He printed his discovery in the year 1651. And now the lacteals having been traced from the intestines to the thoracic duct, and that duct having been traced to its termination in a blood-vessel, the passage of the chyle was completely made out.

The same practice of opening living animals furnished occasions of discovering the lymphatic vessels. This good fortune fell to the lot of Rudbec first, a young Swedish anatomist; and then to Thomas Bartholine, a Danish anatomist, who was the first who appeared in print upon the lymphatics. His book came out in the year 1653, that is, two years after that of Pecquet. And then it was very evident that they had been seen before by Dr. Higmore and others, who had mistaken them for lacteals. But none of the anatomists of those times could make out the origin of the lymphatics, and none of the physiologists could give a satisfactory account of their use.

The circulation of the blood, and the passage of the chyle having been satisfactorily traced out in full-grown animals, the anatomists were naturally led next to consider how these animal processes were carried on in the child while in the womb of the mother. Accordingly the male and female organs, the appearances and contents of the pregnant uterus, the incubated egg, and every phenomenon which could illustrate generation, became the favourite subject, for about 30 years, with the principal anatomists of Europe.

Thus it would appear to have been in theory: but Dr. Hunter believes, that in fact, as Harvey's master Fabricius laid the foundation for the discovery of the circulation of the blood by teaching him the valves of the veins, and thereby inviting him to consider that subject; so Fabricius by his lectures, and by his elegant work *De formato fœtu, et de formatione ovi et pulli*, probably made that likewise a favourite subject with Dr. Harvey. But whether he took up the subject of generation in consequence of his discovery of the circulation, or was led to it by his honoured master Fabricius, he spent a great deal of his time in the inquiry; and published his observations in a book *De generatione animalium*, in the year 1651, that is, six years before his death.

In a few years after this, Swammerdam, Van Horn, Steno, and De Graaf, excited great attention to the subject of generation, by their supposed discovery that the females of viviparous animals have ovaria, that is, clusters of eggs in their loins, like oviparous animals; which, when impregnated by the male, are conveyed into the uterus; so that a child is produced from an egg as well as a chick; with this difference, that one is hatched within, and the other without, the body of the mother.

Malpighi, a great Italian genius, some time after, made considerable advances upon the subject of generation. He had the good fortune to be the first who used magnifying glasses with address in tracing the first appearances in the formation of animals. He likewise made many other observations and improvements in the *minutiæ* of anatomy by his microscopical labours, and by cultivating comparative anatomy.

This distinguished anatomist gave the first public specimen of his abilities, by printing a dissertation on the lungs *anno* 1661; a period so remarkable for the study of nature, that it would be injustice to pass it without particular notice.

At the same time flourished Laurentius Bellinus at Florence, and was the first who introduced mathematical reasoning in physic. In 1662, Simon Pauli published a treatise *De albandis ossibus*. He had long been admired for the white skeletons he prepared; and at last discovered his method, which was by exposing the bones all winter to the weather.

Johannes Swammerdam of Amsterdam also published some anatomical treatises; but was most remarkable for his knowledge of preserving the parts of bodies entire for many years, by injecting their vessels. He also published a treatise on respiration; wherein he mentioned his having figures of all the parts of the body as big as the life, cut in copper, which he designed to publish, with a complete systems of anatomy. These, however, were never made public by Swammerdam; but, in 1683, Gothofridus Bidloo, professor of anatomy at Leyden, published a work entitled *Anatomia corporis humani*, where all the parts were delineated in very large plates almost as big as the life. Mr. Cowper, an English surgeon, bought 300 copies of these figures; and in 1698, published them with an English text, quite different from Bidloo's Latin one; to which were added letters in Bidloo's figures, and some few figures of Mr. Cowper's own. To this work Cowper's name was prefixed, without the least mention of Bidloo, except on purpose to confute him. Bidloo immediately published a very ill-natured pamphlet, called *Gulielmus Cowperus citatus* *coram tribunali;* appealing to the Royal Society, how far Cowper ought to be punished as a plagiary of the worst kind, and endeavouring to prove him an ignorant deceitful fellow. Cowper answered him in his own style, in a pamphlet called his *Vindiciæ;* endeavouring to prove, either that Bidloo did not understand his own tables, or that they were none of his. It was even alleged that those were the tables promised by Swammerdam, and which Bidloo had got from his widow. This, however, appears to have been only an invidious surmise, there being unquestionable evidence that they were really the performance of Bidloo.

Soon after, Isbrandus Diembroeck, professor of anatomy at Utrecht, began to appear as an author. His work contained very little original; but he was at great pains to collect from others whatever was valuable in their writings, and his system was the common standard among anatomical students for many years.

About the same time, Antonius Liewenhoeck of Delft, improved considerably on Malpighi's use of microscopes. These two authors took up anatomy where others had dropt it; and, by this new art, they brought a number of amazing things to light. They discovered the red globules of the blood; they were enabled to see the actual circulation of the blood in the transparent parts of living animals, and could measure the velocity of its motion; they discovered that the arteries and veins had no intermediate cells or spungy substance, as Harvey and all the preceding anatomists had supposed, but communicated one with the other by a continuation of the same tube.

Liewenhoeck was in great fame likewise for his discovery of the animalcula in the semen. Indeed there was scarcely a part of the body, solid or fluid, which escaped his examination; and he almost every where found, that what appeared to the naked eye to be rude undigested matter, was in reality a beautiful and regular compound.

After this period, Nuck added to our knowledge of the absorbent system already mentioned, by his injections of the lymphatic glands; Ruysch, by his description of the valves of the lymphatic vessels; and Dr. Meckel, by his accurate account of the whole system, and by tracing those vessels in many parts where they had not before been described.

Besides these authors, Drs. Hunter and Monro have called the attention of the public to this part of anatomy, in their controversy concerning the discovery of the office of the lymphatics.

When the lymphatic vessels were first seen and traced into the thoracic duct, it was natural for anatomists to suspect, that as the lacteals absorbed from the cavity of the intestines, the lymphatics, which are similar in figure and structure, might possibly do the same office with respect to other parts of the body: and accordingly, Dr. Glisson, who wrote in 1654, supposes these vessels arose from cavities, and that their use was to absorb; and Frederic Hoffman has very explicitly laid down the doctrine of the lymphatic vessels being a system of absorbents. But anatomists in general have been of a contrary opinion; for, from experiments, particularly such as were made by injections, they have been persuaded that the lymphatic vessels did not arise from cavities, and did not absorb, but were merely continuations from small arteries. The doctrine, therefore, that the lymphatics, like the lacteals, were absorbents, as had been suggested by Glisson and by Hoffman, has been revived by Dr. Hunter and Dr. Monro, who have controverted the experiments of their predecessors in anatomy, and have endeavoured to prove that the lymphatic vessels are not continued from arteries, but are absorbents.

To this doctrine, however, several objections have been started, particularly by Haller (Elem. Phys. l. 24. § 2, 3.); and it has been found, that before the doctrine of the lymphatics being a system of absorbents can be established, it must first be determined whether this system is to be found in other animals besides man and quadrupeds. Mr. Hewson claims the merit of having proved the affirmative of this question, by discovering the lymphatic system in birds, fish, and amphibious animals. See *Phil. Trans.* vol. lviii. and lxix.—And latterly, Mr. Cruikshank has traced the ramifications of that system in almost every part of the body; and from his dissections, figures have been made and lately published to the world. To Mr. Sheldon also we are much indebted for his illustration of this system, which promises to give great satisfaction, but of which only a part has yet been published.

The gravid uterus is a subject likewise which has received considerable improvements, particularly relating to one very important discovery; viz. that the internal membrane of the uterus, which Dr. Hunter has named *decidua*, constitutes the exterior part of the secundines or after-birth, and separates from the rest of the uterus every time that a woman either bears a child or suffers a miscarriage. This discovery includes another, to wit, that the placenta is partly made up of an excrescence or efflorescence from the uterus itself.

These discoveries are of the utmost consequence, both in the physiological question about the connection between the mother and child, and likewise in explaining the phenomena of births and abortions, as well as in regulating obstetrical practice.

The anatomists of this century have improved anatomy, and have made the study of it much more easy, by giving us more correct as well as more numerous figures. It is amazing to think of what has been done in that time. We have had four large folio books of figures of the bones, viz. Cheselden's, Albinus's, Sue's and Trew's. Of the muscles, we have had two large folios; one from Cowper, which is elegant; and one from Albinus, which, from the accuracy and labour of the work, we may suppose will never be outdone. Of the blood-vessels we have a large folio from Dr. Haller. We have had one upon the nerves from Dr. Meckel, and another by Dr. Monro junior. We have had Albinus's, Roederer's, Jenty's, and Hunter's works upon the pregnant uterus; Weitbrecht and Leber on the joints and fresh bones; Soemerring on the brain; Zin on the eye; Cotunius, Meckel junior, &c. on the ear; Walterus on the nerves of the thorax and abdomen; Dr. Monro on the bursæ mucosæ, &c.

It would be endless to mention the anatomical figures that have been published in this century, of particular and smaller parts of the body, by Morgagni, Ruysch, Valsalva, Sanctorini, Heister, Vater, Cant, Zimmerman, Walterus, and others.

Those elegant plates of the brain, however, just published by M. Vicq. d'Azyr, must not pass without notice, especially as they form part of an universal system of anatomy and physiology, both human and comparative, proposed to be executed in the same splendid style. Upon the brain alone 19 folio plates are employed; of which several are coloured. The figures are delineated with accuracy and clearness; but the colouring is rather beautiful than correct. Such parts of this work as may be published, cannot fail to be equally acceptable to the anatomist and the philosopher; but the entire design is apparently too extensive to be accomplished within the period of a single life. In Great Britain, also, a very great anatomical work is carrying on by Andrew Bell, F. S. A. S. engraver to his Royal Highness the Prince of Wales, with the approbation of Dr. Monro, and under the inspection of his very ingenious assistant Mr. Fyfe. It is to compose a complete illustration, both general and particular, of the human body, by a selection from the best plates of all the greatest anatomists, as well foreign as British, exhibiting the latest discoveries in the science, and accompanied with copious explanations. The whole number of plates mentioned in the Prospectus is 240, of which 152 are already done; all in royal folio.

To the foreign treatises already mentioned may be added those recently published by Sabbatier and Plenck on anatomy in general. In Great-Britain, the writings of Keil, Douglas, Cheselden, the first Monro, Winslow, &c. are too well known to need description. The last of these used to be recommended as a standard for the students of anatomy: but it has of late given place to a more accurate and comprehensive system, in three volumes, published by Mr. Elliot of Edinburgh, upon a plan approved of by Dr. Monro, and executed by Mr. Fyfe. Dr. Simmons of London has also obliged the world with an excellent system of anatomy; and another work, under the title of "Elements of Anatomy and the Animal Oeconomy:" in which the subjects are treated with uncommon elegance and perspicuity.

In the latter part of the last century, anatomy made two great steps, by the invention of injections, and the method of making what we commonly call *preparations*. These two modern arts have really been of infinite use to anatomy; and besides have introduced an elegance into our administrations, which in former times could not have been supposed to be possible. They arose in Holland under Swammerdam and Ruysch, and afterwards in England under Cowper, St. André, and others, where they have been greatly improved.

The anatomists of former ages had no other knowledge of the blood-vessels, than what they were able to collect from laborious dissections, and from examining the smaller branches of them, upon some lucky occasion, when they were found more than commonly loaded with red blood. But filling the vascular system with a bright coloured wax, enables us to trace the large vessels with great ease, renders the smaller much more conspicuous, and makes thousands of the very minute ones visible, which from their delicacy, and the transparency of their natural contents, are otherwise imperceptible.

The modern art of corroding the fleshy parts with a menstruum, and of leaving the moulded wax entire, is so exceedingly useful, and at the same time so ornamental, that it does great honour to the ingenious inventor Dr. Nicholls.

The wax-work art of the moderns might deserve notice in any history of anatomy, if the masters in that way had not been so careless in their imitation. Many of the wax-figures are so tawdry with a show of unnatural colours, and so very incorrect in the circumstances of figure, situation, and the like, that though they strike a vulgar eye with admiration, they must appear ridiculous to an anatomist. But those figures which are cast in wax, plaster, or lead, from the real subject, and which of late years have been frequently made, are, of course, very correct in all the principal parts, and may be considered as no insignificant acquisition to modern anatomy. The proper, or principal use of this art is, to preserve a very perfect likeness of such subjects as we but seldom can meet with, or cannot well preserve in a natural state; a subject in pregnancy, for example.

The modern improved methods of preserving animal bodies, or parts of them, has been of the greatest service to anatomy; especially in saving the time and labour of the anatomist in the nicer dissections of the small parts of the body. For now, whatever he has prepared with care, he can preserve; and the object is ready to be seen at any time. And in the same manner he can preserve anatomical curiosities, or rarities of every kind; such as, parts that are uncommonly formed; parts that are diseased; the parts of the pregnant uterus and its contents. Large collections of such curiosities, which modern anatomists are striving almost every where to procure, are of infinite service to the art, especially in the hands of teachers. They give students clear ideas about many things which it is very essential to know, and yet which it is impossible that a teacher should be able to show otherwise, were he ever so well supplied with fresh subjects.

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2. *View of the Subject in general, and Plan of the following Treatise.*

THE etymology of the word *anatomy*, as above given, implies simply *dissection;* but by this term something more is usually understood.

It is every day made use of to express a knowledge of the human body; and a person who is said to understand anatomy, is supposed to be conversant with the structure and arrangement of the different solid parts of the body.

It is commonly divided into *Anatomy*, properly so called; and *Comparative* Anatomy: the first of these is confined solely to the human body; the latter includes all animals, so far as a knowledge of their structure may tend to perfect our ideas of the human body.

The term *anatomy* may also have another and more extensive signification: it may be employed to express not only a knowledge of the structure and disposition of the parts but likewise of their œconomy and use. Considered in this light, it will seldom fail to excite the curiosity of people of taste, as a branch of philosophy; since if it is pleasing to be acquainted with the structure of the body, it is certainly more so to discover all the springs which give life and motion to the machine, and to observe the admirable mechanism by which so many different functions are executed.

Astronomy and anatomy, as Dr. Hunter, after Fontenelle, observes, are the studies which present us with the most striking view of the two greatest attributes of the Supreme Being. The first of these fills the mind with the idea of his immensity, in the largeness, distances, and number of the heavenly bodies; the last, astonishes with his intelligence and art in the variety and delicacy of animal mechanism.

The human body has been commonly enough known by the name of *microcosmus*, or the little world; as if it did not differ so much from the universal system of nature in the symmetry and number of its parts as in their size.

Galen's excellent treatise *De usu partium*, was composed as a prose hymn to the Creator; and abounds with as irresistible proofs of a supreme Cause and governing Providence, as we find in modern physico-theology. And Cicero dwells more on the structure and œconomy of animals than on all the productions of nature besides, when he wants to prove the existence of the gods from the order and beauty of the universe. He there takes a survey of the body of man in a most elegant synopsis of anatomy, and concludes thus: "Quibus rebus expositis, satis docuisse videor, hominis natura, quanto omnes anteiret animantes. Ex quo debet intelligi, nec figuram situmque membrorum, nec ingenii mentisque vim talem effici potuisse fortuna."

The satisfaction of mind which arises from the study of anatomy, and the influence which it must naturally have upon our minds as philosophers, cannot be better conveyed than by the following passage from the same author: "Quæ contuens animus, accepit ab his cognitionem deorum, ex qua oritur pietas: cui conjuncta justitia est, reliquæque virtutes: ex quibus vita beata exsistit, par et similes deorum, nulla alia re nisi immortalitate, quæ nihil ad bene vivendum pertinet, cedens cœlestibus."

It would be endless to quote the animated passages of this sort which are to be found in the physicians, philosophers, and theologists, who have considered the structure and functions of animals with a view towards the Creator. It is a view which must strike one with a most awful conviction. Who can know and consider the thousand evident proofs of the astonishing art of the Creator, in forming and sustaining an animal body such as ours, without feeling the most pleasant enthusiasm? Can we seriously reflect upon this awful subject, without being almost lost in adoration? without longing for another life after this, in which we may be gratified with the highest enjoyment, which our faculties and nature seem capable of, the seeing and comprehending the whole plan of the Creator, in forming the universe and in directing all its operations?

But the more immediate purposes of anatomy concern those who are to be the guardians of health, as this study is necessary to lay a foundation for all the branches of medicine. The more we know of our fabric, the more reason we have to believe, that if our senses were more acute, and our judgment more enlarged, we should be able to trace many springs of life which are now hidden from us: by the same sagacity we should discover the true causes and nature of diseases; and thereby be enabled to restore the health of many, who are now, from our more confined knowledge, said to labour under incurable disorders. By such an intimate acquaintance with the œconomy of our bodies, we should discover even the seeds of diseases, and destroy them before they had taken root in the constitution.

That anatomy is the very basis of surgery every body allows. It is dissection alone that can teach us, where we may cut the living body with freedom and dispatch; and where we may venture with great circumspection and delicacy; and where we must not, upon any account, attempt it. This informs the *head*, gives dexterity to the *hand*, and familiarizes the *heart* with a sort of necessary inhumanity, the use of cutting-instruments upon our fellow-creatures.

Besides the knowledge of our body, through all the variety of its *structure* and *operations* in a *sound* state, it is by anatomy only that we can arrive at the knowledge of the true nature of most of the diseases which afflict humanity. The symptoms of many disorders are often equivocal; and diseases themselves are thence frequently mistaken, even by sensible, experienced, and attentive physicians. But by anatomical examination after death, we can with certainty find out the mistake, and learn to avoid it in any similar case.

This use of anatomy has been so generally adopted by the moderns, that the cases already published are almost innumerable: Mangetus, Morgagni, indeed many of the best modern writings in physic, are full of them. And if we look among the physicians of the best character, and observe those who have the *art* itself, rather than the *craft* of the profession at heart; we shall find them constantly taking pains to procure leave to examine the bodies of their patients after death.

After having considered the rise and progress of anatomy; the various discoveries that have been made in it, from time to time; the great number of diligent observers who have applied themselves to this art; and the importance of the study, not only for the prevention and cure of diseases, but in furnishing the liveliest proofs of divine wisdom; the following questions seem naturally to arise: For what purpose is there such a variety of parts in the human body? Why such a complication of nice and tender machinery? Why was there not rather a more simple, less delicate, and less expensive frame?*

In order to acquire a satisfactory general idea of this subject, and find a solution of all such questions, let us, in our imaginations, *make* a man: in other words let us suppose that the *mind*, or immaterial part, is to be placed in a corporeal fabric, in order to hold a correspondence with other material beings by the intervention of the body; and then consider, *a priori*, what will be wanted for her accommodation. In this inquiry, we shall plainly see the necessity or advantage, and therefore the final cause, of most of the parts which we actually find in the human body. And if we consider that, in order to answer some of the requisites, human wit and invention would be very insufficient; we need not be surprised if we meet with some parts of the body whose use we cannot yet perceive, and with some operations and functions which we cannot explain. We can see that the whole bears the most striking characters of excelling wisdom and ingenuity: but the imperfect sen-

* The following beautiful representation is taken from the late Dr. Hunter's *Introductory Lecture in Anatomy.*

ses and capacity of *man* cannot pretend to reach every part of a machine, which nothing less than the intelligence and power of the *Supreme Being* could contrive and execute.

First, then, the *mind*, the thinking, immaterial agent, must be provided with a place of immediate residence, which shall have all the requisites for the union of spirit and body; accordingly she is provided with the *brain*, where she dwells as governor and superintendant of the whole fabric.

In the next place, as she is to hold a correspondence with all the material beings around her, she must be supplied with organs fitted to receive the different kinds of impressions which they will make. In fact, therefore, we see that she is provided with the organs of sense, as we call them: the eye is adapted to light; the ear to sound; the nose to smell; the mouth to taste; and the skin to touch.

Further: She must be furnished with organs of communication between herself in the brain and those organs of sense, to give her information of all the impressions that are made upon them: and she must have organs between herself in the brain and every other part of the body, fitted to convey her commands and influence over the whole. For these purposes the nerves are actually given. They are chords, which rise from the brain, the immediate residence of the mind, and disperse themselves in branches through all parts of the body. They convey all the different kinds of sensations to the mind, in the brain;

and likewise carry out from thence all her commands or influence to the other parts of the body. They are intended to be occasional monitors against all such impressions as might endanger the well-being of the whole, or of any particular part; which vindicates the Creator of all things, in having actually subjected us to those many disagreeable and painful sensations which we are exposed to from a thousand accidents in life.

Moreover, the mind, in this corporeal system, must be endued with the power of moving from place to place, that she may have intercourse with a variety of objects; that she may fly from such as are disagreeable, dangerous or hurtful, and pursue such as are pleasant or useful to her. And accordingly she is furnished with limbs, and with muscles and tendons, the instruments of motion, which are found in every part of the fabric where motion is necessary.

But to support, to give firmness and shape to the fabric; to keep the softer parts in their proper places; to give fixed points for, and the proper direction to its motions, as well as to protect some of the more important and tender organs from external injuries; there must be some firm prop-work interwoven through the whole. And, in fact, for such purposes the bones are given.

The prop-work must not be made into one rigid fabric, for that would prevent motion. Therefore there are a number of bones.

These pieces must all be firmly bound together, to prevent their dislocation. And this end is perfectly well answered by the ligaments.

The extremities of these bony pieces, where they move and rub upon one another, must have smooth and slippery surfaces for easy motion. This is most happily provided for, by the cartilages and mucus of the joints.

The interstices of all those parts must be filled up with some soft and ductile matter, which shall keep them in their places, unite them, and at the same time allow them to move a little upon one another. And these purposes are answered by the cellular membrane or adipose substance.

There must be an outward covering over the whole apparatus, both to give it compactness and to defend it from a thousand injuries: which, in fact, are the very purposes of the skin and other integuments.

Lastly, the mind being formed for society and intercourse with beings of her own kind, she must be endued with powers of expressing and communicating her thoughts by some sensible marks or signs; which shall be both easy to herself, and admit of great variety; and accordingly she is provided with the organs and faculty of speech, by which she can throw out signs with amazing facility, and vary them without end.

Thus we have built up an animal body which would seem to be pretty complete: but as it is the nature of matter to be altered and work-ed upon by matter; so in a very little time such a living creature must be destroyed, if there is no provision for repairing the injuries which she must commit upon herself, and those which she must be exposed to from without. Therefore a treasure of blood is actually provided in the heart and vascular system, full of nutritious and healing particles, fluid enough to penetrate into the minutest parts of the animal; impelled by the heart, and conveyed by the arteries, it washes every part, builds up what was broken down, and sweeps away the old and useless materials. Hence we see the necessity or advantage of the heart and arterial system.

What more there was of this blood than enough to repair the present damages of the machine, must not be lost, but should be returned again to the heart; and for this purpose the venous system is actually provided. These requisites in the animal explain, *a priori*, the circulation of the blood.

The old materials which were become useless, and are swept off by the current of blood, must be separated and thrown out of the system. Therefore glands, the organs of Secretion, are given for straining whatever is redundant, vapid, or noxious, from the mass of blood; and when strained, they are thrown out by emunctories, called organs of Excretion.

But now, as the machine must be constantly wearing, the reparation must be carried on without intermission, and the strainers must always be employed. Therefore there is actually a perpetual circulation of the blood, and the secretions are always going on.

Even all this provision, however, would not be sufficient; for that store of blood would soon be consumed, and the fabric would break down, if there were not a provision made for fresh supplies. These we observe, in fact, are profusely scattered round her in the animal and vegetable kingdoms; and she is furnished with hands, the fittest instruments that could have been contrived, for gathering them, and for preparing them in a variety of ways for the mouth.

But these supplies, which we call food, must be considerably changed; they must be converted into blood. Therefore she is provided with teeth for cutting and bruising the food, and with a stomach for melting it down: In short, with all the organs subservient to digestion.—The finer parts of the aliments only can be useful in the constitution: these must be taken up and conveyed into the blood, and the dregs must be thrown off. With this view the intestinal canal is actually given. It separates the nutritious part, which we call *chyle*, to be conveyed into the blood by the system of absorbent vessels; and the fæces pass downwards, to be conducted out of the body.

Now we have got our animal not only furnished with what is wanted for its immediate existence, but also with the powers of protracting that existence to an indefinite length of time. But its duration, we may presume, must necessarily be limited: for as it is nourished, grows, and is raised up to its full strength and utmost perfection; so it must, in time, in common with all material beings, begin to decay, and then hurry on to final ruin. Hence we see the necessity of a scheme for renovation. Accordingly wise Providence, to perpetuate, as well as preserve his work, besides giving a strong appetite for life and self-preservation, has made animals male and female, and given them such organs and passions as will secure the propagation of the species to the end of time.

Thus we see, that by the very imperfect survey which human reason is able to take of this subject, the animal man must necessarily be complex in his corporeal system, and in its operations.

He must have one great and general system, the vascular, branching through the whole for circulation: Another the nervous, with its appendages the organs of sense, for every kind of feeling: And a third, for the union and connection of all those parts.

Besides these primary and general systems, he requires others which may be more local, or confined: One for strength, support, and protection; the bony compages: Another for the requisite motions of the parts among themselves, as well as for moving from place to place; the muscular part of the body: Another to prepare nourishment for the daily recruit of the body; the digestive organs: And one for propagating the species; the organs of generation.

And in taking this general survey of what would appear, *a priori*, to be necessary for adapting an animal to the situations of life, we observe with great satisfaction, that man is accordingly made of such systems, and for such purposes. He has them all; and he has nothing more, except the organs of respiration. Breathing it seemed difficult to account for *a priori*: we only knew it to be in fact essentially necessary to life. Notwithstanding this, when we saw all the other parts of the body, and their functions, so well accounted for, and so wisely adapted to their several purposes, there could be no doubt that respiration was so likewise: And accordingly, the discoveries of Dr. Priestley have lately thrown light upon this function also, as will be shown in its proper place.

Of all the different systems in the human body, the use and necessity are not more apparent, than the wisdom and contrivance which has been exerted in putting them all into the most compact and convenient form: in disposing them so, that they shall mutually receive, and give helps to one another; and that all, or many of the parts, shall not only answer their principal end or purpose, but operate successfully and usefully in a variety of secondary ways.

If we consider the whole animal machine in this light, and compare it with any machine in which human art has exerted its utmost; suppose the best constructed ship that ever was built, we shall be convinced beyond the possibility of doubt, that there are intelligence and power far surpassing what humanity can boast of.

One superiority in the natural machine is peculiarly striking.—In machines of human contrivance or art, there is no internal power, no principle in the machine itself, by which it can alter and accommodate itself to any injury which it may suffer, or make up any injury which admits of repair. But in the natural machine, the animal body, this is most wonderfully provided for, by internal powers in the machine itself; many of which are not more certain and obvious in their effects, than they are above all human comprehension as to the manner and means of their operation. Thus, a wound heals up of itself; a broken bone is made firm again by a callus; a dead part is separated and thrown off; noxious juices are driven out by some of the emunctories; a redundancy is removed by some spontaneous bleeding; a bleeding naturally stops of itself; and a great loss of blood, from any cause, is in some measure compensated, by a contracting power in the vascular system, which accommodates the capacity of the vessels to the quantity contained. The stomach gives information when the supplies have been expended; represents, with great exactness, the quantity and the quality of what is wanted in the present state of the machine; and in proportion as she meets with neglect, rises in her demand, urges her petition in a louder tone, and with more forcible arguments. For its protection, an animal body resists heat and cold in a very wonderful manner, and preserves an equal temperature in a burning and in a freezing atmosphere.

A farther excellence or superiority in the natural machine, if possible, still more astonishing, more beyond all human comprehension, than what we have been speaking of, is the following. Besides those internal powers of self-preservation in each individual, when two of them co-operate, or act in concert, they are endued with powers of making other animals or machines like themselves, which again are possessed of the same powers of producing others, and so of multiplying the species without end.

These are powers which mock all human invention or imitation. They are characteristics of the divine Architect.

Having premised this general account of the subject, we shall next consider the method to be observed in treating it.

The study of the *human* body, as already noticed, is commonly divided into two parts. The first, which is called *Anatomy*, relates to the matter and structure of its parts; the second, called *Physiology* and *Animal œconomy*, relates to the principles and laws of its internal operations and functions.

As the body is a compound of solids and fluids, *Anatomy* is divided into,

1. The Anatomy of the solids, and
2. The Anatomy of the fluids.

I. The Solids, by which we mean all parts of our body, which are not fluid, are generally divided into two classes, viz.

1. The hard solids or bones. This part of anatomy is called *Osteology;* which signifies the doctrine of the bones.

2. The softer solids; which part is called *Sarcology*, viz. the doctrine of flesh.

This division of the solids, we may observe, has probably taken its origin from the vulgar observation, that the body is made of bone and flesh. And as there are many different kinds of what are called soft or fleshy parts, Sarcology is subdivided into,

(1.) *Angeiology*, or the doctrine of vessels; by which is commonly understood *blood-vessels:*

(2.) *Adenology*, of glands:

(3.) *Neurology*, of nerves:

(4.) *Myology*, of muscles: and,

(5.) *Splanchnology*, of the viscera or bowels. There is, besides, that part which treats of the organs of sense and of the integuments.

This division of the solids has been here mentioned, rather for the sake of explaining so many words, which are constantly used by anatomists, than for its importance or accuracy. For besides many other objections that might be urged, there are in the body three species of solids, viz. gristle or cartilage, hair, and nails; which are of an intermediate nature between bone and flesh; and therefore cannot so properly be brought into the osteology or the sarcology. The cartilages were classed with the bones; because the greatest number of them are appendages to bones: and for the like reason the hair and the nails were classed with the integuments.

II. The FLUIDS of the human body may be divided into *three* kinds, which Dr. Hunter calls the *crude*, the *general* or *perfect*, and the *local* or *secreted fluid.*

1. By the *crude* fluid is meant the chyle, and whatever is absorbed at the surfaces of the body; in other words, what is recently taken into the body, and is not yet mixed with or converted into blood.

2. The *general* or *perfect* fluid is the blood itself; to wit, what is contained in the heart, arteries, and veins, and is going on in the round of the circulation.

3. The *local* or *secreted*, are those fluids peculiar to particular parts of the body, which are strained off from the blood, and yet are very different in their properties from the blood. They are commonly called *secretions;* and some are useful, others excrementitious.

In treating of the *Physiology*, it is very difficult to say what plan should be followed; for every method which has been yet proposed, is attended with manifest inconvenience. The powers and operations of the machine have such a dependence upon one another, such connections and reciprocal influence, that they cannot well be understood or explained separately. In this sense our body may be compared to a circular chain of powers, in which nothing is first or last, nothing solitary or independent; so that wherever we begin, we find that there is something preceding which we ought to have known. If we begin with the brain and the nerves, for example, we shall find that these cannot exist, even in idea, without the heart: if we set out with the heart and vascular system, we shall presently be sensible, that the brain and nerves must be supposed: or, should we take up the mouth, and follow the course of the aliment, we should see that the very first organ which presents itself, supposed the existence of both the heart and brain: Wherefore we shall incorporate the Physiology with the Anatomy, by attempting to explain the functions after we have demonstrated the organs.

Part I. OSTEOLOGY.

WE begin with the bones, which may be considered as the great support of the body, tending to give it shape and firmness.—But before we enter into the detail of each particular bone, it will be necessary to describe their composition and connections, and to explain the nature of the different parts which have an immediate relation to them; as the cartilages, ligaments, periosteum, marrow, and synovial glands.

SECT. I. *Of the Bones in general, with their Appendages, &c.*

The bones are of a firm and hard* substance, of a white colour, and perfectly insensible. They are the most compact and solid parts of the body, and serve for the attachment and support of all the other parts.

Three different substances are usually distinguished in them; their exterior or bony part, properly so called; their spongy cells; and their reticular substance. The first of these is formed of many laminæ or plates, composing a firm hard substance.—The spongy or cellular part is so called on account of its resemblance to a sponge, from the little cells which compose it. This substance forms almost the whole of the extremities of cylindrical bones. The reticular part is composed of fibres, which cross each other in different directions. This net-work forms the internal surface of those bones which have cavities.

The flat bones, as those of the head, are composed only of the laminæ and the cellular substance. This last is usually found in the middle of the bone dividing it into two plates, and is there called *diplöe*.

* Mr. Scheele has lately diſcovered that bones contain the phoſphoric acid united with calcareous earth; and that to this combination they owe their firmneſs.

Gagliardi, who pretended to have discovered an infinite number of claviculi* or bony processes, which he describes as traversing the laminæ to unite them together, has endeavoured to support this pretended discovery by the analogy of bones to the bark of trees, in which certain woody nails have been remarked; but this opinion seems to be altogether fanciful.

Some writers have supposed, that the bones are formed by layers of the periosteum, which gradually ossify, in the same manner as the timber is formed in trees by the hardening of the white substance that is found between the inner bark and the wood. M. Duhamel, who has adopted this opinion, fed different animals with madder and their ordinary food alternately during a certain time; and he asserts, that in dissecting their bones, he constantly observed distinct layers of red and white, which corresponded with the length of time they had lived on madder or their usual aliment. But it has since been proved by Detleff, that M. Duhamel's experiments were inaccurate, and that neither the periosteum nor the cartilages are tinged by the use of madder, which is known to affect the bones only.

We usually consider in a bone, its body and its extremities. The ancients gave the

* In his *Anat. Offium nov. invent. illuſtrat.* he deſcribes four kinds of theſe claviculi or nails, viz. the perpendicular, oblique, headed, and crooked.

name of diaphysis to the body or middle part, and divided the extremities into apophysis and epiphysis. An apophysis, or process, as it is more commonly called, is an eminence continued from the body of the bone, whereas an epiphysis is at first a sort of appendage to the bone, by means of an intermediate cartilage. Many epiphyses, which appear as distinct bones in the fœtus, afterwards become apophyses; for they are at length so completely united to the body of the bone as not to be distinguishable from it in the adult state. It is not unusual, however, at the age of 18 and even 20 years, to find the extremities of bones still in the state of epiphysis.

The names given to the processes of bones are expressive of their shape, size, or use; thus if a process is large and of a spherical form, it is called *caput*, or *head;* if the head is flatted, it is termed *condyle.* Some processes, from their resemblance to a stiletto, a breast, or the beak of a crow, are called *styloid*, *mastoid*, or *coracoid:* others are styled *ridges* or *spines.* The two processes of the os femoris derive their name of *trochanters* from their use.

A bone has its cavities as well as processes. These cavities either extend quite through its substance, or appear only as depressions. The former are called *foramina* or *holes*, and these foramina are sometimes termed *canals* or *conduits*, according to their form and extent. Of the depressions, some are useful in articulation. These are called *cotyloid* when they are deep, as is the case with the os innominatum, where it receives the head of the os femoris; or *glenoid* when they are superficial, as in the scapula, where it receives the os humeri. Of the depressions that are not designed for articulation, those which have small apertures are called *sinuses;* others that are large, and not equally surrounded by high brims, are styled *fossæ;* such as are long and narrow, *furrows;* or if broad and superficial without brims, *sinuosities.* Some are called *digital impressions*, from their resemblance to the traces of a finger on soft bodies.

We shall abridge this article, which is exceedingly diffuse in the generality of anatomical books, and will endeavour to describe it with all the clearness it will allow.

The bones composing the skeleton are so constructed, that the end of every bone is perfectly adapted to the extremity of that with which it is connected, and this connection forms what is called their *articulation.*

Articulation is divided into *diarthrosis*, *synarthrosis*, and *amphiarthrosis*, or moveable, immovable, and mixed articulation. Each of the two first has its subdivisions. Thus the *Diarthrosis*, or moveable articulation, includes, 1. The enarthrosis, as it is called, when a large head is admitted into a deep cavity, as in the articulation of the os femoris with the os innominatum. 2. Arthrodia, when a round head is articulated with a superficial cavity, as is the case of the os humeri and scapula. 3. Ginglimus, or hinge-like articulation, as in the connection of the thigh-bone with the tibia. The enarthrosis and arthrodia allow of motion to all sides; the ginglimus only of flection and extension.

The *synarthrosis*, or immoveable articulation, includes, 1. The suture, when the two bones are indented into each other, as is the case with the parietal bones. 2. Gomphosis, when one bone is fixed into another, in the manner the teeth are placed in their sockets.

The term *amphiarthrosis* is applied to those articulations which partake both of the synarthrosis and diarthrosis, as is the case with the bones of the vertebræ, which are capable of motion in a certain degree, although they are firmly connected together by intermediate cartilages.

What is called *symphysis* is the union of two bones into one; as in the lower jaw, for instance, which in the fœtus consists of two distinct bones, but becomes one in a more advanced age, by the ossification of the uniting cartilage.

When bones are thus joined by the means of cartilages, the union is styled *synchondrosis;* when by ligaments, *syneurosis.*

Cartilages are white, solid, smooth, and elastic substances, between the hardness of bones and ligaments, and seemingly of a fibrous texture. We are not able to trace any vessels into their substance by injection, nor are they ever found tinged in animals that have been fed with madder.

They may be distinguished into, 1st, Those which are connected with the bones; and, 2dly, Those which belong to other parts of the body. The first serve either to cover the ends and cavities of bones intended for motion, as in the articulations, where by their smoothness they facilitate motions, which the bones alone could not execute with so much freedom; or they serve to unite bones together, as in the symphysis pubis, or to lengthen them, as in the ribs.

Many of them ossifying as we advance in life, their number is less in the adult than in the fœtus, and of course there are fewer bones in the old than in the young subject.

Of the second class of cartilages, or those belonging to the soft parts, we have instances in the larynx, where we find them useful in the formation of the voice, and for the attachment of muscles.

The periosteum is a fine membrane of a compact cellular texture, reflected from one joint to another, and serving as a common covering to the bones. It has sanguiferous and lymphatic vessels, and is supplied with nerves from the neighbouring parts. It adheres very firmly to their surface, and by its smoothness facilitates the motion of muscles. It likewise supports the vessels that go to be distributed through the substance of the bones, and may serve to strengthen the articulations. At the extremities of bones, where it is found covering a cartilage, it has by some been improperly considered as a distinct membrane, and named *perichondrium*. This, in its use and structure, resembles the periosteum. Where it covers the bones of the skull, it has gotten the name of *pericranium*.

The periosteum is not a production of the dura mater, as the ancients, and after them Havers, imagined; nor are the bones formed by the ossification of this membrane, at least when it is in a sound state, as some late writers have supposed.

The periosteum is deficient in the teeth above the sockets, and in those parts of bones to which ligaments or tendons are attached.

The marrow is a fat oily substance, filling the cavities of bones. In the great cavities of long bones it is of a much firmer consistence than in the cells of their spongy part. In the former it inclines somewhat to a yellowish tinge, and is of the consistence of fat; in the latter it is more fluid, and of a red colour. This difference in colour and consistence is owing to accidental causes; both kinds are of the same nature, and may both be described under the common name of marrow, though some writers give the name only to the fat-like substance, and call the other the medullary juice.

The marrow is contained in a very fine and transparent membrane, which is supplied with a great number of blood-vessels, chiefly from the periosteum. This membrana medullaris adheres to the inner surface of the bones, and furnishes an infinite number of minute bags or vesicles for inclosing the marrow, which is likewise supported in the cavities of the bones by the long filaments of their reticular substance.

Besides the vessels from the periosteum, the membrana medullaris is furnished with others, which in the long bones may be seen passing in near the extremities of the bone, and sending off numerous branches that ramify through all the vesicles of this membrane.

The bones, and the cells containing the marrow, are likewise furnished with lymphatics. By their means, the marrow, like the fat, may be taken up in a greater quantity than it is secreted; and hence it is that so little is found in the bones of those who die of lingering diseases.

It is still a matter of controversy, Whether the marrow is sensible or not? We are certainly not able to trace any nerves to it; and from this circumstance, and its analogy to fat, Haller has ventured to consider it as insensible. On the other hand, Duverney asserts, that an injury done to this substance in a living animal was attended with great pain. In this dispute physiologists do not seem to have sufficiently discriminated between the marrow itself and the membranous cells in which it is contained. The former, like the fat, being nothing more than a secreted, and of course an inorganized, matter, may with propriety be ranked among the insensible parts, as much as inspissated mucus or any other secreted matter in the body; whereas the membrana medullaris being vascular, though it possesses but an obscure degree of feeling in a sound state, is not perfectly insensible.

The marrow was formerly supposed to be intended for the nourishment and renewal of the bones; but this doctrine is now pretty generally and deservedly exploded. It seems probable that the marrow is to the bones what fat is to the soft parts. They both serve for some important purposes in the animal œconomy; but their particular use has never yet been clearly ascertained. The marrow, from the transudation of the oil through the bones of a skeleton, is supposed to diminish their brittleness; and Havers, who has written professedly on the bones, describes the canals by which the marrow is conveyed through every part of their substance, and divides them into longitudinal and transverse ones. He speaks of the first as extending through the whole length of the bone; and of the latter, as the passages by which the longitudinal ones communicate with each other. The similarity of these to the large cancelli in burnt bones, and the transudation of the oil through the bones of the skeleton, seems to prove that some such passages do actually exist.

The synovial glands are small bodies,* supposed to be of a glandular structure, and exceedingly vascular, secreting a fluid of a clear mucilaginous nature, which serves to lubricate the joints. They are placed in small cavities

* It is now much doubted, however, whether the appearances in the joints, which are usually called *glands*, are any thing more than assemblages of fat.

in the articulations, so as to be capable of being gently compressed by the motion of the joint, which expresses their juice in proportion to the degree of friction. When the synovia is wanting, or is of too thick a consistence, the joint becomes stiff and incapable of flexion or extension. This is what is termed *anchilosis*.

Ligaments are white, glistening, inelastic bands, of a compact substance, more or less broad or thick, and serving to connect the bones together. They are distinguished by different names adapted to their different forms and uses. Those of the joints are called either round or bursal. The round ligaments are white, tendinous, and inelastic. They are strong and flexible, and are found only in the joint of the knee, and in the articulation of the os femoris with the os innominatum. The bursal, or capsular ligaments, surround the whole joint like a purse, and are to be found in the articulations which allow motion every way, as in the articulation of the arm with the scapula.

Of those sacs called *Bursæ mucosæ*, a few were known to former anatomists, but by much the greater number have been since discovered by Dr. Monro,* who observes, that they are to be met with in the extremities of the body only; that many of them are placed entirely on the inner sides of the tendons, between these and the bones. Many others cover not only the inner, but the outer sides of

* See *Descripion of the Bursæ Mucosæ*, &c.

the tendons, or are interposed between the tendons and external parts, as well as between those and the bones.

Some are situated between the tendons and external parts only or chiefly, some between contiguous tendons, or between the tendons or the ligaments and the joints. A few such sacs are observed where the processes of bones play upon the ligaments, or where one bone plays upon another. Where two or more tendons are contiguous, and afterwards separate from each other, we generally find a common bursa divided into branches, with which it communicates; and a few bursæ of contiguous tendons communicate with each other.—Some in healthy children, communicate with the cavities of the joints; and in many old people he has seen such communications formed by use or worn by friction, independent of disease.

Their proper membrane is thin and transparent, but very dense, and capable of confining air or any other fluid. It is joined to the neighbouring parts by the common cellular substance. Between the bursa and the hard substance of bone, a thin layer of cartilage or of tough membrane is very generally interposed. To the cellular substance on the outside of the bursa, the adipose substance is connected; except where the bursa covers a tendon, cartilage, or bone, much exposed to pressure or friction.

In several places a mass of fat, covered with the continuation of the membrane of the bursa, projects into its cavity. The edges of this are divided into fringes.

The inner side of the membrane is smooth, and is extremely slippery from the liquor secreted in it.

The structure of the bursæ bears a strong resemblance to the capsular ligaments of the joints. 1. The inner layer of the ligament, like that of the bursæ, is thin and dense. 2. It is connected to the external ligaments by the common cellular substance. 3. Between it and the bones, layers of cartilage, or the articular cartilages, are interposed. 4. At the sides of the joints, where it is not subjected to violent pressure and friction, the adipose substance is connected with the cellular membrane. 5. Within the cavities of the joints we observe masses of fat projecting, covered with similar blood-vessels, and with similar fimbriæ hanging from their edges. 6. In the knee the upper part of such a mass of fat forms what has been called the *mucilaginous gland of the joint*, and the under part projects into the bursa behind the ligament which ties the patella to the tibia. 7. The liquor which lubricates the bursæ has the same colour, consistence, and properties as that of the joints, and both are affected in the same manner by heat, mineral acids, and ardent spirits. 8. In some places the bursæ constantly communicate with the cavities of the joints, in others they generally do so; from which we may infer a sameness of structure.

When we examine the fimbriæ common to the fatty bodies of the joints and bursæ, and which have been supposed to be the ducts of glands lodged within the masses of fat, we are not able to discover any glandular appearance within them. And although we observe many vessels dispersed upon the membranes of the fatty bodies and fimbriæ; and that we cannot doubt that these fimbriæ consist of ducts which contain a lubricating liquor, and can even press such a liquor from them; yet their cavities and orifices are so minute, that they are not discoverable even by the assistance of magnifying-glasses. These fimbriæ appear, therefore, to be ducts like those of the urethra, which prepare a mucilaginous liquor, without the assistance of any knotty or glandular organ.

Upon the whole, the synovia seems to be furnished by invisible exhalent arteries by the ducts of the fimbriæ, and by oil exuding from the adipose follicles by passages not yet discovered.

The word *skeleton*, which by its etymology implies simply a dry preparation, is usually applied to an assemblage of all the bones of an animal united together in their natural order. It is said to be a natural skeleton, when the bones are connected together by their own proper ligaments; and an artificial one, when they are joined by any other substance, as wire, &c.

The skeleton is generally divided into the head, trunk, and extremities. The first division includes the bones of the cranium and face. The bones of the trunk are the spine, ribs, sternum, and bones of the pelvis.

The upper extremity on each side consists of the two bones of the shoulder, viz. the scapula and clavicle; the bone of the arm, or os humeri; the bones of the fore-arm, and those of the hand.

The lower extremity on each side of the trunk consists of the thigh-bone and the bones of the leg and foot.

SECT. II. *Of the Bones of the Head.*

THE head is of a roundish figure, and somewhat oval.* Its greatest diameter is from the forehead to the occiput; its upper part is called *vertex*, or crown of the head; its anterior or fore-part the face; and the upper part of this *sinciput*, or forehead; its sides the temples; its posterior, or hind-part, the *occiput;* and its inferior part the *basis.*

The bones of the head may be divided into those of the cranium and face.

* The bones of the fœtus being perfectly distinct, and the muscles in young persons not acting much, the shape of the head has been supposed to depend much on the management of children when very young. Vesalius, who has remarked the difference in people of different nations, observes, for instance, that the head of a Turk is conical, from the early use of the turban; whilst that of an Englishman is flattened by the chin-stay. Some of the latest physiologists suppose, with good reason, that this difference is chiefly owing to certain natural causes with which we are as yet unacquainted.

1. *Bones of the Cranium and Face.*

There are eight bones of the cranium, viz. the coronal bone, or os frontis; the two parietal bones, or ossa bregmatis; the os occipitis; the two temporal bones; the sphenoid bone; and the os ethmoides, or cribriforme.

Of these, only the os occipitis and ossa bregmatis are considered as proper to the cranium; the rest being common both to the cranium and face.

These bones are all harder at their surface than in their middle; and on this account they are divided into two tables, and a middle spongy substance called *diplöe.*

In this, as in all the other bones, we shall consider its figure, structure, processes, depressions, and cavities; and the manner in which it is articulated with the other bones.

The os frontis has some resemblance in shape to the shell of the cockle. Externally it is convex, its concave side being turned towards the brain. This bone, in the places where it is united to the temporal bones, is very thin, and has there no diplöe. It is likewise exceedingly thin in that part of the orbit of the eye which is nearest to the nose. Hence it is, that a wound in the eye, by a sword or any other pointed instrument, is sometimes productive of immediate death. In these cases, the sword passing through the weak part of the bone, penetrates the brain, and divides the nerves at their origin; or perhaps opens some blood-vessel, the consequences of which are soon fatal.

We observe on the exterior surface of this bone five apophyses or processes, which are easily to be distinguished. One of these is placed at the bottom and narrowest part of the bone, and is called the nasal process, from its supporting the upper end of the bones of the nose. The four others are called angular or orbitar processes. They assist to form the orbits, which are the cavities on which the eyes are placed. In each of these orbits there are two processes, one at the interior or great angle, and the other at the exterior or little angle of the orbit. They are called the angular processes. Between these a ridge is extended in form of an arch, and on this the eyebrows are placed. It is called the orbitar or superciliary ridge, and in some measure covers and defends the globe of the eye. There is a hole in this for the passage of the frontal vessels and nerves. This arch is interrupted near the nose by a small pit, in which the tendon of the musculus obliquus major of the eye is fixed. From the under part of each superciliary ridge a thin plate runs a considerable way backwards, and has the name of *orbitar;* the external and fore-part of this plate forms a sinuosity for lodging the lacrymal gland. Between the orbitar plates there is a large discontinuation of the bone, which is filled up by the cribriform part of the os ethmoides.

On examining the inner surface of this bone at its under and middle part, we observe an elevation in form of a ridge, which has been called the *spinous process;* it ascends for some way, dividing the bone into two considerable fossæ, in which the anterior lobes of the brain are placed. To a narrow furrow in this ridge is attached the extremity of the falx, as the membrane is called, which divides the brain into two hemispheres. The furrow becoming gradually wider, is continued to the upper and back part of the bone. It has the falx fixed to it, and part of the longitudinal sinus lodged in it. Besides the two fossæ, there are many depressions, which appear like digital impressions, and owe their formation to the prominent circumvolutions of the brain.

In the fœtus, the forehead is composed of two distinct bones; so that in them the sagittal suture reaches from the os occipitis to the nose. This bone is almost every where composed of two tables and a diplöe. These two tables separating from each other under the eyes, form two cavities, one on each side of the face, called the frontal sinuses. These sinuses are lined with a soft membrane, called *membrana pituitaria*. In these sinuses a mucus is secreted, which is constantly passing through two small holes into the nostrils, which it serves to moisten.

The os frontis is joined by suture to many of the bones of the head, viz. to the parietal, maxillary, and temporal bones; to the os ethmoides; os sphenoides; os unguis; and ossa nasi. The suture which connects it with the parietal bones is called the *coronal suture.*

The parietal bones are two in number; they are very thin, and even transparent in some places, the particular figure of each of these bones is that of an irregular square, bordered with indentations through its whole circumference, except at its lower part. It will be easily conceived, that these bones which compose the superior and lateral parts of the cranium, and cover the greatest part of the brain, form a kind of vault. On their inner surface we observe the marks of the vessels of the dura mater; and at their upper edge the groove for the superior longitudinal sinus.

The ossa parietalia are joined to each other by the sagittal suture; to the os sphenoides and ossa temporum by the squamous suture; to the os occipitis by the lambdoidal suture,* so called from its resemblance to the Greek letter lambda; and to the os frontis by the coronal suture.

In the fœtus, the parietal bones are separated from the middle of the divided os frontis by a portion of the cranium then unossified.

The occipital bone forms the posterior and inferior parts of the skull; it approaches nearly to the shape of a lozenge, and is indented throughout three parts of its circumference.

* The lambdoidal suture is sometimes very irregular, being composed of many small sutures, which surround so many little bones called *ossa triquetra*, though perhaps improperly, as they are not always triangular.

There is a considerable hole in the inferior portion of this bone, called the *foramen magnum*, through which the medulla oblongata passes into the spine.—The nervi accessorii, and vertebral arteries, likewise pass through it. Behind the condyles are two holes for the passage of cervical veins into the lateral sinuses; and above them are two others for the passage of the eighth pair and accessory nerves out of the head. At the sides, and a little on the anterior part of the foramen magnum, are two processes, called the condyles, one on each side; they are of an oval figure, and are covered with cartilage.

The external surface of this bone has a large transverse arched ridge, under which the bone is very irregular, where it affords attachment to several muscles. On examining its inner surface, we may observe two ridges in form of a cross; one ascending from near the foramen magnum to the top of the bone; the upper end of this in which the falx is fixed, is hollow, for lodging the superior longitudinal sinus, and the under end has the third process of the dura mater fixed to it. The other ridge, which runs horizontally, is likewise hollow for containing the lateral sinuses. Four fossæ are formed by the cross, two above and two below. In the former are placed the posterior lobes of the brain, and in the latter the lobes of the cerebellum.

At the basis of the cranium, we observe the cuneiform process (which is the name given to the great apophysis at the fore part of this bone); it serves for the reception of the medulla oblongata.

The os occipitis is of greater strength and thickness, than either of the other bones of the head, though irregularly so; at its inferior part, where it is thinnest, it is covered by a great number of muscles.

This bone, from its situation, being more liable to be injured by falls, than any other bone of the head, nature has wisely given it the greatest strength at its upper part, where it is most exposed to danger.

It is joined to the parietal bones by the lambdoidal suture, and to the ossa temporum, by the additamentum of the temporal suture. It is likewise connected to the os sphenoides by the cuneiform process. It is by means of the os occipitis that the head is united to the trunk, the two condyles of this bone being connected to the superior oblique processes of the first vertebra of the neck.

There are two temporal bones, one on each side.—We may distinguish in them two parts; one of which is called the *squamous* or *scaly part*, and the other *pars petrosa* from its hardness. This last is shaped like a pyramid.

Each of these divisions affords processes and cavities: externally there are three processes; one anterior, called the zygomatic process; one posterior, called the *mastoid* or *mamillary process*, from its resemblance to a nipple; and one inferior, called the *styloid process*, because it is shaped like a stiletto, or dagger.

The cavities are, 1. The meatus auditorius externus. 2. A large fossa which serves for the articulation of the lower jaw; it is before the meatus auditorius, and immediately under the zygomatic process. 3. The stylo-mastoid hole, so called from its situation between the styloid and mastoid processes; it is likewise styled the aquæduct of Fallopius, and affords a passage to the portio dura of the auditory, or seventh pair of nerves. 4. Below, and on the fore-part of the last foramen, we observe part of the jugular fossa, in which the beginning of the internal jugular vein is lodged. Anterior and superior to this fossa is the orifice of a foramen through which passes the carotid artery. This foramen runs first upwards and then forwards, forming a kind of elbow, and terminates at the end of the os petrosum.—At this part of each temporal bone, we may observe the opening of the Eustachian tube, a canal which passes from the ear to the back part of the nose.

In examining the internal surface of these bones, we may remark the triangular figure of their petrous part which separates two fossæ; one superior and anterior; the other inferior and posterior: the latter of these composes part of the fossa, in which the cerebellum is placed; and the former, a portion of the least fossa for the basis of the brain. On the posterior side of the pars petrosa, we observe the meatus auditorius internus, into which enters the double nerve of the seventh pair. On the under side of this process, part of a hole appears, which is common to the temporal and occipital bones; through it the lateral sinus, the eighth pair, and accessory nerves, pass out of the head.

The pars petrosa contains several little bones called the bones of the ear; which, as they do not enter into the formation of the cranium, shall be described when we are treating of the organs of hearing.

The ossa temporum are joined to the ossa malarum, by the zygomatic sutures; to the parietal bones, by the squamous sutures; to the os occipitis, by the lambdoidal suture; and to the sphenoid bone, by the suture of that name.

This bone, from its situation amidst the other bones of the head, has sometimes been called *cuneiforme*. It is of a very irregular figure, and has been compared to a bat with its wings extended.

It is commonly divided into its middle part or body, and its sides or wings.

The fore part of the body has a spine or ridge, which makes part of the septum narium. The upper part of each wing forms a share of the temple. The fore part of this belongs to the orbit; while the under and back part, termed *spinous process*, is lodged in the base of the skull at the point of the pars petrosa. But two of the most remarkable processes are the ptergoid or aliform, one on each side of the body of the bone, and at no great distance from it. Each of these processes is divided into two wings, and of these the exterior one is the widest. The other terminates in a hook-like process.

The internal surface of this bone affords three fossæ. Two of these are formed by the wings of the bone, and make a part of the lesser fossæ of the basis of the cranium. The third, which is smaller, is on the top of the body of the bone; and is called *sella turcica*, from its resemblance to a Turkish saddle. This fossa, in which the pituitary gland is placed, has posteriorly and anteriorly processes called the *clinoid processes.*

There are twelve holes in this bone, viz. six on each side. The first is the passage of the optic nerve and ocular artery; the second, or large slit, transmits the third, fourth, sixth, and first part of the fifth pair of nerves with the ocular vein; the third hole gives passage to the second branch of the fifth pair; and the fourth hole to the third branch of the fifth pair of nerves. The fifth hole is the passage of the artery of the dura mater. The sixth hole is situated above the ptergoid process of the sphenoid bone; through it a reflected branch of the second part of the fifth pair passes.

Within the substance of the os sphenoides there are two sinuses separated by a bony plate. They are lined with the pituitary membrane; and, like the frontal sinuses, separate a mucus which passes into the nostrils.

The os sphenoides is joined to all the bones of the cranium; and likewise to the ossa maxillaria, ossa malarum, ossa palati, and vomer.

This bone makes part of the basis of the skull, assists in forming the orbits, and affords attachment to several muscles.

The os ethmoides is situated at the fore part of the basis of the cranium, and is of a very irregular figure. From the great number of holes with which it is pierced, it is sometimes called *os cribriforme* or sieve-like bone.

It consists of a middle part and two sides. The middle part is formed of a thin bony plate, in which are an infinite number of holes that afford a passage to filaments of the olfactory nerve. From the middle of this plate, both on the outside and from within, there rises up a process, which may be easily distinguished. The inner one is called *crista galli*, from its supposed resemblance to a cock's comb. To this process the falx of the dura mater is attached. The exterior process, which has the same common basis as the crista galli, is a fine lamella which is united to the vomer; and divides the cavity of the nostrils, though unequally, it being generally a little inclined to one side.

The lateral parts of this bone are composed of a cellular substance; and these cells are so very intricate, that their figure or number cannot be described. Many writers have on this account called this part of the bone the *labyrinth*. These cells are externally covered with a very thin bony lamella. This part of the bone is called the *os planum*, and forms part of the orbit.

The different cells of this bone, which are numerous, and which are every where lined with the pituitary membrane, evidently serve to enlarge the cavity of the nose, in which the organ of smelling resides.

This bone is joined to the os sphenoides, os frontis, ossa maxillaria, ossa palati, ossa nasi, ossa unguis, and vomer.

The ancients, who considered the brain as the seat of all the humours, imagined that this viscus discharged its redundant moisture through the holes of the ethmoid bone. And the vulgar still think, that abscesses of the brain discharge themselves through the mouth and ears, and that snuff is liable to get into the head; but neither snuff nor the matter of an abscess are more capable of passing through the cribriform bone, than the serosity which they supposed was discharged through it in a common cold.—All the holes of the ethmoid bone are filled up with the branches of the olfactory nerve. Its inner part is likewise covered with the dura mater, and its cells are every where lined with the pituitary membrane; so that neither matter nor any other fluid can possibly pass through this bone either externally or internally. Matter is indeed sometimes discharged through the nostrils; but the seat of the disease is in the sinuses of the nose, and not in the brain; and imposthumations are observed to take place in the ear, which suppurate and discharge themselves externally.

Before we leave the bones of the head, we wish to make some general observations on its structure and figure.—As the cranium might have been composed of a single bone, the articulation of its several bones being absolutely without motion, it may be asked perhaps, Why such a multiplicity of bones, and so great number of sutures? Many advantages may possibly arise from this plurality of bones and sutures, which may not yet have been observed. We are able, however, to point out many useful ends, which could only be accomplished by this peculiarity of structure.—In this, as in all the other works of nature, the great wisdom of the Creator is evinced, and cannot fail to excite our admiration and gratitude.

The cranium, by being divided into several bones, grows much faster and with greater facility, than if it was composed of one piece only. In the fœtus, the bones, as we have before observed, are perfectly distinct from each other. The ossification begins in the middle of each bone, and proceeds gradually to the circumference. Hence the ossification, and of course the increase of the head, is carried on from an infinite number of points at the same time, and the bones consequently approach each other in the same proportion. To illustrate this doctrine more clearly, if it can want further illustration, suppose it necessary for the parietal bones which compose the upper part of the head, to extend their ossification, and form the fore part of the head likewise.—Is it not evident, that this process would be much more tedious than it is now, when the os frontis and the parietal bones are both growing at the same time? Hence it happens, that the heads of young people, in which the bones begin to touch each other, increase slowly; and that the proportionate increase of the volume of the head is greater in three months in the fœtus, than it is perhaps in twenty-four months at the age of fourteen or fifteen years.

The sutures, exclusive of their advantage in suspending the processes of the dura mater, are evidently of great utility in preventing the too great extent of fractures of the skull.—Suppose, for instance, that by a fall or blow, one of the bones of the cranium becomes fractured. The fissure, which in a head composed of only one bone, would be liable to extend itself through the whole of it, is checked, and sometimes perhaps stopped by the first suture it meets, and the effects of the injury are confined to the bone on which the blow was received. Ruysch indeed, and some others, will not allow the sutures to be of any such use; but cases have been met with where they seemed to have had this effect, and in young subjects their utility in this respest must be still more obvious.

The spherical shape of the head seems likewise to render it more capable of resisting external violence than any other shape would do. In a vault, the parts mutually support and strengthen each other, and this happens in the cranium.

2. *Proper Bones of the Face.*

THE face, which consists of a great number of bones, is commonly divided into the upper and lower jaws. The upper jaw consists of thirteen bones, exclusive of the teeth. Of these, six are placed on each side of the maxilla superior, and one in the middle.

The bones, which are in pairs, are the ossa malarum, ossa maxillaria, ossa nasi, ossa unguis, ossa palati, and ossa spongiosa inferiora. The single bone is the vomer.

These are the prominent square bones which are placed under the eyes, forming part of the orbits and the upper part of the cheeks. Each of them affords three surfaces ; one exterior and a little convex ; a second superior and concave, forming the inferior part and sides of the orbit ; and a third posterior, irregular, and hollowed for the lodgment of the lower part of the temporal muscle.

The angles of each bone form four processes, two of which may be called *orbitar processes ;* of these the upper one is joined by suture to the os frontis, and that below to the maxillary bone. The third is connected with the os sphenoides by means of the transverse suture ; and the fourth is joined to the zygomatic process of the temporal bone, with which it forms the zygoma.

These bones, which are of a very irregular, figure, are so called because they form the most considerable portion of the upper jaw.

They are two in number, and generally remain distinct through life.

Of the many processes which are to be seen on these bones, and which are connected with the bones of the face and skull, we shall describe only the most remarkable.

One of these processes is at the upper and fore part of the bone, making part of the side of the nose, and called the *nasal process*. Another forms a kind of circular sweep at the inferior part of the bone, in which are the alveoli or sockets for the teeth: this is called the *alveolar process*. A third process is united to the os malæ on each side. Between this and the nasal process there is a thin plate, which forms a share of the orbit, and lies over a passage for the superior maxillary vessels and nerves.—The alveolar process has posteriorly a considerable tuberosity on its internal surface, called the *maxillary tuberosity*.

Behind the alveolar process we observe two horizontal lamellæ, which uniting together, form a part of the roof of the mouth, and divide it from the nose. The hollowness of the roof of the mouth is owing to this partition's being seated somewhat higher than the alveolar process.—At the fore part of the horizontal lamellæ there is a hole called *foramen incisivum*, through which small blood-vessels and nerves go between the mouth and nose.

In viewing these bones internally, we observe a fossa in the inferior portion of the nasal process, which with the os unguis and os spongiosum inferius, forms a passage for the lachrymal duct.

Where these two bones are united to each other, they project somewhat upwards and forwards, leaving between them a furrow, into which the lower portion of the septum nasi is admitted.

Each of these bones being hollow, a considerable sinus is formed under its orbitar part. This cavity, which is usually named after Highmore, though it was described by Fallopius and others before his time, is lined with the pituitary membrane. It is intended for the same purposes as the other sinuses of the nose, and opens into the nostrils.

The ossa maxillaria are connected with the greater part of the bones of the face and cranium, and assist in forming not only the cheeks, but likewise the palate, nose, and orbits.

The ossa nasi form two irregular squares. They are thicker and narrower above than below. Externally they are somewhat convex, and internally slightly concave. These bones constitute the upper part of the nose. At their fore part they are united to each other, above to the os frontis, by their sides to the ossa maxillaria superiora, posteriorly and interiorly to the septum narium, and below to the cartilages that compose the rest of the nostrils.

These little transparent bones owe their name to their supposed resemblance to a finger-nail. Sometimes they are called *ossa lachrymalia*, from their concurring with the nasal process of each maxillary bone in forming a lodgement for the lachrymal sac and duct.

The ossa unguis are of an irregular figure. Their external surface consists of two smooth parts, divided by a middle ridge. One of these parts, which is concave and nearest to the nose, serves to support the lachrymal sac and part of the lachrymal duct. The other, which is flat, forms a small part of the orbit.

Each of these bones is connected with the os frontis, os ethmoides, and os maxillare superius.

These bones which are situated at the back part of the roof of the mouth, between the os sphenoides and the ossa maxillaria superiora, are of a very irregular shape, and serve to form the nasal and maxillary fossa, and a small portion of the orbit. Where they are united to each other, they rise up into a spine on their internal surface. This spine appears to be a continuation of that of the superior maxillary bones, and helps to form the septum narium.

These bones are joined to the ossa maxillaria superiora, os ethmoides, os sphenoides, and vomer.

This bone derives its name from its resemblance to a ploughshare. It is a long and flat bone, somewhat thicker at its back than at its fore part. At its upper part we observe a furrow extending through its whole length. The posterior and largest part of this furrow receives a process of the sphenoid bone. From this the furrow advances forwards, and becoming narrower and shallower, receives some part of the nasal lamella ethmoidea; the rest serves to support the middle cartilage of the nose.

The inferior portion of this bone is placed on the nasal spine of the maxillary and palate bones, which we mentioned in our description of the ossa palati.

The vomer is united to the os sphenoides, os ethmoides, ossa maxillaria superiora, and ossa palati. It forms part of the septum narium, by dividing the back part of the nose into two nostrils.

The parts which are usually described by this name, do not seem to deserve to be distinguished as distinct bones, except in young subjects. They consist of a spongy lamella in each nostril, which is united to the spongy lamina of the ethmoid bone, of which they are by some considered as a part.

Each of these lamellæ is longest from behind forwards; with its convex surface turned towards the septum narium, and its concave part towards the maxillary bone, covering the opening of the lachrymal duct into the nose.

These bones are covered with the pituitary membrane; and, besides their connection with the ethmoid bone, are joined to the ossa maxillaria superiora, ossa palati, and ossa unguis.

The maxilla inferior, or lower jaw, which in its shape resembles a horse-shoe, consists of two distinct bones in the fœtus; but these unite together soon after birth, so as to form only one bone. The upper edge of this bone, like the os maxillare superius, has an alveolar process, furnished with sockets for the teeth.

On each side the posterior part of the bone rises almost perpendicularly into two processes. The highest of these, called the coronoid process, is pointed and thin, and serves for the insertion of the temporal muscle. The other, or condyloid process, as it is called, is shorter and thicker, and ends in an oblong rounded head, which is received into a fossa of the temporal bone, and is formed for a moveable articulation with the cranium. This joint is furnished with a moveable cartilage. At the bottom of each coronoid process, on its inner part, we observe a foramen extending under the roots of all the teeth, and terminating at the outer surface of the bone near the chin. Each of these canals transmits an artery, vein, and nerve, from which branches are sent off to the teeth.

The lower jaw is capable of a great variety of motion. By sliding the condyles from the cavity towards the eminences on each side, we bring it horizontally forwards, as in biting; or we may bring the condyles only forward, and tilt the rest of the jaw backward, as in opening the mouth. We are likewise able to slide the condyles alternately backwards and forwards from the cavity to the eminence, and *vice versa*, as in grinding the teeth. The cartilages, by adapting themselves to the different inequalities in these several motions of the jaw, serve to secure the articulation, and to prevent any injuries from friction.

The alveolar processes are composed of an outer and inner bony plate, united together by thin partitions, which at the fore part of the jaw divide the processes into as many sockets as there are teeth. But at the back part of the jaw, where the teeth have more than one root, we find a distinct cell for each root. In both jaws these processes begin to be formed with the teeth; they likewise accompany them in their growth, and gradually disappear when the teeth are removed.

3. *Of the Teeth.*

The teeth are bones of a particular structure, formed for the purposes of mastication and the articulation of the voice. It will be necessary to consider their composition and figure, their number and arrangement, and the time and order in which they appear.

In each tooth we may distinguish a body, a neck, and a root or fangs.

The body of the tooth is that part which appears above the gums. The root is fixed into the socket, and the neck is the middle part between the two.

The teeth are composed of two substances, viz. enamel and bone. The enamel, or the vitreous or cortical part of the tooth, is a white and very hard and compact substance peculiar to the teeth, and appears fibrous or striated when broken. This substance is thickest on the grinding surface, and becoming gradually thinner, terminates insensibly at the neck of the tooth. Ruysch * affirmed, that he could trace the arteries into the hardest part of the teeth; Liewenhoeck † suspected the fibres of the enamel to be so many vessels; and Monro ‡ says, he has frequently injected the vessels of the teeth in children, so as to make the inside of the cortex appear perfectly red. But it is certain, that it is not tinged by a madder diet, and that no injection will ever reach it, so that it has no appearance of being vascular §.

The bony part, which composes the inner substance of the body, neck, and root of the tooth, resembles other bones in its structure, but it is much harder than the most compact part of bones in general. As a tooth when once formed receives no tinge from a madder diet, and as the minutest injections do not penetrate into its substance, this part of the tooth has, like the enamel, been supposed not to be vascular. But when we consider that the fangs of a tooth are invested by a periosteum, and that the swellings of these fangs are analogous to the swellings of other bones, we may reasonably conclude, that there is a similarity of structure; and that this bony part has a circulation through its substance,

* Thesaur 10. no. 27.
† Arcan. Natur. continuat. Epistol.
‡ Anat. of the Human Bones.
§ Hunter on the Teeth.

although from its hardness we are unable to demonstrate its vessels.

In each tooth we find an inner cavity, into which enter an artery, vein, and nerve. This cavity begins by a small opening, and becoming larger, terminates in the body of the tooth. In advanced life this hole sometimes closes, and the tooth is of course rendered insensible.

The periosteum surrounds the teeth from their fangs to a little beyond their bony sockets, where we find it adhering to the gums. This membrane, while it incloses the teeth, serves at the same time to line the sockets, so that it may be considered as common to both.

The teeth are likewise secured in their sockets by means of the gums; a red, vascular, firm, and elastic substance, that possesses but little sensibility. In the gums of infants we find a hard ridge extending through their whole length, but no such ridge is to be seen in old people who have lost their teeth.

The number of the teeth in both jaws at full maturity, usually varies from twenty-eight to thirty-two. They are commonly divided into three classes, viz. incisores, canini, and grinders or molares.* The incisores are the four teeth in the fore part of each jaw. They have each of them two surfaces; one anterior

* Mr. Hunter has thought proper to vary this division. He retains the old name of *incisores* to the four fore teeth, but he distinguishes the canine teeth by the name of the *cuspidati*. The two teeth which are next to these, and which have been usually ranked with the molares, he calls the *bicuspides*; and he gives the name of *grinders* only to the three last teeth on each side.

and convex, the other posterior and slightly concave, both of which terminate in a sharp edge. They are called *incisores* from their use in dividing the food. They are usually broader and thicker in the upper than in the under jaw; and, by being placed somewhat obliquely, generally fall over the latter.

The canini derive their name from their resemblance to a dog's tusks, being the longest of all the teeth. We find one on each side of the incisores, so that there are two canini in each jaw. Their fang resembles that of the incisores, but is much larger; and in their shape they appear like an incisor with its edge worn off, so as to terminate in a narrow point. These teeth not being calculated for cutting and dividing the food like the incisores, or for grinding it like the molares, seem to be intended for laying hold of substances.*

The molares or grinders, of which there are ten in each jaw, are so called, because from their shape and size they are fitted for grinding the food. Each of the incisores and canini is furnished only with one fang; but in the molares of the under jaw we constantly find two fangs, and in those of the upper jaw three fangs. These fangs are sometimes separated into two points, and each of these points has sometimes been described as a distinct fang.

* Mr. Hunter remarks of these teeth, that we may trace in them a similiarity in shape, situation, and use, from the most imperfectly carnivorous animal, which we believe to be the human species, to the lion, which is the most perfectly carnivorous.

The two first of the molares, or those nearest to the canine teeth on each side, differ from the other three, and are with great propriety named *bicuspides* by Mr. Hunter. They have sometimes only one root, and seem to be of a middle nature between the incisores and the larger molares. The two next are much larger. The fifth or last grinder on each side is smaller and shorter than the rest; and from its not cutting the gum till after the age of twenty, and sometimes not till much later in life, is called *dens sapientiæ.*

There is in the structure and arrangement of all these teeth an art which cannot be sufficiently admired. To understand it properly, it will be necessary to consider the under jaw as a kind of lever, with its fixed points at its articulations with the temporal bones:—it will be right to observe, too, that its powers arise from its different muscles, but in elevation chiefly from the temporalis and masseter; and that the aliment constitutes the object of resistance. It will appear, then, that the molares, by being placed nearest the centre of motion, are calculated to press with a much greater force than the other teeth, independent of their grinding powers which they possess by means of the pterygoid muscles; and that it is for this reason we put between them any hard body we wish to break.

The canini and incisores are placed farther from this point, and of course cannot exert so much force; but they are made for cutting and tearing the food, and this form seems to make amends for their deficiency in strength.

There are examples of children who have come into the world with two, three, and even four teeth; but these examples are very rare; and it is seldom before the seventh, eighth, or ninth month after birth, that the incisores, which are the first formed, begin to pass through the gum. The symptoms of dentition, however, in consequence of irritation from the teeth, frequently take place in the fourth or fifth month.—About the twentieth or twenty-fourth month, the canini and two molares make their appearance.

The dangerous symptoms that sometimes accompany dentition, are owing to the pressure of the teeth on the gum, which they irritate so as to excite pain and inflammation. This irritation seems to occasion a gradual wasting of the gum at the part, till at length the tooth makes its appearance.

The symptoms are more or less alarming, in proportion to the resistance which the gum affords to the teeth, and according to the number of teeth which may chance to seek a passage at the same time. Were they all to appear at once, children would fall victims to the pain and excessive irritation; but Nature has so very wisely disposed them, that they usually appear one after the other, with some distance of time between each. The first incisor that appears is generally in the lower jaw, and is followed by one in the upper jaw. Sometimes the canini, but more commonly one of the molares, begins to pass through the gum first.

These 20 teeth, viz. eight incisores, four canini, and eight molares, are called *temporary or milk teeth*, because they are all shed between the age of seven and fourteen, and are succeeded by what are called the *permanent or adult teeth*. The latter are of a firmer texture, and have larger fangs.

These adult teeth being placed in a distinct set of alveoli, the upper sockets gradually disappear, as the under ones increase in size, till at length the temporary, or upper teeth, having no longer any support, consequently fall out.

To these 20 teeth, which succeed the temporary ones, 12 others are afterwards added, viz. three molares on each side in both jaws: and in order to make room for this addition, we find that the jaws gradually lengthen in proportion to the growth of the teeth; so that with 20 teeth, they seem to be as completely filled as they are afterwards with 32. This is the reason why the face is rounder and flatter in children than in adults.

With regard to the formation of the teeth, we may observe, that in a fœtus of four months, the alveolar process appears only as a shallow longitudinal groove, divided by minute ridges into a number of intermediate depressions; in each of which we find a small pulpy substance surrounded by a vascular membrane. This pulp gradually ossifies, and its lower part is lengthened out to form the fang. When the bony part of the tooth is formed, its surface begins to be incrusted with the enamel. How the latter is formed and deposited, we are not yet able to determine.

The rudiments of some of the adult teeth begin to be formed at a very early period, for the pulp of one of the incisores may generally be perceived in a fœtus of eight months, and the ossification begins in it soon after birth. The first bicuspis begins to ossify about the fifth or sixth, and the second about the seventh year. The first adult grinder cuts the gum about the 12th, the second about the 18th, and the third, or *dens sapientiæ*, usually between the 20th and 30th year.

The teeth, like other bones, are liable to be affected by disease. Their removal is likewise the natural consequences of old age; for as we advance in life, the alveoli fill up, and the teeth, especially the incisores, fall out. When this happens, the chin projects forward, and the face is much shortened.

4. *Of the Os Hyoides.**

The os hyoides, which is placed at the root of the tongue, was so called by the ancients on account of its supposed resemblance to the Greek letter υ.

* This bone is very seldom preserved with the skeleton, and cannot be included among the bones of the head, or any other division of the skeleton Thomas Bartholin has perhaps very properly described it among parts contained in the mouth; but the generality of anatomical writers have placed it, as it is here, after the bones of the face.

It will be necessary to distinguish in it, its body, horns, and appendices.

The body, which is the middle and broadest part of the bone, is so placed that it may be easily felt at the fore part of the throat. Anteriorly it is irregularly convex, and its inner surface is unequally concave. Its cornua, or horns, which are flat and a little bent, being much longer than the body part, may be described as forming the sides of the υ. The appendices, or little horns, as they are called by M. Windslow, and some other writers, are two processes which rise up from the articulations of the cornua with the body, and are usually connected with the styloid process on each side by means of a ligament.

The uses of this bone are to support the tongue, and afford attachment to a great number of muscles; some of which perform the motions of the tongue, while others act on the larynx and fauces.

Sect. III. *Of the Bones of the Trunk.*

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

1. *Of the Spine.*

The spine is composed of a great number of bones called *vertebræ*, forming a long bony column, in figure not much unlike the letter ſ. This column, which extends from the head to the lower part of the body, may be said to consist of two irregular and unequal pyramids, united to each other in that part of the loins where the last lumbar vertebra joins the os sacrum.

The vertebræ of the upper and longest pyramid are called *true vertebræ*, in contradistinction to those of the lowermost pyramid, which, from their being immoveable in the adult, are styled *false vertebræ*. It is upon the bones of the spine that the body turns; and it is to this circumstance they owe their name, which is derived from the Latin verb *vertere*, to turn.

The true vertebræ are divided into three classes of cervical, dorsal and lumbar vertebræ.—The false vertebræ consist of the os sacrum and os coccygis.

In each vertebra, as in other bones, it will be necessary to remark the body of the bone, its processes, and cavities.

The body, which is convex before, and concave behind, where it assists in forming the cavity of the spine, may be compared to part of a cylinder cut off transversely.

Each vertebra affords seven processes. The first is at the back part of the vertebra, and from its shape and direction is named the *spinous process*. On each side of this are two others, which, from their situation with respect to the spine, are called *transverse processes*. The four others are styled *oblique* or *articular processes*. They are much smaller than the spinous or transverse ones. Two of them are placed on the upper, and two on the lower part of each vertebra, rising from near the basis of each transverse process. They have gotten the name of *oblique processes*, from their situation with respect to the processes with which they are articulated; and they are sometimes styled *articular processes*, from the manner in which they are articulated with each other; the two superior processes of one vertebra being articulated with the two inferior processes of the vertebra above it. Each of these processes is covered with cartilage at its articulation, and their articulations with each other are by a species of ginglimus.

In each vertebra, between its body and its processes, we find a hole large enough to admit a finger. These holes or foramina, correspond with each other through all the vertebræ, and form the long bony channel in which the spinal marrow is placed. We may likewise observe four notches in each vertebra. Two of these notches are at the upper, and two at the lower part of the bone, between the oblique processes and the body of the vertebra. Each of these notches meeting with a similar opening in the vertebra above or below it, forms a foramen for the passage of blood-vessels, and of the nerves out of the spine.

The bones of the spine are united together by means of a substance, which in young subjects appears to be of a ligamentous, but in adults more of a cartilaginous nature. This intervertebral substance, which forms a kind of partition between the several vertebræ, is thicker and more flexible between the lumbar vertebræ than in the other parts of the spine, the most considerable motions of the trunk being performed on those vertebræ. This substance being very elastic, the extension and flexion of the body, and its motion backwards and forwards, or to either side, are performed with great facility. This elasticity seems to be the reason why people who have been long standing, or have carried a considerable weight, are found to be shorter than when they have been long in bed. In the two first instances the intervertebral cartilages (as they are usually called) are evidently more exposed to compression than when we are in bed in an horizontal posture.

In advanced life these cartilages become shrivelled, and of course lose much of their elasticity. This may serve to account for the decrease in stature and the stooping forward which are usually to be observed in old people.

Besides the connection of the several vertebræ by means of this intervertebral substance, there are likewise many strong ligaments, both external and internal, which unite the bones of the spine to each other. Their union is also strengthened by a variety of strong muscles that cover and surround the spine.

The bones of the spine are found to diminish in density, and to be less firm in their texture in proportion as they increase in bulk; so that the lowermost vertebræ, though the largest, are not so heavy in proportion as the upper ones. By this means the size of these bones is increased without adding to their weight: a circumstance of no little importance in a part like the spine, which, besides flexibility and suppleness, seems to require lightness as one of its essential properties.

In very young children, each vertebra consists of three bony pieces united by cartilages which afterwards ossify.

There are seven vertebræ of the neck—they are of a firmer texture than the other bones of the spine. Their transverse processes are forked for the lodgment of muscles, and at the bottom of each we observe a foramen, through which pass the cervical artery and vein. The first and second of these vertebræ must be described more particularly. The first approaches almost to an oval shape —On its superior surface it has two cavities which admit the condyles of the occipital bone with which it is articulated. This vertebra, which is called *atlas* from its supporting the head, cannot well be described as having either body or spinous process, being a kind of bony ring. Anteriorly, where it is articulated to the odontoid process of the second vertebra, it is very thin. On its upper surface it has two cavities which admit the condyles of the occipital bone. By this connection the head is allowed to move forwards and backwards, but has very little motion in any other direction.

The second vertebra has gotten the name of *dentata*, from its having, at its upper and anterior part, a process called the *odontoid* or *tooth-like process*, which is articulated with the atlas, to which this second vertebra may be said to serve as an axis. This odontoid process is of a cylindrical shape, somewhat flattened, however, anteriorly and posteriorly. At its fore-part where it is received by the atlas, we may observe a smooth, convex, articulating surface. It is by means of this articulation that the head performs its rotatory motion, the atlas in that case moving upon this odontoid process as upon a pivot. But when this motion is in any considerable degree, or, in other words, when the head moves much either to the right or left, all the cervical vertebræ seem to assist, otherwise the spinal marrow would be in danger of being divided transversely by the first vertebra.

The spinous process of each of the cervical vertebræ is shorter, and their articular processes more oblique, than in the other bones of the spine.

These 12 vertebræ are of a middle size between those of the neck and loins. At their sides we may observe two depressions, one at the upper and the other at the lower part of the body of each vertebræ; which uniting with similar depressions in the vertebræ above and below, form articulating surfaces, covered with cartilages, for receiving the heads of the ribs; and at the fore-part of their transverse process (excepting the two last) we find an articulating surface for receiving the tuberosity of the ribs.

These five vertebræ differ only from those of the back in their being larger, and in having their spinous processes at a greater distance from each other. The most considerable motions of the trunk are made on these vertebræ; and these motions could not be performed with so much ease, were the processes placed nearer to each other.

The os sacrum, which is composed of five or six pieces in young subjects, becomes one bone in more advanced age.

It is nearly of a triangular figure, its inferior portion being bent a little forwards. Its superior part has two oblique processes which are articulated with the last of the lumbar vertebræ; and it has likewise commonly three small spinous processes, which gradually become shorter, so that the lowermost is not so long as the second, nor the second as the uppermost. Its transverse processes are formed into one oblong process, which becomes gradually smaller as it descends. Its concave or anterior side is usually smooth, but its posterior convex side has many prominences (the most remarkable of which are the spinous processes just now mentioned,) which are filled up and covered with the muscular and tendinous parts behind.

This bone has five pair of holes, which afford a passage to blood-vessels, and likewise to the nerves that are derived from the spinal marrow, which is continued even here, being lodged in a triangular cavity, that becomes smaller as it descends, and at length terminates obliquely at the lower part of this bone. Below the third division of the os sacrum, this canal is not completely bony as in the rest of the spine, being secured at its back part only by a very strong membrane, so that a wound at this part must be extremely dangerous.

The os sacrum is united laterally to the ossa innominata or hip-bones, and below to the coccyx.

The coccyx, which, like the os sacrum, is in young people made up of three or four distinct parts, usually becomes one bone in the adult state.

It serves to support the intestinum rectum; and, by its being capable of some degree of motion at its articulation with the sacrum, and being like that bone bent forwards, we are enabled to sit with ease.

This bone is nearly of a triangular shape, being broadest at its upper part, and from thence growing narrower to its apex, where it is not bigger than the little finger.

It has got its name from its supposed resemblance to a cuckow's beak. It differs greatly from the vertebræ, being commonly without any processes, and having no cavity for the spinal marrow, or foramina for the transmission of nerves.

The spine, of which we have now finished the anatomical description, is destined for many great and important uses. The medulla spinalis is lodged in its bony canal secure from external injury. It serves as a defence to the abdominal and thoracic viscera, and at the same time supports the head, and gives a general firmness to the whole trunk.

We have before compared it to the letter *ſ*, and its different turns will be found to render it not very unlike the figure of that letter.—In the neck we see it projecting somewhat forward to support the head, which without this assistance would require a great number of muscles.—Lower down, in the thorax, we find it taking a curved direction backwards, and of course increasing the cavity of the chest. After this, in the loins, it again projects forwards in a direction with the centre of gravity, by which means we are easily enabled to keep the body in an erect posture, for otherwise we should be liable to fall forward. Towards its inferior extremity, however, it again recedes backward, and thus assists in forming the pelvis, the name given to the cavity in which the urinary bladder, intestinum rectum, and other viscera are placed.

If this bony column had been formed only of one piece, it would have been much more easily fractured than it is now: and by confining the trunk to a stiff situation, a variety of motions would have been altogether prevented, which are now performed with ease by the great number of bones of which it is composed.

It is firm, and yet to this firmness there is added a perfect flexibility. If it be required to carry a load upon the head, the neck becomes stiff with the assistance of its muscles, and accommodates itself to the load, as if it was composed only of one bone—In stooping likewise, or in turning to either side, the spine turns itself in every direction, as if all its bones were separated from each other.

In a part of the body, like the spine, that is made up of so great a number of bones, and intended for such a variety of motion, there must be a greater danger of dislocation than fracture; but we shall find, that this is very wisely guarded against in every direction by the processes belonging to each vertebra, and by the ligaments, cartilages, &c. by which these bones are connected with each other.

2. *Of the Bones of the Thorax.*

The thorax, or chest, is composed of many bones, *viz.* the sternum which is placed at its anterior part, twelve ribs on each side which make up its lateral parts, and the dorsal vertebræ which constitute its posterior part. These last have been already described.

The sternum is the long bone which extends itself from the upper to the lower part of the breast anteriorly, and to which the ribs and the clavicles are articulated.

In children it is composed of several bones united by cartilages; but as we advance in life, most of these cartilages ossify, and the sternum in the adult state is found to consist only of three pieces, and sometimes becomes one bone. It is however generally described as being composed of three parts—one superior, which is broad, thick, and short; and one in the middle, which is thinner, narrower, and longer than the other.

It terminates at its lower part by a third piece, which is called the *xyphoid*, or *sword-like cartilage*, from its supposed resemblance to the blade of a sword, and because in young subjects it is commonly in a cartilaginous state.

We have already observed, that this bone is articulated with the clavicle on each side. It is likewise joined to the fourteen true ribs, *viz.* seven on its right and seven on its left side.

The ribs are bones shaped like a bow, forming the sides of the chest. There are twelve on each side. They are distinguished into true and false ribs: The seven upper ribs which are articulated to the sternum are called *true ribs*, and the five lower ones that are not immediately attached to that bone are called *false ribs*.

On the inferior and interior surface of each rib, we observe a sinuosity for the lodgment of an artery, vein, and nerve.

The ribs are not bony through their whole length, their anterior part being cartilaginous. They are articulated with the vertebræ and sternum. Every rib (or at least the greater number of them) has at its posterior part two processes; one at its extremity called the head of the rib, by means of which it is articulated with the body of two vertebræ; and another, called its tuberosity, by which it is articulated with the transverse process of the lowest of these two vertebræ. The first rib is not articulated by its extremity to two vertebræ, being simply attached to the upper part of the first vertebra of the back. The seven superior or true ribs are articulated anteriorly with the sternum by their cartilages; but the false ribs are supported in a different manner—the eighth, which is the first of these ribs, being attached by its cartilage to the seventh; the ninth to the eighth, &c.

The two lowermost ribs differ likewise from all the rest in the following particulars: they are articulated only with the body of the vertebra, and not with a transverse process; and anteriorly, their cartilage is loose, not being attached to the cartilages of the other ribs; and this seems to be, because the most considerable motions of the trunk are not performed on the lumbar vertebræ alone, but likewise on the two last vertebræ of the back; so that if these two ribs had been confined at the fore part like the other ribs, and had been likewise articulated with the bodies of two vertebræ, and with the transverse processes, the motion of the two last vertebræ, and consequently of the whole trunk, would have been impeded.

The ribs help to form the cavity of the thorax; they afford attachment to different muscles; they are useful in respiration; and they serve as a security to the heart and lungs.

3. *Of the Bones of the Pelvis.*

THE pelvis is composed of the os sacrum, os coccygis, and two ossa innominata. The two first of these bones were included in the account of the spine, to which they more properly belong.

In children, each os innominatum is composed of three distinct bones; but as we advance in life the intermediate cartilages gradually ossify, and the marks of the original separation disappear, so that they become one irregular bone; still however continuing to retain the names of ilium, ischium, and pubis, by which their divisions were originally distinguished, and to be described as three different bones by the generality of anatomists. The os ilium forms the upper and most considerable part of the bone, the os ischium its lower and posterior portion, and the os pubis its fore part.

The os ilium or haunch bone, is articulated posteriorly to the os sacrum by a firm cartilaginous substance, and is united to the os pubis before and to the os ischium below. Its superior portion is thin, and terminates in a ridge called the crista or spine of the ilium, and more commonly known by the name of the haunch. This crista rises up like an arch; being turned somewhat outwards, so as to resemble the wings of a phaeton.

Externally this bone is unequally prominent and hollowed for the lodgment of muscles; internally we find it smooth and concave. At its lower part there is a considerable ridge on its inner surface. This ridge extends from the os sacrum, and corresponds with a similar prominence both on that bone and the ischium; forms with the inner part of the ossa pubis what in midwifery is termed the brim of the pelvis.

The crista or spine, which at first is an epiphysis, has two considerable tuberosities; one anteriorly, and the other posteriorly, which is the largest of the two: these, from their projecting more than the parts of the bone below them, have gotten the name of spinal processes. From the anterior spinous process, the sartorius and tensor vaginæ femoris muscles have their origin; and below the posterior process we observe a considerable niche in the bone, which, in the recent subject, is formed into a large foramen, by means of a strong ligament that is stretched over its lower part from the os sacrum to the sharp-pointed process of the ischium. This hole affords a passage to the great sciatic nerve, and to the posterior crural vessels under the pyriform muscle, part of which likewise passes out here.

The os ischium, or hip-bone, which is of a very irregular figure, constitutes the lower lateral parts of the pelvis, and is commonly divided into its body, tuberosity, and ramus. The body forms the lower and most considerable portion of the acetabulum, and sends a sharp-pointed process backwards, called the spine of the ischium. To this process the ligament adheres, which was just now spoken of, as forming a foramen for the passage of the sciatic nerve.—The tuberosity, which is the lowest part of the trunk, and supports us when we sit, is large and irregular, affording origin to several muscles. From this tuberosity we find the bone becoming thinner and narrower. This part, which has the name of ramus or branch, passes forwards and upwards, and concurs with the ramus of the os pubis, to form a large hole called the *foramen magnum ischii*, or *thyroideum*, as it is sometimes named, from its resemblance to a door or shield. This hole, which in the recent subject is closed by a strong membrane called the obturator ligament, affords through its whole circumference attachment to muscles. At its upper part where we observe a niche in the bone, it gives passage to the obturator vessels and nerves, which go to the inner part of the thigh. Nature seems every where to avoid an unnecessary weight of bone, and this foramen, no doubt, serves to lighten the bones of the pelvis.

The os pubis or share-bone, which with its fellow forms the fore-part of the pelvis, is the smallest division of the os innominatum. It is united to its fellow by means of a strong cartilage, which forms what is called the symphysis pubis.

In each os pubis we may distinguish the body of the bone, its angle, and ramus. The body or outer part is united to the os ilium. The angle comes forward to form the sym-

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physis, and the ramus is a thin process which unites with the ramus of the ischium, to form the foramen thyroideum.

The three bones we have described as composing each os innominatum, all assist in forming the acetabulum, in which the head of the os femoris is received.

This cavity is every where lined with a smooth cartilage, excepting at its inner part, where we may observe a little fossa, in which are lodged the mucilaginous glands of the joint. We may likewise notice the pit or depression made by the round ligament, as it is improperly called, which, by adhering to this cavity and to the head of the thigh-bone, helps to secure the latter in the socket.

These bones, which are united to each other and to the spine by many very strong ligaments, serve to support the trunk, and to connect it with the lower extremities ; and at the same time to form the pelvis or bason, in which are lodged the intestines and urinary bladder, and in women the uterus ; so that the study of this part of osteology is of the utmost importance in midwifery.

It is worthy of observation, that in women the os sacrum is usually shorter, broader, and more hollowed, the ossa ilia more expanded, and the inferior opening of the pelvis larger than in men.

Sect. IV. *Of the Extremities.*

These parts of the skeleton consist of the upper extremity and the lower.

1. *Of the* Upper Extremity.

This consists of the shoulder, the arm, and the hand.

1. Of the shoulder.

The shoulder consists of two bones, the clavicula and the scapula.

The former, which is so named from its resemblance to the key in use amongst the ancients, is a little curved at both its extremities like an italic *ſ*. It is likewise called *jugulum*, or collar-bone, from its situation. It is about the size of the little finger, but longer, and being of a very spongy substance is very liable to be fractured. In this, as in other long bones, we may distinguish a body and two extremities. The body is rather flattened than rounded. The anterior extremity is formed into a slightly convex head, which is nearly of a triangular shape. The inferior surface of the head is articulated with the sternum. The posterior extremity, which is flatter and broader than the other, is connected to a process of the scapula, called *acromion*. Both these articulations are secured by ligaments, and in that with the sternum we meet with a moveable cartilage, to prevent any injury from friction.

The clavicle serves to regulate the motions of the scapula, by preventing it from being brought too much forwards, or carried too far backwards. It affords origin to several muscles, and helps to cover and protect the subclavian vessels, which derive their name from their situation under this bone.

The scapula, or shoulder-blade, which is nearly of a triangular shape, is fixed to the posterior part of the true ribs, somewhat in the manner of a buckler. It is of a very unequal thickness, and, like all other broad, flat bones, is somewhat cellular. Exteriorly it is convex, and interiorly concave, to accommodate itself to the convexity of the ribs. We observe in this bone three unequal sides, which are thicker and stronger than the body of the bone, and are therefore termed its *costæ*. The largest of the three, called also the basis, is turned towards the vertebræ. Another, which is less than the former, is below this; and the third, which is the least of the three, is at the upper part of the bone. Externally the bone is elevated into a considerable spine, which rising small at the basis of the scapula, becomes gradually higher and broader, and divides the outer surface of the bone into two fossæ. The superior of these, which is the smallest, serves to lodge the supra spinatus muscle; and the inferior fossa, which is much larger than the other, gives origin to the infra spinatus. This spine terminates in a broad and flat process at the top of the shoulder, called the *processus acromion*, to which the clavicle is articulated. This process is hollowed at its lower part to allow a passage to the supra and infra spinati muscles. The scapula has likewise another considerable process at its upper part, which, from its resemblance to the beak of a bird, is called the *coracoid process*. From the outer side of this coracoid process, a strong ligament passes to the processus acromion, which prevents a luxation of the os humeri upwards. A third process begins by a narrow neck, and ends in a cavity called *glenoid*, for the connection of the os humeri.

The scapula is articulated with the clavicle and os humeri, to which last it serves as a fulcrum; and by varying its position it affords a greater scope to the bones of the arm in their different motions. It likewise gives origin to several muscles, and posteriorly serves as a defence to the trunk.

2. Bones of the Arm.

The arm is commonly divided into two parts, which are articulated to each other at the elbow. The upper part retains the name of arm, properly so called, and the lower part is usually called the fore-arm.

The arm is composed of a single bone called *os humeri*. This bone, which is almost of a cylindrical shape, may be divided into its body and its extremities.

The upper extremity begins by a large, round smooth head, which is admitted into the glenoid cavity of the scapula. On the upper and fore part of the bone there is a groove for lodging the long head of the biceps muscle of the arm; and on each side of the groove, at the upper end of the bone, there is a tubercle to which the spinata muscles are fixed.

The lower extremity has several processes and cavities. The principal processes are its two condyles, one exterior and the other interior, and of these the last is the largest. Between these two we observe two lateral protuberances, which, together with a middle cavity, form as it were a kind of pully upon which the motions of the fore-arm are chiefly performed. At each side of the condyles, as well exteriorly as interiorly, there is another eminence which gives origin to several muscles of the hand and fingers. Posteriorly and superiorly, speaking with respect to the condyles, we observe a deep fossa which receives a considerable process of the ulna; and anteriorly and opposite to this fossa, we observe another, which is much less and receives another process of the same bone.

The body of the bone has at its upper and anterior part a furrow which begins from behind the head of the bone, and serves to lodge the tendon of a muscle. The body of the os humeri is hollow through its whole length, and, like all other long bones, has its marrow.

This bone is articulated at its upper part to the scapula. This articulation, which allows motion every way, is surrounded by a capsular ligament; that is sometimes torn in luxation, and becomes an obstacle to the easy reduction of the bone. Its lower extremity is articulated with the bones of the fore-arm.

The fore-arm is composed of two bones, the ulna and radius.

The ulna or elbow-bone is much less than the os humeri, and becomes gradually smaller as it descends to the wrist. At its upper part it has two processes and two cavities. Of the two processes, the largest, which is situated posteriorly, and called the *olecranon*, is admitted into the posterior fossa of the os humeri. The other process is placed anteriorly, and is called the *coronoid process.* In bending the arm it enters into the anterior fossa of the os humeri. This process being much smaller than the other, permits the fore-arm to bend inwards; whereas the olecranon, which is shaped like a hook, reaches the bottom of its fossa in the os humeri as soon as the arm becomes straight, and will not permit the fore-arm to be bent backwards. The ligaments likewise oppose this motion.

Between the two processes we have described, there is a considerable cavity called the sygmoid cavity, divided into two fossæ by a small eminence, which passes from one process to the other; it is by means of this cavity and the two processes, that the ulna is articulated with the os humeri by ginglimus.

At the bottom of the coronoid process interiorly, there is a small sygmoid cavity, which serves for the articulation of the ulna with the radius.

The body of the ulna is of a triangular shape: Its lower extremity terminates by a small head and a little styloid process. The ulna is articulated above to the os humeri—both above and below to the radius, and to the wrist at its lower extremity. All these articulations are secured by means of ligaments. The chief use of this bone seems to be to support and regulate the motions of the radius.

The radius, which is so named from its supposed resemblance to the spoke of a wheel, is placed at the inside of the fore-arm. It is somewhat larger than the ulna, but not quite so long as that bone. Its upper part is cylindrical, hollowed superiorly to receive the outer condyle of the os humeri. Laterally it is admitted into the little sygmoid cavity of the ulna, and the cylindrical part of the bone turns in this cavity in the motions of pronation and supination.* This bone follows the ulna in flexion and extension, and may likewise be moved round its axis in any direction. The lower extremity of the radius is much larger and stronger than its upper part; the ulna, on the contrary, is smaller and weaker below than above; so that they serve to supply each other's deficiencies in both those parts.

On the external side of this bone, we observe a small cavity which is destined to receive the lower end of the ulna; and its lower extremity is formed into a large cavity, by means of which it is articulated with the bones

* The motions of pronation and supination may be easily described. If the palm of the hand, for instance, is placed on the surface of a table, the hand may be said to be in a state of pronation; but if the back part of the hand is turned towards the table, the hand will be then in a state of supination.

of the wrist, and on this account it is sometimes called *manubrium manus*. It supports the two first bones of the wrist on the side of the thumb, whereas the ulna is articulated with that bone of the wrist which corresponds with the little finger.

Through the whole length both of this bone and the ulna, a ridge is observed, which affords attachment to an interosseous ligament. This ligament fills up the space between the two bones.

3. Bones of the Hand.

The carpus or wrist consists of eight small bones of an irregular shape, and disposed in two unequal rows. Those of the upper row are articulated with the bones of the fore-arm, and those of the lower one with the metacarpus.

The ancient anatomists described these bones numerically; Lyserus seems to have been the first who gave to each of them a particular name. The names he adopted are founded on the figure of the bones, and are now pretty generally received, except the first, which instead of κοτυλοειδης (the name given to it by Lyserus, on account of its sinus that admits a part of the os magnum), has by later writers been named *Scaphoides* or *Naviculare*. This, which is the outermost of the upper row (considering the thumb as the outer side of the hand), is articulated with the radius; on its inner side it is connected with the os lunare, and below to the trapezium and trapezoides. Next to this is a smaller bone, called the *os lunare:* because its outer side, which is connected with the scaphoides, is shaped like a crescent. This is likewise articulated with the radius. On its inner side it joins the os cuneiforme, and anteriorly, the os magnum and os unciforme.

The os cuneiforme, which is the third bone in the upper row, is compared to a wedge, from its being broader above, at the back of the hand, than it is below. Posteriorly it is articulated with the ulna, and anteriorly with the os unciforme.

These three bones form an oblong articulating surface, covered by cartilage, by which the hand is connected with the fore-arm.

The os pisiforme, or pea-like bone, which is smaller than the three just now described, though generally classed with the bones of the upper row, does not properly belong to either series, being placed on the under surface of the os cuneiforme, so as to project into the palm of the hand. The four bones of the second row correspond with the bones of the thumb and fingers; the first, second, and fourth, are from their shapes named *trapezium*, *trapezoides*, and *unciforme;* the third, from its being the largest bone of the carpus, is styled *os magnum.*

All these bones are convex towards the back, and slightly concave towards the palm of the hand; their articulating surfaces are covered with cartilages, and secured by many strong ligaments, particularly by two ligamentous expansions, called the external and internal annular ligaments of the wrist. The former extends in an oblique direction from the os pisiforme to the styloid process of the radius, and is an inch and an half in breadth; the latter or internal annular ligament is stretched from the os pisiforme and os unciforme, to the os scaphoides and trapezium. These annular ligaments likewise serve to bind down the tendons of the wrist and fingers.

The metacarpus consists of four bones, which support the fingers; externally they are a little convex, and internally somewhat concave, where they form the palm of the hand. They are hollow and of a cylindrical shape.

At each extremity they are a little hollowed for their articulation; superiorly with the bones of the carpus, and inferiorly with the first phalanx of the fingers, in the same manner as the several phalanges of the fingers are articulated with each other.

The five fingers of each hand are composed of fifteen bones, disposed in three ranks called phalanges: the bones of the first phalanx, which are articulated with the metacarpus, are the largest, and those of the last phalanx the smallest. All these bones are larger at their extremities than in their middle part.

We observe at the extremities of the bones of the carpus, metacarpus, and fingers, several inequalities that serve for their articulation with each other; and these articulations are strengthened by means of the ligaments which surround them.

It will be easily understood that this multiplicity of bones in the hand (for there are 27 in each hand) is essential to the different motions we wish to perform. If each finger was composed only of one bone instead of three, it would be impossible for us to grasp any thing.

2. *Of the* Lower Extremities.

Each lower extremity is divided into four parts, viz. the os femoris, or thigh bone: the rotula, or knee pan; the leg and the foot.

1. Of the Thigh.

The thigh is composed only of this bone, which is the largest and strongest we have. It will be necessary to distinguish its body and extremities: its body, which is of a cylindrical shape, is convex before and concave behind, where it serves to lodge several muscles. Throughout two-thirds of its length we observe a ridge called *linea aspera*, which originates from the trochanters, and after running for some way downwards, divides into two branches, that terminate in the tuberosities at the lower extremity of the bone.

At its upper extremity we must describe the neck and smooth head of the bone, and likewise two considerable processes: the head, which forms the greater portion of a sphere unequally divided, is turned inwards, and received into the great cotyloid cavity of the os innominatum. At this part of the bone there is a little fossa to be observed, to which the round ligament is attached, and which we have already described as tending to secure the head of this bone in the great acetabulum. The neck is almost horizontal, considered with respect to its situation with the body of the bone. Of the two processes, the external one, which is the largest, is called trochanter major; and the other, which is placed on the inside of the bone, trochanter minor. They both afford attachment to muscles. The articulation of the os femoris with the trunk is strengthened by means of a capsular ligament, which adheres every where round the edge of the great cotyloid cavity of the os innominatum, and surrounds the head of the bone.

The os femoris moves upon the trunk in every direction.

At the lower extremity of the bone are two processes called the condyles, and an intermediate smooth cavity, by means of which it is articulated with the leg by ginglimus.

All round the under end of the bone there is an irregular surface where the capsular ligament of the joint has its origin, and where blood-vessels go into the substance of the bone.

Between the condyles there is a cavity posteriorly, in which the blood-vessels and nerves are placed, secure from the compression to which they would otherwise be exposed in the action of bending the leg, and which would not fail to be hurtful.

At the side of each condyle externally, there is a tuberosity, from whence the lateral ligaments originate, which are extended down to the tibia.

A ligament likewise arises from each condyle posteriorly. One of these ligaments passes from the right to the left, and the other from the left to the right, so that they intersect each other, and for that reason are called the *cross ligaments*.

The lateral ligaments prevent the motion of the leg upon the thigh to the right or left; and the cross ligaments, which are also attached to the tibia, prevent the latter from being brought forwards.

In new-born children all the processes of this bone are cartilaginous.

2. The Rotula, or Knee-pan.

The rotula, patella, or knee-pan, as it is differently called, is a flat bone about four or five inches in circumference, and is placed at the fore-part of the joint of the knee. In its shape it is somewhat like the common figure of the heart, with its point downwards.

It is thinner at its edge than in its middle part; at its fore-part it is smooth and somewhat convex; its posterior surface, which is more unequal, affords an elevation in the middle which is admitted between the two condyles of the os femoris.

This bone is retained in its proper situation by a strong ligament which every where surrounds it, and adheres both to the tibia and os femoris; it is likewise firmly connected with the tibia by means of a strong tendinous ligament of an inch in breadth, and upwards of two inches in length, which adheres to the lower part of the patella, and to the tuberosity at the upper end of the tibia. On account of this connection, it is very properly considered as an appendage to the tibia, which it follows in all its motions, so as be to it what the olecranon is to the ulna. There is this difference, however, that the olecranon is a fixed process; whereas the patella is moveable, being capable of sliding from above downwards and from below upwards. This mobility is essential to the rotatory motion of the leg.

In very young children this bone is entirely cartilaginous.

The principal use of the patella seems to be to defend the articulation of the knee from external injury; it likewise tends to increase the power of the extensor muscles of the leg, by removing their direction farther from the centre of motion in the manner of a pulley.

3. Of the Leg.

The leg is composed of two bones: of these the inner one, which is the largest, is called tibia; the other is much smaller, and named fibula.

The tibia, which is so called from its resemblance to the musical pipe of the ancients, has three surfaces, and is not very unlike a triangular prism. Its posterior surface is the broadest; anteriorly it has a considerable ridge called the shin, between which and the skin there are no muscles. At the upper extremity of this bone are two surfaces, a little concave, and separated from each other by an intermediate elevation. The two little cavities receive the condyles of the os femoris, and the eminence between them is admitted into the cavity which we spoke of as being between the two condyles; so that this articulation affords a specimen of the complete ginglimus. Under the external edge of the upper end of this bone is a circular flat surface, which receives the head of the fibula.

At the lower and inner portion of the tibia, we observe a considerable process called *malleolus internus*. The basis of the bone terminates in a large transverse cavity, by which it is articulated with the uppermost bone of the foot. It has likewise another cavity at its lower end and outer side, which is somewhat oblong, and receives the lower end of the fibula.

The tibia is hollow through its whole length.

The fibula is a small long bone situated on the outside of the tibia. Its superior extremity does not reach quite so high as the upper part of the tibia, but its lower end descends somewhat lower. Both above and below, it is articulated with the tibia by means of the lateral cavities we noticed in our description of that bone.

Its lower extremity is stretched out into a coronoid process, which is flattened at its inside, and is convex externally, forming what is called the *malleolus externus* or *outer ankle*. This is rather lower than the malleolus internus of the tibia.

The body of this bone, which is irregularly triangular, is a little hollow at its internal surface, which is turned towards the tibia; and it affords like that bone, through its whole length, attachment to a ligament, which from its situation is called the interosseous ligament.

4. Of the Foot.

The foot consists of the tarsus, metatarsus, and toes.

The tarsus is composed of seven bones, viz. the astragalus, os calcis, os naviculare, os cuboides, and three others called cuneiform bones.

The astragalus is a large bone with which both the tibia and fibula are articulated. It is the uppermost bone of the foot; it has several surfaces to be considered; its upper, and somewhat posterior part, which is smooth and convex, is admitted into the cavity of the tibia. Its lateral parts are connected with the malleoli of the two bones of the leg; below, it is articulated with the os calcis, and its anterior surface is received by the os naviculare. All these articulations are secured by means of ligaments.

The os calcis, or calcaneum, which is of a very irregular figure, is the largest bone of the foot. Behind, it is formed into a considerable tuberosity called the heel; without this tuberosity, which supports us in an erect posture, and when we walk, we should be liable to fall backwards.

On the internal surface of this bone, we observe a considerable sinuosity, which affords a passage to the tendon of a muscle: and to the posterior part of the os calcis, a strong tendinous cord called *tendo achillis** is attached, which is formed by the tendons of several muscles united together. The articulation of this with the other bones is secured by means of ligaments.

The os naviculare, or scaphoides, (for these two terms have the same signification), is so called on account of its resemblance to a little bark. At its posterior part, which is concave, it receives the astragalus; anteriorly it is articulated with the cuneiform bones, and laterally is connected with the os cuboides.

The os cuboides forms an irregular cube. Posteriorly it is articulated with the os calcis; anteriorly it supports the two last bones of the metatarsus, and laterally it joins the third cuneiform bone and the os naviculare.

Each of the ossa cuneiformia, which are three in number, resembles a wedge, and from this similitude their name is derived. They

* This tendon is sometimes ruptured by jumping, dancing, or other violent efforts.

are placed next to the metatarsus by the sides of each other, and are usually distinguished into *os cuneiforme externum*, *medium* or *minimum*, and *internum* or *maximum*. The superior surface of these bones, from their wedge-like shape, is broader than that which is below, where they help to form the sole of the foot; posteriorly they are united to the os naviculare, and anteriorly they support the three first metatarsal bones.

When these seven bones composing the tarsus are viewed together in the skeleton, they appear convex above, where they help to form the upper part of the foot; and concave underneath, where they form the hollow of the foot, in which the vessels, tendons, and nerves of the foot are placed secure from pressure.

They are united to each other by very strong ligaments, and their articulation with the foot is secured by a capsular and two lateral ligaments; each of the latter is covered by an annular ligament of considerable breadth and thickness, which serves to bind down the tendons of the foot, and at the same time to strengthen the articulation.

The os cuneiforme externum is joined laterally to the os cuboides.

These bones complete our account of the tarsus. Though what we have said of this part of the osteology has been very simple and concise, yet many readers may not clearly understand it: but if they will be pleased to view these bones in their proper situation in the skeleton, all that we have said of them will be easily understood.

The metatarsus is made up of five bones, whereas the metacarpus consists only of four. The cause of this difference is, that in the hand the last bone of the thumb is not included among the metacarpal bones; whereas in the foot the great toe has only two bones. The first of these bones supports the great toe and is much larger than the rest, which nearly resemble each other in size.

These bones are articulated by one extremity with the cuneiform bones and the os cuboides, and by their other end with the toes.

Each of the toes, like the fingers, consists of three bones, except the great toe, which is formed of two bones. Those of the other four are distinguished into three phalanges. Although the toes are more confined in their motion than the fingers, yet they appear to be perfectly fitted for the purposes they are designed for. In walking, the toes bring the centre of gravity perpendicular to the advanced foot; and as the soles of the feet are naturally concave, we can at pleasure increase this concavity, and form a kind of vault, which adjusts itself to the different inequalities that occur to us in walking; and which, without this mode of arrangement, would incommode us exceedingly, especially when bare-footed.

4. *Of the Ossa* SESAMOIDEA.

BESIDES the bones we have already described, there are several small ones that are met with only in the adult skeleton, and in persons who are advanced in life; which, from their supposed general resemblance to the seeds of the sesamum, are called *ossa sesamoidea*. They are commonly to be seen at the first joint of the great toe, and sometimes at the joints of the thumb; they are likewise now and then to be found at the lower extremity of the fibula, upon the condyles of the thigh-bone, under the os cuboides of the tarsus, and in other parts of the body. Their size and number seem constantly to be increased by age and hard labour; and as they are generally found in situations where tendons and ligaments are most exposed to the action of muscles, they are now generally considered as ossified portions of ligaments or tendons.

The upper surface of these bones is usually convex, and adherent to the tendon that covers it; the side which is next to the joint is smooth and flat. Though their formation is accidental, yet they seem to be of some use, by raising the tendons farther from the centre of motion, and consequently increasing the power of the muscles. In the great toe and thumb they are likewise useful, by forming a groove for the flexor tendons.

EXPLANATION OF THE PLATES OF OSTEOLOGY.

Plate. XIX.

Fig. 1. A Front-view of the Male Skeleton.

A, The os frontis. B, The os parietale. C, The coronal suture. D, The squamous part of the temporal bones. E, The squamous suture. F, The zygoma. G, The mastoid process. H, The temporal process of the sphenoid bone. I, The orbit. K, The os malæ. L, The os maxillare superius. M, Its nasal process. N, The ossa nasi. O, The os unguis. P, The maxilla inferior. Q, The teeth which are sixteen in number in each jaw. R, The seven cervical vertebræ, with their intermediate cartilages. S, Their transverse processes. T, The twelve dorsal vertebræ, with their intermediate cartilages. U, The five lumbar vertebræ. V, Their transverse processes. W, The upper part of the os sacrum. X, Its lateral parts. The holes seen on its fore part are the passages of the undermost spinal nerves and small vessels. Opposite to the holes, the marks of the original divisions of the bone are seen. Y, The os ilium. Z, Its crest or spine. a, The anterior spinous processes. b, The brim of the pelvis. c, ANATOMY Plate XIV

The ischiatic niche. d, The os ischium. e, Its tuberosity. f, Its spinous process. g, Its crus. h, The foramen thyroideum. i, The os pubis. k, The symphysis pubis. l, The crus pubis. m, The acetabulum. n, The seventh or last true rib. o, The twelfth or last false rib. p, The upper end of the sternum. q, The middle piece. r, The under end, or cartilage ensiformis. s, The clavicle. t, The internal surface of the scapula. u, Its acromion. v, Its coracoid process. w, Its cervix. x, The glenoid cavity. y, The os humeri. z, Its head which is connected to the glenoid cavity. 1, Its external tubercle. 2, Its internal tubercle. 3. The groove for lodging the long head of the biceps muscle of the arm. 4, The internal condyle. 5, The external condyle. Between 4 and 5, the trochlea. 6, The radius. 7, Its head. 8, Its tubercle. 9, The ulna. 10, Its coronoid process. 11, 12, 13, 14, 15, 16, 17, 18, The carpus; composed of os naviculare, os lunare, os cuneiforme, os pisiforme, os trapezium, os trapezoides, os magnum, os unciforme. 19, The five bones of the metacarpus. 20, The two bones of the thumb. 21, The three bones of each of the fingers. 22, The os femoris. 23, Its head. 24, Its cervix. 25, The trochanter major. 26, The trochanter minor. 27, The internal condyle. 28, The external condyle 29, The rotula. 30, The tibia. 31, Its head. 32, Its tubercle. 33, Its spine. 34, The malleolus internus. 35, The fibula. 36, Its head. 37, The malleolus externus. The tarsus is composed of, 38, The astragalus; 39, The os calcis; 40, The os naviculare; 41, Three ossa cuneiformia, and the os cuboides, which is not seen in this figure. 42, The five bones of the metatarsus. 43, The two bones of the great toe. 44, The three bones of each of the small toes.

FIG. 2. A Front-view of the SKULL.

A, The os frontis. B. The lateral part of the os frontis, which gives origin to part of the temporal muscle. C, The superciliary ridge. D, The superciliary hole through which the frontal vessels and nerves pass. E E, The orbitar processes. F, The middle of the transverse suture. G, The upper part of the orbit. H, The foramen opticum. I, The foramen lacerum. K, The inferior orbitar fissure. L, The os unguis. M, The ossa nasi. N, The os maxillare superius. O, Its nasal process. P, The external orbitar hole through which the superior maxillary vessels and nerves pass. Q, The os malæ. R, A passage for small vessels into, or out of, the orbit. S, The under part of the left nostril. T, The septum narium. U, The os spongiosum superius. V, The os spongiosum inferius. W, The edge of the alveoli, or spongy sockets, for the teeth. X, The maxilla inferior. Y, The passage for the inferior maxillary vessels and nerves.

Fig. 3. A Side-view of the Skull.

A, The os frontis. B, The coronal suture. C, The os parietale. D, An arched ridge which gives origin to the temporal muscle. E, The squamous suture. F, The squamous part of the temporal bone; and, farther forwards, the temporal process of the sphenoid bone. G, The zygomatic process of the temporal bone. H, The zygomatic suture. I, The mastoid process of the temporal bone. K, The meatus auditorius externus. L, The orbitar plate of the frontal bone, under which is seen the transverse suture. M, The pars plana of the ethmoid bone. N, The os unguis. O, The right os nasi. P, The superior maxillary bone. Q, Its nasal process. R, The two dentes incisores. S, The dens caninus. T, The two small molares. U, The three large molares. V, The os malæ. W, The lower jaw. X, Its angle. Y, The coronoid process. Z, The condyloid process, by which the jaw is articulated with the temporal bone.

Fig. 4. The posterior and right Side of the Skull.

A, The os frontis. B B, The ossa parietalia. C, The sagittal suture. D, The parietal hole, through which a small vein runs to the superior longitudinal sinus. E, The lambdoid suture. F F, Ossa triquetra. G, The os occipitis. H, The squamous part of the temporal bone. I, The mastoid process. K, The zygoma. L, The os malæ. M, The temporal part of the sphenoid bone. N, The superior maxillary bone and teeth.

FIG. 5. The external Surface of the Os FRONTIS.

A, The convex part. B, Part of the temporal fossa. C, The external angular process. D, The internal angular process. E, The nasal process. F, The superciliary arch. G, The superciliary hole. H, The orbitar plate.

FIG. 6. The Interior Surface of the Os FRONTIS.

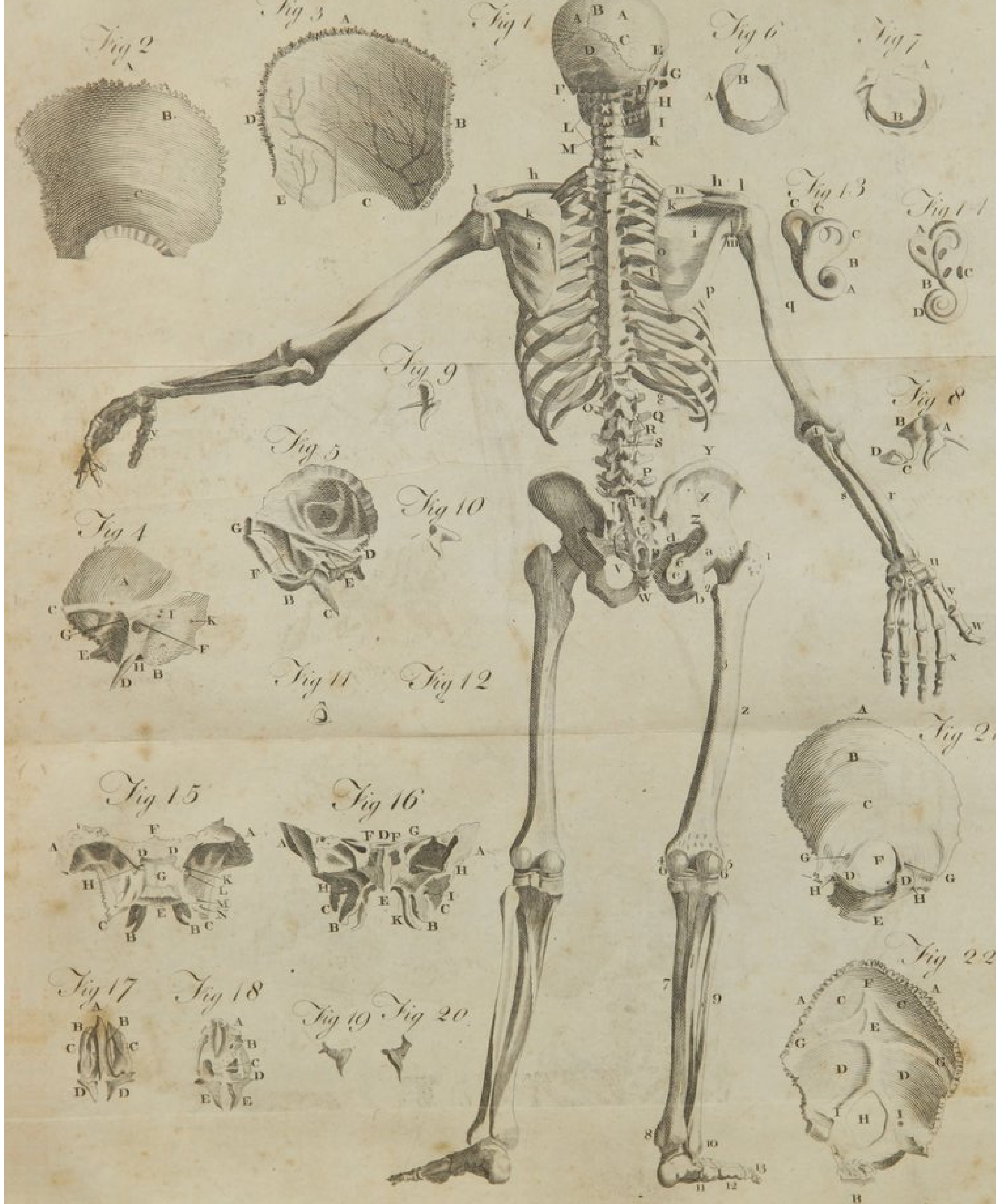
A A, The serrated edge which assists to form the coronal suture. B, The external angular process. C, The internal angular process. D, The nasal process. E, The orbitar plate. F, The cells which correspond with those of the ethmoid bone. G, The passage from the frontal sinus. H, The opening which receives the cribriform plate of the ethmoid bone. I, The cavity which lodges the fore part of the brain. K, The spine to which the falx is fixed. L, The groove which lodges the superior longitudinal sinus.

PLATE XX.

FIG. 1. A Back-view of the SKELETON.

A A, The ossa parietalia. B, The sagittal suture. C, The lambdoid suture. D, The

ANATOMY



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occipital bone. E, The squamous suture. F, The mastoid process of the temporal bone. G, The os malæ. H, The palate-plates of the superior maxillary bones. I, The maxilla inferior. K, The teeth of both jaws. L, The seven cervical vertebræ. M, Their spinous processes. N, Their transverse and oblique processes. O, The last of the twelve dorsal vertebræ. P, The fifth or last lumbar vertebra. Q, The transverse processes. R, The oblique processes. S, The spinous processes. T, The upper part of the os sacrum. U, The posterior holes which transmit small blood-vessels and nerves. V, The under part of the os sacrum which is covered by a membrane. W, The os coccygis. X, The os ilium. Y, Its spine or crest. Z, The ischiatic niche. a, The os ischium. b, Its tuberosity. c, Its spine. d, The os pubis. e, The foramen hydroideum. f, The seventh or last true rib. g, The twelfth or last false rib. h, The clavicle. i, The scapula. k, Its spine. l, Its acromion. m, Its cervix. n, Its superior costa. o, Its posterior costa. p, Its inferior costa. q, The os humeri. r, The radius. s, The ulna. t, Its oleclarnon. u, All the bones of the carpus, excepting the os pisiforme, which is seen in plate XIX. fig. 1. v, The five bones of the metacarpus. w, The two bones of the thumb. x, The three bones of each of the fingers. y, The two sesamoid bones at the root of the left thumb. z, The os femoris. 1, The trochanter major. 2, The trochanter minor. 3, The linea aspera. 4, The internal condyle. 5, The external condyle. 6 6, The semilunar cartilages. 7, The tibia. 8, The malleolus internus. 9, The fibula. 10, The malleolus externus. 11, The tarsus. 12, The metatarsus. 13, The toes.

FIG. 2. The External Surface of the left Os PARIETALE.

A, The convex smooth surface. B, The parietal hole. C, An arch made by the beginning of the temporal muscle.

FIG. 3. The Internal Surface of the same bone.

A, Its superior edge, which, joined with the other, forms the sagittal suture. B, The anterior edge, which assists in the formation of the coronal suture. C. The inferior edge for the squamous suture. D, The posterior edge for the lambdoid suture. E, A depression made by the lateral sinus. F F, The prints of the arteries of the dura mater.

FIG. 4. The External Surface of the Left Os TEMPORUM.

A, The squamous part. B, The mastoid process. C, The zygomatic process. D, The styloid process. E, The petrosal process. F. The meatus auditorius externus. G, The glenoid cavity for the articulation of the lower jaw. H, The foramen stylo-mastoideum for the portio dura of the seventh pair of nerves I, Passages for blood-vessels into the bone.

K, The foramen mastoideum through which a vein goes to the lateral sinus.

FIG. 5. The Internal Surface of the Left Os TEMPORUM.

A, The squamous part; the upper edge of which assists in forming the squamous suture. B, The mastoid process. C, The styloid process. D, The pars petrosa. E, The entry of the seventh pair, or auditory nerve. F, The fossa which lodges a part of the lateral sinus. G, The foramen mastoideum.

FIG. 6. The External Surface of the OSSEOUS CIRCLE, which terminates the meatus auditorius externus.

A, The anterior part. B, A small part of the groove in which the membrana tympani is fixed.

N. B. This with the subsequent bones of the ear, are here delineated as large as the life.

FIG. 7. The Internal Surface of the OSSEOUS CIRCLE.

A, The anterior part. B, The groove in which the membrana tympani is fixed.

FIG. 8. The Situation and Connection of the Small Bones of the EAR.

A, The malleus. B, The incus. C, The os orbiculare. D, The stapes.

FIG. 9. The MALLEUS, with its Head, Handle, and Small processes.

FIG. 10. The INCUS, with its Body, Superior and Inferior Branches.

FIG. 11. The OS ORBICULARE.

FIG. 12. The STAPES, with its Head, Base, and two Crura.

FIG. 13. An Internal View of the LABYRINTH of the EAR.

A, The hollow part of the cochlea, which forms a share of the meatus auditorius internus. B, The vestibulum. C C C, The semicircular canals.

FIG. 14. An External View of the LABYRINTH.

A, The semicircular canals. B, The fenestra ovalis which leads into the vestibulum. C, The fenestra rotunda which opens into the cochlea. D, The different turns of the cochlea.

FIG. 15. The Internal Surface of the OS SPHENOIDES.

A A, The temporal processes. B B, The pterygoid processes. C C, The spinous processes. D D, The anterior clinoid processes. E, The posterior clinoid process. F, The anterior process which joins the ethmoid bone. G, The sella turcica for lodging the glandula pituitaria. H, The foramen opticum. K, The foramen lacerum. L, The foramen rotundum. M, The foramen ovale. N, The foramen spinale.

Fig. 16. The External Surface of the Os Sphenoides.

A A, The temporal processes. B B, The pterygoid processes. C C, The spinous processes. D, The processus azygos. E, The small triangular processes which grow from the body of the bone. F F, The orifices of the sphenoidal sinuses. G, The foramen lacerum. H, The foramen rotundum. I, The foramen ovale. K, The foramen pterygoideum.

Fig. 17. The External View of the Os Ethmoides.

A, The nasal lamella. B B, The grooves between the nasal lamella and ossa spongiosa superiora. C C, The ossa spongiosa superiora. D D, The sphenoidal cornua. See Fig. 16. E.

Fig. 18. The Internal View of the Os Ethmoides.

A, The crista galli. B, The cribriform plate, with the different passages of the olfactory nerves. C C, Some of the ethmoidal cells. D, The right os planum. E E, The sphenoidal cornua.

Fig. 19. The right Sphenoidal Cornu.

Fig. 20. The left Sphenoidal Cornu.

FIG. 21. The External Surface of the Os Occipitis.

A, The upper part of the bone. B, The superior arched ridge. C, The inferior arched ridge. Under the arches are prints made by the muscles of the neck. D D, The two condyloid processes which articulate the head with the spine. E, The cuneiform process. F, The foramen magnum through which the spinal marrow passes. G G, The posterior condyloid foramina which transmit veins into the lateral sinuses. H H, The foramina lingualia for the passage of the nine pair of nerves.

FIG. 22. The Internal Surface of the Os Occipitis.

A A, The two sides which assist to form the lambdoid suture. B, The point of the cuneiform process, where it joins the sphenoid bone. C C, The prints made by the posterior lobes of the brain. D D, Prints made by the lobes of the cerebellum. E, The cruciform ridge for the attachment of the processes of the dura mater. F, The course of the superior longitudinal sinuses. G G, The course of the two lateral sinuses. H, The foramen magnum. II, The posterior condyloid foramina.

PLATE XXI.

FIG. 1. A Side-view of the SKELETON.

A A, The ossa parietalia. B, The sagittal suture. C, The os occipitis. D D, The lambdoid suture. E, The squamous part of the temporal bone. F, The mastoid process. G, The meatus auditorius externus. H, The os frontis. I, The os malæ. K, The os maxillare superius. L, The maxilla inferior. M, The teeth of both jaws. N, The seventh, or last cervical vertebra. O, The spinous processes. P, Their transverse and oblique processes. Q, The twelfth or last dorsal vertebra. R, The fifth, or last lumbar vertebra. S. The spinous processes. T, Openings between the vertebræ for the passage of the spinal nerves. U, The under end of the os sacrum. V, The os coccygis. W, The os ilium. X, The anterior spinous processes. Y, The posterior spinous processes. Z, The ischiatic niche. a, The right os ilium. b, The ossa pubis. c, The tuberosity of the left os ischium. d, The scapula. e, Its spine. f, The os humeri. g, The radius. h, The ulna. i, The carpus. k, The metacarpal bone of the thumb. l, The metacarpal bones of the fingers. m, The two bones of the thumb. n, The three bones of each of the fingers. o, The os femoris. p, Its head. q, The trochanter major. r, The external condyle. s, The rotula. t, The tibia.

u, The fibula. v, The malleolus externus. w, The astragalus. x, The os calcis. y, The os naviculare. z, The three ossa cuneiformia. 1, The os cuboides. 2, The five metatarsal bones. 3, The two bones of the great toe. 4, The three bones of each of the small toes.

Fig. 2. A View of the Internal Surface of the Base of the Skull.

A A A, The two tables of the skull with the diplöe. B B, The orbitar plates of the frontal bone. C, The crista galli, with cribriform plate of the ethmoidal bone on each side of it, through which the first pair of nerves pass. D, The cuneiform process of the occipital bone. E, The cruciform ridge. F, The foramen magnum for the passage of the spinal marrow. G, The zygoma, made by the joining of the zygomatic processes of the os temporum and os malæ. H, The pars squamosa of the os temporum. I, The pars mammillaris. K, The pars petrosa. L, The temporal process of the sphenoid bone. M M, The anterior clinoid processes. N, The posterior clinoid process. O, The sella turcica. P, The foramen opticum, for the passage of the optic nerve and ocular artery of the left side. Q, The foramen lacerum, for the third, fourth, sixth, and first of the fifth pair of nerves and ocular vein. R, The foramen rotundum, for the second of the fifth pair. S, The foramen ovale, for the third of the fifth pair. T, The foramen spinale, for the principal artery of the dura mater. U, The entry of the au-

ANATOMY Plate XXI

ditory nerve. V, The passage for the lateral sinus. W, The passage of the eighth pair of nerves. X, The passage of the ninth pair.

Fig. 3. A View of the External Surface of the Base of the Skull.

A, The two dentes incisores of the right side. B, The dens caninus. C, The two small molares. D, The three large molares. E, The foramen incisivum, which gives passage to small blood-vessels and nerves. F, The palate-plates of the ossa maxillaria and palati, joined by the longitudinal and transverse palate sutures. G, The foramen palatinum posterius, for the palatine vessels and nerves. H, The os maxillare superius of the right side. I, The os malæ. K, The zygomatic process of the temporal bone. L, The posterior extremity of the ossa spongiosa. M, The posterior extremity of the vomer, which forms the back-part of the septum nasi. N, The pterygoid process of the right side of the sphenoid bone. O O, The foramina ovalia. PP, The foramina spinalia. Q Q, The passages of the internal carotid arteries. R, A hole between the point of each pars petrosa and cuneiform process of the occipital bone, which is filled up with a ligamentous substance in the recent subject. S, The passage of the left lateral sinus. T, The posterior condyloid foramen of the left side. U, The foramen mastoideum. V, The foramen magnum. W, The inferior orbitar fissure. X, The glenoid cavity, for the articulation of the lower jaw. Y, The squamous part of the temporal bone. Z, The mastoid process, at the inner side of which is a fossa for the posterior belly of the digastric muscle. a, The styloid process. b, The meatus auditorius externus. c, The left condyle of the occipital bone. d, The perpendicular occipital spine. e e, The inferior horizontal ridge of the occipital bone. f f, The superior horizontal ridge, which is opposite to the crucial ridge where the longitudinal sinus divides to form the lateral sinuses. g g g, The lambdoid suture. h, The left squamous suture. i, The parietal bone.

FIG. 4. The anterior surface of the OSSA NASI.

A, The upper part, which joins the os frontis. B, The under end, which joins the cartilage of the nose. C, The inner edge, where they join each other.

FIG. 5. The posterior surface of the OSSA NASI.

A A, Their cavity, which forms part of the arch of the nose. B B, Their ridge or spine, which projects a little to be fixed to the forepart of the septum narium.

FIG. 6. The external surface of the OS MAXILLARE SUPERIUS of the left side.

A, The nasal process. B, The orbitar plate. C, The unequal surface which joins the os malæ. D, The external orbitar hole. E, The opening into the nostril. F, The palate-plate. G, The maxillary tuberosity. H, Part of the os palati. I, The two dentes incisores. K, The dens caninus. L, The two small dentes molares. M, The three large dentes molares.

FIG. 7. The internal surface of the OS MAXILLARE SUPERIUS and OS PALATI.

A, The nasal process. B B, Eminences for the connection of the os spongiosum inferius. D, The under end of the lachrymal groove. E, The antrum maxillare. F, The nasal spine, between which and B is the cavity of the nostril. G, The palate-plate. H, The orbitar part of the os palati. I, The nasal plate. K, The suture which unites the maxillary and palate bones. L, The pterygoid process of the palate bones.

FIG. 8. The external surface of the right OS UNGUIS.

A, The orbitar part. B, The lachrymal part. C, The ridge between them.

FIG. 9. The internal surface of the right OS UNGUIS.

This side of the bone has a furrow opposite to the external ridge; all behind that is irregular, where it covers part of the ethmoidal cells.

FIG. 10. The external surface of the left Os MALÆ.

A, The superior orbitar process. B, The inferior orbitar process. C, The malar process. D, The zygomatic process. E, The orbitar plate. F, A passage for small vessels into or out of the orbit.

FIG. 11. The internal surface of the left Os MALÆ.

A, The superior orbitar process. B, The inferior orbitar process. C, The malar process. D, The zygomatic process. E, The internal orbitar plate or process.

FIG. 12. The external surface of the right Os SPONGIOSUM INFERIUS.

A, The anterior part. B, The hook-like process for covering part of the antrum maxillare. C, A small process which covers part of the under end of the lachrymal groove. D, The inferior edge turned a little outwards.

FIG. 13. The internal surface of the Os SPONGIOSUM INFERIUS.

A, The anterior extremity. B, The upper edge which joins the superior maxillary and palate bones.

FIG. 14. The posterior and external surface of the right Os PALATI.

A, The orbitar process. B, The nasal lamella. C, The pterygoid process. D, The palate process.

FIG. 15. The anterior and external surface of the right OS PALATI.

A, The orbitar process. B, An opening through which the lateral nasal vessels and nerves pass. C, The nasal lamella. D, The pterygoid process. E, The posterior edge of the palate process for the connection of the velum palati. F, The inner edge by which the two ossa palati are connected.

FIG. 16. The right side of the VOMER.

A, The upper edge which joins the nasal lamella of the ethmoid bone and the middle cartilage of the nose. B, The inferior edge, which is connected to the superior maxillary and palate bones. C, The superior and posterior part which receives the processus azygos of the sphenoid bone.

FIG. 17. The MAXILLA INFERIOR.

A, The chin. B, The base and left side. C, The angle. D, The coronoid process. E, The condyloid process. F, The beginning of the inferior maxillary canal of the right side, for the entry of the nerve and blood-vessels. G, The termination of the left canal. H, The two dentes incisores. I, The dens caninus. K, The two small molares. L, The three large molares.

FIG. 18. The different classes of the TEETH.

1, 2, A fore and back view of the two anterior dentes incisores of the lower jaw. 3, 4, Similar teeth of the upper jaw. 5, 6, A fore and back view of the dentes canini. 7, 8, The anterior dentes molares. 9, 10, 11, The posterior dentes molares. 12, 13, 14, 15, 16, Unusual appearances in the shape and size of the teeth.

Fig. 19. The external surface of the Os Hy oides.

A, The body. B B, The cornua. C C, The appendices.

Plate XXII.

Fig. 1. A Posterior View of the Sternum and Clavicles, with the ligament connecting the clavicles to each other.

a, The posterior surface of the sternum. b b, The broken ends of the clavicles. c c c c, The tubercles near the extremity of each clavicle. d, The ligament connecting the clavicles.

Fig. 2. A Fore-view of the Left Scapula, and of a half of the Clavicle, with their Ligaments.

a, The spine of the scapula. b, the acromion. c, The inferior angle. d, Inferior costa. e, Cervix. f, Glenoid cavity, covered with cartilage for the arm-bone. g g, The capsular ligament of the joint. h, Coracoid


Fig. 1
Fig. 2
Fig. 3
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Fig. 5
Fig. 6
Fig. 7
Fig. 8
Fig. 9
Fig. 10
Fig. 11
Fig. 12
Fig. 13
Fig. 14
Fig. 15

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process. i, The broken end of the clavicle. k, Its extremity joined to the acromion. l, A ligament coming out single from the acromion to the coracoid process. m, A ligament coming out single from the acromion, and dividing into two, which are fixed to the coracoid process.

Fig. 3. The Joint of the Elbow of the Left Arm, with the Ligaments.

a, The os humeri. b, Its internal condyle. c c, The two prominent parts of its trochlea appearing through the capsular ligament. d, The ulna. e, The radius. f, The part of the ligament including the head of the radius.

Fig. 4. The Bones of the Right-Hand, with the Palm in view.

a, The radius. b, The ulna. c, The scaphoid bone of the carpus. d, The os lunare. e, The os cuneiforme. f, The os pisiforme. g, Trapezium. h, Trapezoides. i, Capitatum. k, Unciforme. l, The four metacarpal bones of the fingers. m, The first phalanx. n, The second phalanx. o, The third phalanx. p, The metacarpal bone of the thumb. q, The first joint. r, The second joint.

Fig. 5. The Posterior View of the Bones of the Left Hand.

The explication of Fig. 4. serves for this figure ; the same letters pointing out the same bones, though in a different view.

FIG. 6. The Upper Extremity of the TIBIA, with the Semilunar Cartilages of the Joint of the Knee, and some Ligaments.

a, The strong ligament which connects the rotula to the tubercle of the tibia. b b, The parts of the extremity of the tibia, covered with cartilage, which appear within the semilunar cartilages. c c, The semilunar cartilages. d, The two parts of what is called the cross ligament.

FIG. 7. The Posterior View of the Joint of the RIGHT KNEE.

a, The os femoris cut. b, Its internal condyle. c, Its external condyle. d, The back part of the tibia. e, The superior extremity of the fibula. f, The edge of the internal semilunar cartilage. g, An oblique ligament. h, A larger perpendicular ligament. i, A ligament connecting the femur and fibula.

FIG. 8. The Anterior View of the Joint of the RIGHT KNEE.

b, The internal condyle. c, Its external condyle. d, The part of the os femoris, on which the patella moves. e, A perpendicular ligament. f f, The two parts of the crucial ligaments. g g, The edges of the two moveable semilunar cartilages. h, The tibia. i, The strong ligament of the patella. k, The back part of it where the fat has been dissected away. l, The external depression. m, The internal one. n, The cut tibia.

FIG. 9. A View of the inferior part of the Bones of the RIGHT FOOT.

a, The great knob of the os calcis. b, A prominence on its outside. c, The hollow for the tendons, nerves, and blood-vessels. d, The anterior extremity of the os calcis. e, Part of the astragalus. f, Its head covered with cartilage. g, The internal prominence of the os naviculare. h, The os cuboides. i, The os cuneiforme internum; k,—Medium; l,—Externum. m, The metatarsal bones of the four lesser toes. n, The first—o, The second—p, The third phalanx of the four lesser toes. q, The metatarsal bones of the great toe. r, Its first—s, Its second joint.

FIG. 10. The Inferior Surface of the two large SESAMOID BONES, at the first Joint of the Great Toe.

FIG. 11. The Superior View of the Bones of the RIGHT FOOT.

a, b, as in Fig. 9. c, The superior head of the astragalus. d, *&c.* as in Fig. 9.

FIG. 12. The View of the SOLE of the FOOT, with its Ligaments.

a, The great knob of the os calcis. b, The hollow for the tendons, nerves, and blood-vessels. c, The sheaths of the flexores pollicis and digitorum longi opened. d, The strong cartilaginous ligament supporting the head of the astragalus. e, h, Two ligaments which unite into one, and are fixed to the metatarsal bone of the great toe. f, A ligament from the knob of the os calcis to the metatarsal bone of the little toe. g, A strong triangular ligament, which supports the bones of the tarsus. i, The ligaments of the joints of the five metatarsal bones.

Fig. 13. a, The head of the thigh bone of a child. b, The ligamentum rotundum connecting it to the acetabulum. c, The capsular ligament of the joint with its arteries injected. d, The numerous vessels of the mucilaginous gland injected.

Fig. 14. The Back-view of the Cartilages of the Larynx, with the Os Hyoides.

a, The posterior part of the base of the os hyoides. b b, Its cornua. c, The appendix of the right side. d, A ligament sent out from the appendix of the left side, to the styloid process of the temporal bone. e, The union of the base with the left cornu. f f, The posterior sides of (g) the thyroid cartilage. h h, Its superior cornua. i i, Its inferior cornua. k, The cricoid cartilage. l l, The arytenoid cartilages. m, The entry into the lungs, named *glottis*. n, The epiglottis. o o, The superior cartilages of the trachea. p, Its ligamentous back part.

Fig. 15. The Superior Concave surface of the Sesamoid Bones at the first joint of the Great Toe, with their Ligaments.

a, Three sesamoid bones. b, The ligamentous substance in which they are formed.

PART II. OF THE SOFT PARTS IN GENERAL;

Of the Common Integuments, with their appendages; and of the Muscles.

ANATOMICAL writers usually proceed to a description of the muscles after having finished the osteology; but we shall deviate a little from the common method, with a view to describe every thing clearly and distinctly, and to avoid a tautology which would otherwise be unavoidable. All the parts of the body are so intimately connected with each other, that it seems impossible to convey a just idea of any one of them, without being in some measure obliged to say something of others; and on this account we wish to mention in this place the names and situation of the principal viscera of the body, that when mention is hereafter made of any one of them in the course of the work, the reader may at least know where they are placed.

After this little digression, the common integuments, and after them the muscles will be described; we then propose to enter into an examination of the several viscera and their different functions. In describing the brain, occasion will be taken to speak of the nerves and animal spirits. The circulation of the blood will follow the anatomy of the heart, and the secretions and other matters will be introduced in their proper places.

The body is divided into three great cavities. Of these the uppermost is formed by the bones of the cranium, and incloses the brain and cerebellum.

The second is composed of the vertebræ of the back, the sternum, and true ribs, with the additional assistance of muscles, membranes, and common integuments, and is called the *thorax*—It contains the heart and lungs.

The third, and inferior cavity, is the abdomen. It is separated from the thorax by means of the diaphragm, and is formed by the lumbar vertebræ, the os sacrum, the ossa innominata, and the false ribs, to which we may add the peritonæum, and a variety of muscles. This cavity incloses the stomach, intestines, omentum or cawl, liver, pancreas, spleen, kidneys, urinary bladder, and parts of generation.

Under the division of common integuments are usually included the epidermis, or scarf-skin, the reticulum mucosum of Malpighi, the cutis or true skin, and the membrana adiposa—The hair and nails, as well as the sebaceous glands, may be considered as appendages to the skin.

Sect. I. *Of the* Skin.

1. *Of the* Scarf-*skin.*

The epidermis, cuticula, or scarf-skin, is a fine, transparent, and insensible pellicle, destitute of nerves and blood-vessels, which invests the body, and every where covers the true skin. This scarf-skin, which seems to be very simple, appears, when examined with a microscope, to be composed of several laminæ or scales which are increased by pressure, as we may observe in the hands and feet, where it is frequently much thickened, and becomes perfectly callous. It seems to adhere to the cutis by a number of very minute filaments, but may easily be separated from it by heat, or by maceration in water. Some anatomical writers have supposed that it is formed by a moisture exhaled from the whole surface of the body, which gradually hardens when it comes into contact with the air. They were perhaps induced to adopt this opinion, by observing the speedy regeneration of this part of the body when it has been by any means destroyed, it appearing to be renewed on all parts of the surface at the same time; whereas other parts which have been injured, are found to direct their growth from their circumference only towards their centre. But a demonstrative proof that the epidermis is not a fluid hardened by means of the external air, is that the fœtus in utero is found to have this covering. Lieuwenhoeck supposed its formation to be owing to the expansion of the extremities of the excretory vessels which are found every where upon the surface of the true skin. Ruysch attributed its origin to the nervous papillæ of the skin; and Heister thinks it probable, that it may be owing both to the papillæ and the excretory vessels. The celebrated Morgagni, on the other hand, contends,* that it is nothing more than the surface of the cutis, hardened and rendered insensible by the liquor amnii in utero, and by the pressure of the air. This is a subject, however, on which we can advance nothing with certainty.

The cuticle is pierced with an infinite number of pores or little holes, which afford a passage to the hairs, sweat, and insensible perspiration, and likewise to warm water, mercury, and whatever else is capable of being taken in by the absorbents of the skin. The lines which we observe on the epidermis belong to the true skin. The cuticle adjusts itself to them, but does not form them.

2. *Of the Rete Mucosum.*

Between the epidermis and cutis we meet with an appearance to which Malpighi, who first described it, gave the name of *rete mucosum*, supposing it to be of a membranous structure, and pierced with an infinite number of pores; but the fact is, that it seems to be

* Adversar. Anat. II. Animadver. 2.

nothing more than a mucous substance which may be dissolved by macerating it in water, while the cuticle and cutis preserve their texture.

The colour of the body is found to depend on the colour of this rete mucosum; for in negroes it is observed to be perfectly black, whilst the true skin is of the ordinary colour.

The blisters which raise the skin when burnt or scalded, have been supposed by some to be owing to a rarefaction of this mucus; but they are more probably occasioned by an increased action of the vessels of the part, together with an afflux and effusion of the thinner parts of the blood.

3. *Of the* Cutis, *or True Skin.*

The cutis is composed of fibres closely compacted together, as we may observe in leather, which is the prepared skin of animals. These fibres form a thick net-work, which every where admits the filaments of nerves, and an infinite number of blood-vessels and lymphatics.

The cutis, when the epidermis is taken off, is found to have, throughout its whole surface, innumerable papillæ, which appear like very minute granulations, and seem to be calculated to receive the impressions of the touch, being the most easily observed where the sense of feeling is the most delicate, as in the palms of the hands and on the fingers.

These papillæ are supposed by many anatomical writers to be continuations of the pulpy substance of nerves, whose coats have terminated in the cellular texture of the skin. The great sensibility of these papillæ evidently proves them to be exceedingly nervous; but surely the nervous fibrellæ of the skin are of themselves scarcely equal to the formation of these papillæ, and it seems to be more probable that they are formed like the rest of the cutis.

These papillæ being described, the uses of the epidermis and the reticulum mucosum will be more easily understood; the latter serving to keep them constantly moist, while the former protects them from the external air, and modifies their too great sensibility.

4. *Of the* Glands *of the Skin.*

In different parts of the body we meet, within the substance of the skin, with certain glands or follicles, which discharge a fat and oily humour that serves to lubricate and soften the skin. When the fluid they secrete has acquired a certain degree of thickness, it approaches to the colour and consistence of suet; and from this appearance they have derived their name of *sebaceous glands.* They are found in the greatest number in the nose, ear, nipple, axilla, groin, scrotum, vagina, and prepuce.

Besides these sebaceous glands, we read, in anatomical books, of others that are described as small spherical bodies placed in all parts of the skin, in much greater abundance than those just now mentioned, and named *miliary*, from their supposed resemblance to millet-seed. Steno, who first described these glands, and Malpighi, Ruysch, Verheyen, Windslow, and others, who have adopted his opinions on this subject, speak of them as having excretory ducts, that open on the surface of the cuticle, and distil the sweat and matter of insensible perspiration; and yet, notwithstanding the positive manner in which these pretended glands have been spoken of, we are now sufficiently convinced that their existence is altogether imaginary.

5. *Of the* INSENSIBLE *Perspiration and* SWEAT.

THE matter of insensible perspiration, or in other words, the subtile vapour that is continually exhaling from the surface of the body, is not secreted by any particular glands, but seems to be derived wholly from the extremities of the minute arteries that are everywhere dispersed through the skin. These exhaling vessels are easily demonstrated in the dead subject, by throwing water into the arteries; for then small drops exude from all parts of the skin, and raise up the cuticle, the pores of which are closed by death; and in the living subject, a looking-glass placed against the skin, is soon obscured by the vapour. Bidloo fancied he had discovered ducts leading from the cutis to the cuticle, and transmitting this fluid; but in this he was mistaken.

When the perspiration is by any means increased, and several drops that were insensible when separate, are united together and condensed by the external air, they form upon the skin small, but visible, drops called *sweat.** This particularly happens after much exercise, or whatever occasions an increased determination of fluids to the surface of the body; a greater quantity of perspirable matter being in such cases carried through the passages that are destined to convey it off.

It has been disputed, indeed, whether the insensible perspiration and sweat are to be considered as one and the same excretion, differing only in degree; or whether they are two distinct excretions derived from different sources. In support of the latter opinion, it has been alleged, that the insensible perspiration is agreeable to nature, and essential to health, whereas sweat may be considered as a species of disease. But this argument proves nothing; and it seems probable, that both the insensible vapour and the sweat are exhaled in a similar manner, though they differ in quantity, and probably in their qualities; the former being more limpid, and seemingly less impregnated with salts than the latter: at any rate we may consider the skin as an emunctory through which the redundant water, and

* Lieuwenhoeck asserts that one drop of sweat is formed by the conflux of fifteen drops of perspirable vapour.

sometimes the other more saline parts of the blood, are carried off. But the insensible perspiration is not confined to the skin only—a great part of what we are constantly throwing off in this way is from the lungs. The quantity of fluid exhaled from the human body by this insensible perspiration is very considerable. Sanctorius* an Italian physician, who indefatigably passed a great many years in a series of statical experiments, demonstrated long ago what has been confirmed by later observations, that the quantity of vapour exhaled from the skin and from the surface of the lungs, amounts nearly to 5-8ths of the aliment we take in. So that if in the warm climate of Italy a person eats and drinks the quantity of eight pounds in the course of a day, five pounds of it will pass off by insensible perspiration, while three pounds only will be evacuated by stool, urine, saliva, &c. But in countries where the degree of cold is greater than in Italy, the quantity of perspired matter is less; in some of the more northern climates, it being found not to equal the discharge by urine. It is likewise observ-

* The insensible perspiration is sometimes distinguished by the name of this physician, who was born in the territories of Venice, and was afterwards a professor in the university of Padua. After estimating the aliment he took in, and the sensible secretions and discharges, he was enabled to ascertain with great accuracy the weight or quantity of insensible perspiration by means of a statical chair which he contrived for this purpose; and from his experiments, which were conducted with great industry and patience, he was led to determine what kinds of solid or liquid aliment increased or diminished it. From these experiments he formed a system, which he published at Venice in 1614, in the form of aphorisms, under the title of "Ars de Medicina Statica."

ed to vary according to the season of the year, and according to the constitution, age, sex, diseases, diet, exercise, passions, &c. of different people.

From what has been said on this subject, it will be easily conceived, that this evacuation cannot be either much increased or diminished in quantity without affecting the health.

The perspirable matter and the sweat are in some measure analogous to the urine, as appears from their taste and saline nature.* And it is worthy of observation, that when either of these secretions is increased in quantity, the other is diminished; so that they who perspire the least, usually pass the greatest quantity of urine, and vice versa.

6. *Of the* NAILS.

THE nails are of a compact texture, hard and transparent like horn. Their origin is still a subject of dispute. Malpighi supposed them to be formed by a continuation of the papillæ of the skin: Ludwig, on the other hand, maintained, that they were composed of the extremities of blood-vessels and nerves; both these opinions are now deservedly rejected.

They seem to possess many properties in common with the cuticle; like it they are neither vascular nor sensible, and when the cuti-

* Minute chrystals have been observed to shoot upon the clothes of men who work in glass-houses. *Haller Elem. Phys.*

cle is separated from the true skin by maceration or other means, the nails come away with it.

They appear to be composed of different layers, of unequal size, applied one over the other. Each layer seems to be formed of longitudinal fibres.

In each nail we may distinguish three parts, viz. the root, the body or middle, and the extremity. The root is of a soft, thin, and white substance, terminating in the form of a crescent; the epidermis adheres very strongly to this part; the body of the nail is broader, redder, and thicker, and the extremity is of still greater firmness.

The nails increase from their roots, and not from their upper extremity.

Their principal use is to cover and defend the ends of the fingers and toes from external injury.

7. *Of the* Hair.

The hairs, which from their being generally known do not seem to require any definition, arise from distinct capsules or bulbs seated in the cellular membrane under the skin.* Some

* Malpighi, and after him the celebrated Ruysch, supposed the hairs to be continuations of nerves, being of opinion that they originated from the papillæ of the skin, which they considered as nervous; and as a corroborating proof of what they advanced, they argued the pain we feel in plucking them out; but later anatomists seem to have rejected this doctrine, and consider the hairs as particular bodies, not arising from the papillæ (for in the parts where the papillæ abound most there are no hairs,) but from bulbs or capsules, which are peculiar to them.

of these bulbs inclose several hairs. They may be observed at the roots of the hairs which form the beard or whiskers of a cat.

The hairs, like the nails, grow only from below by a regular propulsion from their root, where they receive their nourishment. Their bulbs, when viewed with a microscope, are found to be of various shapes. In the head and scrotum they are roundish; in the eye-brows they are oval; in the other parts of the body they are nearly of a cylindrical shape. Each bulb seems to consist of two membranes, between which there is a certain quantity of moisture. Within the bulb the hair separates into three or four fibrillæ; the bodies of the hairs, which are the parts without the skin, vary in softness and colour according to the difference of climate, age, or temperament of body.*

Their general use in the body does not seem to be absolutely determined; but hairs in particular parts, as on the eye-brows and eye-lids, are destined for particular uses, which will be mentioned when those parts are described.

8. *Of the* Cellular Membrane *and* Fat.

The cellular membrane is found to invest the most minute fibres we are able to trace; so that by modern physiologists, it is very pro-

* The hairs differ likewise from each other, and may not be improperly divided into two classes; one of which may include the hair of the head, chin, pubes, and axillæ; and the other, the softer hairs, which are to be observed almost every where on the surface of the body.

perly considered as the universal connecting medium of every part of the body.

It is composed of an infinite number of minute cells united together, and communicating with each other. The two diseases peculiar to this membrane are proofs of such a communication; for in the *emphysema* all its cells are filled with air, and in the anasarca they are universally distended with water. Besides these proofs of communication from disease, a familiar instance of it may be observed among butchers, who usually puncture this membrane, and by inflating it with air add to the good appearance of their meat.

The cells of this membrane serve as reservoirs to the oily part of the blood or *Fat*, which seems to be deposited in them, either by transudation through the coats of the arteries, that ramify through these cells, or by particular vessels, continued from the ends of arteries. These cells are not of a glandular structure, as Malpighi and others after him have supposed. The fat is absorbed and carried back into the system by the lymphatics. The great waste of it in many diseases, particularly in the consumption, is a sufficient proof that such an absorption takes place.

The fulness and size of the body are in a great measure proportioned to the quantity of fat contained in the cells of this membrane.

In the living body it seems to be a fluid oil, which concretes after death. In graminivorous animals, it is found to be of a firmer consistence than in man.

The fat is not confined to the skin alone, being met with every where in the interstices of muscles, in the omentum, about the kidneys, at the basis of the heart, in the orbits, &c.

The chief uses of the fat seem to be to afford moisture to all the parts with which it is connected; to facilitate the action of the muscles; and to add to the beauty of the body, by making it every where smooth and equal.

SECT. II. *Of the* MUSCLES.

THE muscles are the organs of motion. The parts that are usually included under this name consist of distinct portions of flesh, susceptible of contraction and relaxation; the motions of which in a natural and healthy state, are subject to the will, and for this reason they are called *voluntary* muscles. But besides these, there are other parts of the body that owe their power of contraction to their muscular fibres; thus the heart is of a muscular texture, forming what is called a *hollow* muscle; and the urinary bladder, stomach, intestines, &c. are enabled to act upon their contents, merely because they are provided with muscular fibres. These are called *involuntary* muscles, because their motions are not dependent on the will. The muscles of respiration, being in some measure influenced by the will, are said to have a *mixed* motion.

The names by which the voluntary muscles are distinguished, are founded on their size, figure, situation, use, or the arrangement of their fibres, or their origin and insertion. But besides these particular distinctions, there are certain general ones that require to be noticed.

Thus, if the fibres of a muscle are placed parallel to each other in a straight direction, they form what are styled a *rectilinear* muscle; if the fibres cross and intersect each other, they constitute a *compound* muscle; a *radiated* one, if the fibres are disposed in the manner of rays; or a *penniform* muscle, if, like the plume of a pen, they are placed obliquely with respect to the tendon.

Muscles that act in opposition to each other, are called *antagonistæ;* thus every extensor muscle has a flexor for its antagonist, and *vice versa.* Muscles that concur in the same action are styled *congeneres.*

The muscles being attached to the bones, the latter may be considered as levers that are moved in different directions by the contraction of those organs.

The end of a muscle which adheres to the most fixed part is usually called the *origin*, and that which adheres to the more moveable part, the *insertion*, of the muscle.

In every muscle we may distinguish two kinds of fibres; the one soft, of a red colour, sensible and irritable, called *fleshy* fibres; the other of a firmer texture, of a white glistening colour, insensible, without irritability or the power of contracting, and named tendinous fibres. They are occasionally intermixed; but the fleshy fibres generally prevail in the belly or middle part of a muscle, and the tendinous ones in the extremities. If these tendinous fibres are formed into a round slender chord, they form what is called the *tendon* of the muscle; on the other hand, if they are spread into a broad flat surface, the extremity of the muscle is styled *aponeurosis*.

The tendons of many muscles, especially when they are long and exposed to pressure or friction in the grooves formed for them in the bones, are surrounded by a tendinous sheath or *fascia*, in which we sometimes find a small mucous sac or *bursa mucosa*, which obviates any inconvenience from friction. Sometimes we find whole muscles, and even several muscles, covered by a fascia of the same kind, that affords origin to many of their fibres, dipping down between them, adhering to the ridges of bones, and thus preventing them from swelling too much when in action. The most remarkable instance of such a covering is the *fascia lata* of the thigh.

Each muscle is inclosed by a thin covering of cellular membrane, which has been sometimes improperly considered as peculiar to the muscles, and described under the name of *propria membrana musculosa*. This cellular covering dips down into the substance of the muscle, connecting and surrounding the most minute fibres we are able to demonstrate, and affording a support to their vessels and nerves.

Lieuwenhoeck fancied he had discovered, by means of his microscope, the ultimate division of a muscle, and that he could point out the simple fibre, which appeared to him to be an hundred times less than a hair; but he was afterwards convinced how much he was mistaken on this subject, and candidly acknowledged, that what he had taken for a simple fibre was in fact a bundle of fibres.

It is easy to observe several of these fasciculi or bundles in a piece of beef, in which, from the coarseness of its texture, they are very evident.

The red colour which so particularly distinguishes the muscular or fleshy parts of animals, is owing to an infinite number of blood-vessels that are dispersed through their substance. When we macerate the fibres of a muscle in water, it becomes of a white colour like all other parts of the body divested of their blood. The blood-vessels are accompanied by nerves, and they are both distributed in such abundance to these parts, that in endeavouring to trace the course of the blood-vessels in a muscle, it would appear to be formed altogether by their ramifications; and in an attempt to follow the branches of its nerves, they would be found to be equal in proportion.

If a muscle is pricked or irritated, it immediately contracts. This is called its irritable principle; and this irritability is to be considered as the characteristic of muscular fibres, and may serve to prove their existence in parts that are too minute to be examined by the eye.

This power, which disposes the muscles to contract when stimulated, independent of the will, is supposed to be inherent in them; and is therefore named *vis insita.* This property is not to be confounded with elasticity, which the membranes and other parts of the body possess in a greater or less degree in common with the muscles; nor with sensibility, for the heart, though the most irritable, seems to be the least sensible of any of the muscular parts of the body.

After a muscular fibre has contracted, it soon returns to a state of relaxation, till it is excited afresh, and then it contracts and relaxes again. We may likewise produce such a contraction, by irritating the nerve leading to a muscle, although the nerve itself is not affected.

This principle is found to be greater in small than in large, and in young than in old, animals.

In the voluntary muscles these effects of contraction and relaxation of the fleshy fibres are produced in obedience to the will, by what may be called the *vis nervosa*, a property that is not to be confounded with the *vis insita.* As the existence of a *vis insita* different from a *vis nervea*, was the doctrine taught by Doctor Haller in his *Elem. Phys.* but is at present called in question by several, particularly 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 Dr. 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 Dr. 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 Dr. 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 farther, let us learn the effect 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 observed 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 limb; 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."

The *vis nervosa*, or operation of the mind, if we may so call it, by which a muscle is brought into contraction, is not inherent in the muscle like the *vis insita;* neither is it perpetual, like this latter property. After long continued or violent exercise, for example, the voluntary muscles become painful, and at length incapable of further action; whereas the heart and other involuntary muscles, the motions of which depend solely on the *vis insita*, continue through life in a constant state of action, without any inconvenience or waste of this inherent principle.

The action of the vis nervosa on the voluntary muscles, constitutes what is called *muscular motion;* a subject that has given rise to a variety of hypotheses, many of them ingenious, but none of them satisfactory.

Borelli and some others have undertaken to explain the cause of contraction, by supposing that every muscular fibre forms as it were a chain of very minute bladders, while the nerves which are distributed through the muscle, bring with them a supply of animal spirits, which at our will fill these bladders, and by increasing their diameter in width, shorten them, and of course the whole fibre.

Borelli supposes these bladders to be of a rhomboidal shape; Bernouilli on the other hand contends that they are oval. Our countryman, Cowper, fancied he had filled them with mercury; the cause of this mistake was probably owing to the mercury's insinuating itself into some of the lymphatic vessels. The late ingenious Mr. Elliot undertook to account for the phenomena of muscular motion on principles very different from those just now mentioned. He supposed that a dephlogisticated state of the blood is requisite for muscular action, and that a communication of phlogiston to the blood is a necessary effect of such action.

We know that the muscular fibre is shortened, and that the muscle itself swells when in action; but how these phenomena are produced, we are unable to determine. We likewise know that the nerves are essential to muscular motion; for upon dividing or making a ligature round the nerve leading to a muscle, the latter becomes incapable of motion. A ligature made on the artery of a muscle produces a similar effect; a proof this, that a regular supply of blood is also equally necessary to muscular motion. The cause of palsy is usually not to be sought for in the muscle affected, but in the nerve leading to that muscle, or in that part of the brain or spinal marrow from which the nerve derives its origin.

Of the particular Muscles.

As the enumeration and description of the particular muscles must be dry and unentertaining to the generality of readers, yet cannot be altogether omitted in a work of this nature, it appeared eligible to throw this part of the subject into the form of a table; in which the name, origin, insertion, and principal use of each muscle, will be found described in few words, and occasionally its etymology when it is of Greek derivation or difficult to be understood.

A TABLE of the MUSCLES, arranged according to their SITUATION.

[*N. B.* This table does not include all the muscles of the body; thofe belonging to the eyes, internal ear, intestinum rectum, and the male and female organs of generation, being described in other parts of the work. The reader will be pleased to observe likewise, that although all the muscles (a few only excepted) are in pairs, mention is here made only of the muscles of one side.]

MUSCLES situated under the integuments of the cranium - - - -	*Name.*	*Origin.*	*Insertion.*	*Use.*
	1 Occipito frontalis.	From the transverse ridge of the os occipitis.	Into the skin of the eye-brows.	To pull the skin of the head backwards, and to raise the eye-brows and skin of the forehead.
	2. Corrugator supercilii.	From above the joining of the os frontis, os nasi, and os maxillare.	Into the inner part of the occipito-frontalis.	To draw the eye-brows towards each other, and to wrinkle the forehead.

	Name.	*Origin.*	*Insertion.*	*Use.*
———— of the eye-lids	1. Orbicularis palpebrarum.	From around the edge of the orbit.	Into the nasal process of the os maxillare.	To shut the eye.
	2. Levator palpebræ superioris.	From the bottom of the orbit, near the optic foramen.	Into the cartilage of the upper eye-lid.	To open the eye.
———— of the external ear	1. Attollens auriculam.	From the tendon of the occipito frontalis near the os temporis.	Into the upper part of the ear.	To raise the ear.
	2. Anterior auriculæ.	From near the back part of the zygoma.	Into an eminence behind the helix.	To raise this eminence, and to pull it forwards.
	3. Retrahentes(*) auriculæ.	From the outer and back part of the root of the mastoid process.	Into the convex part of the concha.	To stretch the concha, and pull the ear backwards.
Muscles of the cartilages of the ear	1. Tragicus.	From the outer and middle part of the concha, near the tragus.	Into the upper part of the tragus.	To depress the concha, and pull the point of the tragus a little outwards.

* These are three small slender muscles. The inferior one is sometimes wanting.

	Name.	Origin.	Insertion.	Use.
	2. Antitragicus.	From the root of the inner part of the helix.	Into the upper part of the anti-tragus.	To dilate the mouth of the concha.
	3. Transversus-auriculæ.	From the upper part of the concha.	Into the inner part of the helix.	To stretch the concha and scapha, and likewise to pull the parts it is connected with towards each other.
	4. Helicis major.	From the upper, anterior, and acute part of the helix.	Into the cartilage of the helix, a little above the tragus.	To depress the upper part of the helix.
	5. Helicis minor.	From the lower and fore part of the helix.	Into the helix, near the fissure in its cartilage.	To contract the fissure.
——of the nose,	1. Compressor (*) naris.	From the outer part of the root of the ala nasi.	Into the nasal process of the os maxillare, and anterior extremity of the os nasi.	To straighten the nostrils, and likewise to corrugate the skin of the nose.

* The nose is affected by fibres of the occipito frontalis, and by several muscles of the face; but this pair, the compressores, is the only one that is proper to it.

	Name.	Origin.	Insertion.	Use.
———of the mouth and lips,	1. Levator labii superioris, alæque nasi.	From the outer part of the orbitar process of the os maxillare and from the nasal process of that bone, where it joins the os frontis.	Into the upper lip and ala of the nose.	To draw the upper lip and skin of the nose upwards and outwards.
	2. Levator anguli oris.	From the os maxillare superius, between the orbitar foramen and the first dens molaris.	Into the orbicularis oris at the angle of the mouth.	To raise the corner of the mouth.
	3. Zygomaticus major.	From the os malæ near the zygomatic suture.	Into the angle of the mouth.	To raise the angle of the mouth, and make the cheek prominent, as in laughing.
	4. Zygomaticus minor.	Immediately above the origin of the zyg. major.	Into the angle of the mouth.	To raise the angle of the mouth obliquely outwards.
	5. Buccinator.	From the alveoli of the dentes molares in the upper and lower jaws.	Into the angle of the mouth.	To contract the mouth and draw the angle of it outwards and backwards.

Name.	*Origin.*	*Insertion.*	*Use.*
6. Depressor labii superioris, alæque nasi.	From the os maxill. super. immediately above the gums of the dentes incisores.	Into the root of the ala nasi and upper lip.	To draw the ala nasi and upperlip downwards.
7. Depressor anguli oris.	At the side of the chin from the lower edge of the maxilla inferior.	Into the angle of the mouth.	To draw the corner of the mouth downwards.
8. Depressor labii inferioris.	From the lower and anterior part of the maxilla inferior.	Into the under lip.	To draw the under lip downwards and somewhat outwards
9. Levator labii inferioris.	From near the gums of the incisores and caninus of the maxilla inferior.	Into the under lip and skin of the chin.	To raise the under lip and skin of the chin.
10. Orbicularis Oris. (*)			To shut the mouth by constraining the lips.

(*) This muscle is in a great measure, if not wholly, formed by the buccinator, zygomatici, depressores, and other muscles that move the lips. Its fibres surround the mouth like a ring.

	Name.	*Origin.*	*Insertion.*	*Use.*
MUSCLES of the lower jaw, - - -	1. Temporalis.	From part of the os bregmatis and os frontis; squamous part of the os temporis; back part of the os malæ, and the temporal process of the os sphenoides. (*)	Into the coronoid process of the lower jaw.	To move the lower jaw upwards.
	2. Masseter. (†)	From the malar process of the os maxillare, and the lower edges of the os malæ and of the zygomatic process of the os temporis.	Into the basis of the coronoid process, and that part of the jaw which supports that and the condyloid process.	To raise and likewise to move the jaw a little forwards and backwards.

(*) Some of its fibres likewise have their origin from a strong fascia that covers the muscle and adheres to the bone round the whole circumference of its origin. When we remove this covering, we find the muscle of a semicircular shape with its fibres, converging and forming a strong middle tendon.

(†) So called from its use in chewing, its derivation being from μασιτασμαι, *manduco*, "*to eat.*"

	Name.	*Origin.*	*Insertion.*	*Use.*
	3. Pterygoideus internus.	From the inner surface of the outer wing of the pterygoid process of the os sphenoides, and from the process of the os palati that helps to form the pterygoid fossa.	Into the lower jaw on its inner side and near its angle.	To raise the lower jaw and draw it a little to one side.
	4. Pterygoideus externus.	From the external ala of the pterygoid process, a small part of the adjacent os maxillare, and a ridge in the temporal process of the os sphenoides.	Into the fore part of the condyloid process of the lower jaw, and likewise of the capsular ligament.	To move the jaw forwards and to the opposite side; (*) and at the same time to prevent the ligament of the joint from being pinched.
———situated at the fore part of the neck.	1. Latissimus colli. (†)	From the cellular membrane covering	Into the side of the chin and integu-	To draw the cheeks and skin of the face

(*) This happens when the muscle acts singly. When both act, the jaw is brought horizontally forwards.

(†) This broad and thin muscular expansion, which is situated immediately under the common integuments, is by Winslow named *musculus cutaneus*. Galen gave it the name of πλατυσμα μυωδης (*Platysma-myoides*); the etymology of which is from πλατυσμος *dilatatio*, and μυς, *musculus*, and ειδος, *forma*.

	Name.	*Origin.*	*Insertion.*	*Use.*
		the pectoral, deltoid, and trapezius muscles.	ments of the cheek.	downwards; and when the mouth is shut, to draw all that part of the skin to which it is connected below the lowerjaw upwards.
	2. Mastoideus (*).	From the upper part of the sternum and from the upper and fore part of the clavicle.	Into the mastoid process, and as far back as the lambdoidal suture.	To move the head to one side, or when both muscles act, to bend it forwards.
MUSCLES situated between the trunk and the os hyoides.	1. Omo-hyoideus (†).	From the upper costa of the scapula near its niche; from part of a ligament that extends across this niche, and some-	Into the basis of the os hyoides.	To draw the os hyoides in an oblique direction downwards.

(*) This, on account of its two origins, is by Albinus described as two distinct muscles, which he names *sterno-mastoideus* and *cleido-mastoideus*.

(†) This muscle does not always arise from the coracoid process, it seems to have been improperly named *coraco-hyoides* by Douglas and Albinus. Winslow calls it *omo-hyoideus*, on account of its general origin from the scapula.

Name.	*Origin.*	*Insertion.*	*Use.*
	times by a few fibres, from the coracoid process.		
2. Sterno-hyoideus.	From the cartilage of the first rib, the inner and upper part of the sternum, and a small part of the clavicle.	Into the basis of the os hyoides.	To draw the os hyoides downwards.
3. Hyo-thyroideus.	From part of the basis and horn of the os hyoides.	Into a rough oblique line at the side of the thyroid cartilage.	To raise the thyroid cartilage, or depress the os hyoides.
4. Sterno-thyroideus.	From between the cartilages of the 1st and 2d ribs at the upper and inner part of the sternum.	Immediately under the hyo-thyroideus.	To pull the thyroid cartilage downwards.
5. Crico-thyroideus.	From the anterior part and side of the cricoid cartilage.	Into the lower part and inferior horn of the thyroid cartilage.	To pull the cricoid cartilage upwards and backwards, or the thyroid forwards and downwards.

	Name.	Origin.	Insertion.	Use.
——situated between the os hyoides and lower jaw.	1. Diagrasticus (*.)	From a fossa at the root of the mastoid process, and likewise from the os hyoides.	Into the lower and anterior part of the chin.	To draw the lower jaw downwards.
	2. Stylo-hyoideus(†).	From the basis of the styloid process.	Into the side and fore part of the os hyoides near its base.	To draw the os hyoides obliquely upwards.
	3. Mylo-hyoideus (‡).	From the inside of the lower jaw, between the last dens molaris and the chin.	Into the basis of the os hyoides.	To move the os hyoides to either side, forwards or upwards.
	4. (§) Geno-hyoideus.	From the inside of the chin.	Into the base of the os hyoides.	To move the os hyoides forwards or upwards.

(*) From δις γαστηρ *(biventer,)* because it has two fleshy bellies with a middle tendon. This tendon passes through the stylo-hyoideus.

(†) In some subjects we meet with another muscle, which from its having nearly the same origin, insertion, and use as this, has been named *stylo-hyoideus alter*.

(‡) So named from its arising near the dentes molares (μυλοι,) and its being inserted into the os hyoides.

(§) From γενειον, *mentum*, the "chin."

Name.	*Origin.*	*Insertion.*	*Use.*
5. Genio-glossus.	From the inside of the chin.	Into the tongue and basis of the os hyoides.	To move the tongue in various directions.
6. Hyo-glossus (*).	From the horn, basis, and appendix of the os hyoides	Into the tongue laterally.	To draw the tongue downwards and inwards.
7. Lingualis.	Laterally from the root of the tongue.	Into the extremity of the tongue.	To shorten the tongue and draw it backwards.
8. Stylo-glossus.	From the styloid process, and sometimes also from a ligament that extends from thence to the angle of the lower jaw.	Into the side of the tongue from the root to near its tip.	To move the tongue backwards and to one side.
9. Stylo-pharyngæus.	From the basis of the styloid process.	Into the side of the pharynx and posterior part of the thyroid cartilage.	To raise the thyroid cartilage and pharynx, and likewise to dilate the latter.
10. Circumflexus-palati.	From near the bony part of the Eustachian tube, and	Into the semilunar edge of the os palati and the velum	To dilate and draw the velum obliquely downwards.

(*) From κερας, *cornu*, and γλωσσα, *lingua*, "the tongue."

	Name.	*Origin.*	*Insertion.*	*Use.*
		from the spinous process of the os sphenoides.	pendulum palati (*).	
	11. Levator palati.	From the membranous part of the Eustachian tube, and the extremity of the os petrosum.	Into the velum pendulum palati.	To pull the velum backwards.
MUSCLES situated about the fauces,	1. Palato-pharyngæus.	From the lower and anterior part of the cartilaginous extremity of the Eustachian tube (†); the tendinous expansion of the circumflexus palati; and the velum pendulum palati near the basis and back part of the uvula.	Into the upper and posterior part of the thyroid cartilage.	To raise the pharynx and thyroid cartilage, or to pull the velum and uvula backwards and downwards.

(*) This muscle in its course forms a round tendon, which, after crossing over a kind of hook formed by the inner plate of the pterygoid process of the sphenoid bone, expands into a tendinous membrane.

(†) The two fibres that arise from the Eustachian tube are described as a distinct muscle by Albinus, under the name of *salpingo-pharyngeus*. They serve to dilate the mouth of the tube.

	Name.	*Origin.*	*Insertion.*	*Use.*
	2. Constrictor isthmi faucium.	From near the basis of the tongue laterally.	Into the velum pendulum palati, near the basis and fore part of the uvula.	To raise the tongue and draw the velum towards it (*)
	3. Azygos uvulæ.	From the end of the suture that unites the ossa palati.	Into the extremity of the uvula.	To shorten the uvula, and bring it forwards and upwards.
Muscles at the back part of the pharynx.	1. Constrictor pharyngis superior.	From the cuneiform process of the occipital bone; the pterygoid process of the os sphenoides, and from each jaw near the last dens molaris (†).	Into the middle of the pharynx.	To move the pharynx upwards and forwards, and to compress its upper part.
	2. Constrictor pharyngis medius (‡).	From the horn and appendix of the os	Into the middle of the processus cunei-	To draw the os hyoides and pharynx

(*) This muscle, and the palato-pharyngæus, likewise serve to close the passage into the fauces, and to carry the food into the pharynx.

(†) The three orders of fibres here mentioned, with a few others derived from the tongue, have given occasion to Douglas to describe them as four distinct muscles, under the names of *cephalo-pharyngæus*, *mylo-pharyngæus*, *ptery-pharyngæus*, and *glosso-pharyngæus*.

(‡) Douglas makes two muscles of this the *hyo-pharyngæus* and *syndesmo-pharyngæus*.

	Name.	*Origin.*	*Insertion.*	*Use.*
		hyoides, and from the ligament that unites it with the thyroid cartilage.	formis of the occipital bone, about its middle and before the great foramen.	upwards, and to compress the latter.
	3. Constrictor pharyngis inferior (*).	From the cricoid and thyroid cartilages.	Into the middle of the pharynx.	To compress part of the pharynx.
——— about the glottis - - -	1. Crico arytænoideus lateralis.	From the side of the cricoid cartilage.	Into the basis of the arytænoid cartilage laterally.	To open the glottis.
	2. Crico-arytænoideus posticus.	From the cricoid cartilage posteriorly.	Into the basis of the arytænoid cartilage posteriorly	To open the glottis.
	3. Arytænoideus obliquis.	From the basis of one of the arytænoid cartilages	Near the extremity of the other arytænoid cartilage.	To draw the parts it is connected with towards each other.
	4. Arytænoideus transversus.	From one of the arytænoid cartilages laterally.	Into the other arytænoid cartilage laterally.	To shut the glottis.
	5. Thyreo-arytænoideus.	From the posterior and under part of the thyroid cartilage.	Into the arytænoid cartilage.	To draw the arytænoid cartilage forwards.

(*) The crico-pharyngæus and thyro-pharyngæus of Douglas.

	Name.	Origin.	Insertion.	Use.
	6. Arytæno-epiglottideus.	From the upper part of the arytænoid cartilage laterally.	Into the side of the epiglottis.	To move the epiglottis outwards.
	7. Thyreo-epiglottideus.	From the thyroid cartilage.	Into the side of the epiglottis.	To pull the epiglottis obliquely downwards (*.)
Muscles at the fore part of the neck, close to the vertebræ - - -	1. Rectus capitis internus major.	From the anterior extremities of the transverse processes of the five lowermost cervical vertebræ.	Into the fore part of the cuneiform process of the os occipitis.	To bend the head forwards.
	2. Rectus capitis internus minor.	From the anterior and upper part of the first cervical vertebra	Near the basis of the condyloid process of the os occipitis.	To assist the last described muscle.
	3. Rectus capitis lateralis.	From the anterior and upper part of	Into the os occipitis, opposite to the	To move the head to one side.

(*) When either this or the preceding muscle acts with its fellow, the epiglottis is drawn directly downwards upon the glottis.

Name.	*Origin.*	*Insertion.*	*Use.*
	the transverse process of the first cervical vertebra.	stylo mastoid foramen.	
4. Longus colli.	Within the thorax, laterally from the bodies of the three uppermost dorsal vertebræ; from the basis and fore part of the transverse processes of the first and second dorsal vertebræ, and of the last cervical vertebra; and lastly, from the anterior extremities of the transverse processes of the 6th, 5th, 4th, and 3d cervical vertebræ.	Into the second cervical vertebra anteriorly.	To pull the neck to one side (*).

(*) When both muscles act, the neck is drawn directly forwards.

Name.		*Origin.*	*Insertion.*	*Use.*
——— at the fore part of the abdomen - - -	1. Obliquus externus.	From the lower edges of the eight inferior ribs, near their cartilages.	Into the linea alba (*), ossa pubis (†), and spine of the ilium (‡).	To compress and support the viscera, assist in evacuating the fæces and urine, draw down the ribs, and bend the trunk forwards, or obliquely to one side.
	2. Obliquus internus.	From the spinous process of the three lowermost lumbar vertebræ, the back part of the os sa-	Into the cartilages of all the false ribs, linea alba (§), and fore part of the pubis.	To assist the obliquus externus.

(*) The linea alba is that tendinous expansion which reaches from the cartilago ensiformis to the os pubis. It is formed by the interlacement of the tendinous fibres of the oblique and transverse muscles, and on this account some anatomists have considered these as three digastric muscles.

(†) A little above the pubis the tendinous fibres of this muscle separate from each other, so as to form an opening called the *ring* of the obliquus externus, and commonly, though improperly, the ring of the abdominal muscles, there being no such aperture either in the transversalis or obliquus internus. This ring in the male subject affords a passage to the spermatic vessels, and in the female to the round ligament of the uterus.

(‡) From the anterior and upper spinous process of the ilium, this muscle is stretched tendinous to the os pubis, and thus forms what is called by some *Fallopius's*, and by others *Paupart's ligament*. The blood-vessels pass under it to the thigh.

(§) The tendon formed by the upper part of this muscle in its way to the linea alba is divided into two layers. The posterior layer runs under, and the anterior one over, the rectus muscle.

Name.	*Origin.*	*Insertion.*	*Use.*
	crum, the spine of the ilium, and back part of Fallopius's ligament (*).		
3. Transversalis.	From the cartilages of the seven inferior ribs; the transverse processes of the last dorsal, and four upper lumbar vertebræ; the inner part of Fallopius's ligament and the spine of the ilium.	Into the linea alba and cartilago ensiformis.	To compress the abdominal viscera.
4. Rectus abdominis.	From the upper edge of the pubis and the symphysis pubis.	Into the cartilages of the 5th, 6th, and 7th ribs, and the edge of the cartilago ensiformis (+)	To compress the fore part of the abdomen, and to bend the trunk forwards.

(*) From this part it detaches some fibres which extend downwards upon the spermatic chord, and form what is described as the cremaster muscle.

(+) The fibres of the rectus are generally divided by three tendinous intersections. The two upper thirds of this muscle passing between the tendinous layers of the obliquus internus, are inclosed as it were in a sheath; but at its lower part we find it immediately contiguous to the peritonæum, the inferior portion of the tendon of the transversalis passing over the rectus, and adhering to the anterior layer of the obliquus internus.

	Name.	Origin.	Insertion.	Use.
	5. Pyramidalis (*).	From the anterior and upper part of the pubis.	Into the linea alba and inner edge of the rectus, commonly about two inches above the pubis.	To affift the lower portion of the rectus.
Muscles at the fore part of the thorax.	1. Pectoralis Major.	From the cartilaginous ends of the 5th and 6th ribs; the sternum, and anterior part of the clavicle.	Into the upper and inner part of the os humeri (†).	To draw the arm forwards, or obliquely forwards.
	2. Subclavius.	From the cartilage of the first rib.	Into the under surface of the clavicle.	To move the clavicle forwards and downwards, and to as ist in raising the first rib.

(*) This muscle is sometimes wanting.
(†) The fibres of this muscle pass towards the axilla in a folding manner, and with those of the latissimus dorsi form the arm-pit.

	Name.	Origin.	Insertion.	Use.
	3. Pectoralis minor (*).	From the upper edges of the 3d, 4th, and 5th ribs.	Into the coracoid process of the scapula.	To move the scapula forwards and downwards, or to elevate the ribs.
	4. Serratus Magnus.	From the eight superior ribs.	Into the basis of the scapula.	To bring the scapula forwards.
Muscles that concur in forming the thorax, - -	1. Diaphragma (†).			
	2. Levatores constarum.	From the transverse processes of the last cervical and the eleven upper dorsal vertebræ.	Into the upper side of each rib, near its tuberosity.	To move the ribs upwards and outwards.
	3. Intercostales externi.	From the lower edge of each upper rib.	Into the superior edge of each lower rib.	To elevate the ribs.
	4. Intercostales interterni (‡).			

(*) This and some other muscles derive their name of *serratus*, from their arising by a number of tendinous or fleshy digitations, resembling the teeth of a saw *(serra.)*

(†) For a description of the diaphragm, see Part IV. Sect. IV.

(‡) The origin, insertion, and use of the internal intercostales, are similar to those of the external. The reader, however, will be pleased to observe, that the intercostales externi occupy the spaces between the ribs only from the spine to their cartilages; from thence to the sternum, there being only a thin membrane, which is spread over the intercostales interni; and the latter, on the contrary, extend only from the sternum to the angles of each rib.

	Name.	Origin.	Insertion.	Use.
	5. Sterno-costales (*).	From the cartilago ensiformis, and lower and middle part of the sternum.	Into the cartilages of the 2d, 3d, 4th, 5th, and 6th ribs.	To depress the cartilages of the ribs.
——at the back part of the neck and trunk, - -	1. Trapezius (†), or cucullaris.	From the middle of the os occipitis, and the spinous processes of the two inferior cervical, and of all the dorsal, vertebræ (‡).	Into the posterior half of the clavicle, part of the acromion, and the spine of the scapula.	To move the scapula.

The fibres of the external mufcles run obliquely forwards; thofe of the internal obliquely backwards. This difference in the direction of their fibres induced Galen to fuppofe that they were intended for different ufes; that the external intercoftals, for inftance, serve to elevate, and the internal ones to depress the ribs. Fallopius seems to have been the first who ventured to dispute the truth of this doctrine, which has since been revived by Boyle, and more lately still by Hamberger, whose theoretical arguments on this subject have been clearly refuted by the experiments of Haller.

(*) These consist of four, and sometimes five distinct muscles on each side. Vesalius, and after him Douglas and Albinus, consider them as forming a single muscle, which, on account of its shape, they name *triangularis*. Verheyen, Winslow, and Haller, more properly describe them as so many separate muscles, which, on account of their origin and insertion, they name *fterno-coftales*.

(†) So named by Riolanus, from τράπεζα, on account of its quadrilateral fhape. Columbus and others gave it the name of *cucullaris*, from its refemblance to a monk's hood.

(‡) The tendinous fibres of this mufcle, united with thofe of its fellow in the nape of the neck, form what is called the *ligamentum colli*.

Name.	*Origin.*	*Insertion.*	*Use.*
2. Rhomboideus (*).	From the ſpinous proceſſes of the three lowermoſt cervical, and of all the dorſal vertebræ.	Into the basis of the scapula.	To move the scapula upwards and backwards.
3. Latissimus dorsi.	From part of the spine of the os ilium, the spinous processes of the os sacrum and lumbar vertebræ, and of six or eight of the dorsal vertebræ; also from the four inferior false ribs near their cartilages.	Into the os humeri, at the inner edge of the groove for lodging the long head of the biceps muscle.	To draw the os humeri downwards and backwards, and to roll it upon its axis.
4. Serratus inferior posticus.	From the spinous processes of the two lowermost dorsal, and of three of the lumbar vertebræ.	Into the lower edges of the three or four lowermost ribs near their cartilages.	To draw the ribs outwards, downwards, and backwards.

(*) This muscle consists of two distinct portions, which are described as separate muscles by Albinus, under the names of *rhomboideus minor* and *rhomboideus major*.

Name.	*Origin.*	*Insertion.*	*Use.*
5. Levator scapulæ.	From the transverse processes of the four uppermost vertebræ colli.	Into the upper angle of the scapula.	To move the scapula forwards and upwards.
6. Serratus superior posticus.	From the lower part of the ligamentum colli, the spinous process of the lowermost cervical vertebra, and of the two superior dorſal vertebræ.	Into the 2d, 3d, and 4th ribs.	To expand the thorax.
7. Splenius (*).	From the spinous processes of the four or five uppermost vertebræ of the back, and of the lowermost cervical vertebra.	Into the transverse processes of the two first cervical vertebræ, the upper and back part of the mastoid process, and a ridge on the os occipitis.	To move the head backwards.

(*) According to some writers, this muscle has gotten its name from its resemblance to the spleen; others derive it from *ſplenium* splint.

Name.	*Origin.*	*Insertion.*	*Use.*
8. Complexus (*).	From the transverse processes of the four or five uppermost dorsal, and of the six lowermost cervical vertebræ.	Into the os occipitis	To draw the head backwards.
9. Trachelo-mastoideus (†).	From the transverse processes of the first dorsal vertebra, and four or five of the lowermost, cervical vertebræ.	Into the mastoid process.	To draw the head backwards.
10. Rectus capitis posticus major.	From the spinous process of the second cervical vertebra.	Into the os occipitis.	To extend the head and draw it backwards.
11. Rectus capitis posticus minor.	From the first vertebra of the neck.	Into the os occipitis.	To assist the rectus major.
12. Obliquus superior capitis.	From the transverse process of the first cervical vertebra.	Into the os occipitis.	To draw the head backwards.

(*) So named on account of its complicated stricture.
(†) So named from its origin from the neck (τραχηλος) and its insertion into the mastoid process.

Name.	*Origin.*	*Insertion.*	*Use.*
13. Obliquus inferior capitis.	From the spinous process of the second cervical vertebra.	Into the transverse process of the first cervical vertebra.	To draw the face towards the shoulder, and to move the first vertebra upon the second.
14. Sacro-lumbalis (*).	From the back part of the os sacrum, spine of the ilium, spinous processes and roots of the transverse processes of the vertebræ of the loins.	Into the lower edge of each rib.	To draw the ribs downwards, move the body upon its axis, assist in erecting the trunk, and turn the neck backwards, or to one side.
15. Longissimus dorsi (†).	The same as that of the sacro-lumbalis.	Into the transverse processes of the dorsal vertebræ.	To stretch the vertebræ of the back, and keep the trunk erect.

(*) Several thin fasciculi of fleshy fibres arise from the lower ribs, and terminate in the inner side of this muscle. Steno names them *musculi ad sacro-lumbalem accessorii*. The sacro-lumbalis likewise sends off a fleshy slip from its upper part, which by Douglas and Albinus is described as a distinct muscle, under the name of *cervicalis descendens*. Morgagni has very properly considered it as a part of the sacro-lumbalis.

† At the upper part of this muscle a broad thin layer of fleshy fibres is found crossing, and intimately adhering to it. This portion, which is described by Albinus, under the name of *transversalis cervicis*, may very properly be considered as an appendage to the longissimus dorsi. It arises from the transverse processes of the five or six superior dorsal vertebræ, and is inserted into the transverse processes of

Name.	*Origin.*	*Insertion.*	*Use.*
16. Spinalis dorsi.	From the spinous processes of the uppermost lumbar and lowermost dorsal vertebræ.	Into the spinous processes of the nine superior dorsal vertebræ.	To extend the vertebræ.
17. Semi-ſpinalis dorsi.	From the transverse processes of the 7th, 8th, 9th, and 10th vertebræ of the back.	Into the spinous processes of the four uppermost dorsal, and lowermost of the cervical vertebræ.	To extend the ſpine obliquely backwards.
18. Multifidus Spinæ (*).	From the os sacrum, ilium, oblique and transverse processes of the lumbar vertebræ, transverse processes of	Into the spinous processes of the lumbar, dorsal, and six of the cervical vertebræ.	To extend the back and draw it backwards, or to one side.

the six inferior cervical vertebræ. By means of this appendage the longissimus dorsi may serve to move the neck to one side, or obliquely backwards.

(*) Anatomists in general have unnecessarily multiplied the muscles of the spine. Albinus has the merit of having introduced greater simplicity into this part of myology. Under the name of *multifidus spinæ*, he has very properly included those portions of muscular flesh intermixed with tendinous fibres, situated close to the back part of the spine, and which are described by Douglas under the names of *transversales colli, dorsi, & lumborum.*

Name.	Origin.	Insertion.	Use.
	the dorsal, and four of the cervical vertebræ.		
19. Semi-spinalis colli.	From the transverse processes of the five or six uppermost dorsal vertebræ.	Into the spinous processes of the 2d, 3d, 4th, 5th, and 6th cervical vertebræ.	To stretch the neck obliquely backwards.
20. Scalenus (*).	From the transverse processes of the five inferior cervical vertebræ.	Into the upper and outer part of the first and second ribs.	To move the neck forwards, or to one side.
21. Inter-spinalis (†).	From the upper part of each of the ſpinous processes of the six inferior cervical vertebræ.	Into the under part of each of the spinous processes of the vertebræ above.	To draw the spinous processes towards each other.

(*) The ancients gave it this name from its resemblance to an irregular triangle (σκαληνός). It consists of three fleshy portions. The anterior one affords a passage to the axillary artery, and between this and the middle portion we find the nerves going to the upper extremities. The middle is in part covered by the posterior portion, which is the longest and thinnest of the three.

(†) In the generality of anatomical books we find these muscles divided into *inter-spinalis cervicis*, *dorsi*, and *lumborum*, but we do not find any such muscles either in the loins or back.

	Name.	*Origin.*	*Insertion.*	*Use.*
	22. Inter-transversales (*).	From the upper part of each of the transverse processes of the vertebræ.	Into the under part of each of the transverse processes of the vertebræ above.	To draw the transverse processes towards each other.
Muscles within the cavity of the abdomen, on the anterior and lateral parts of the spine,	1. Psoas parvus (†).	From the sides and transverse processes of the uppermost lumbar vertebra, and sometimes of the lowermost dorsal vertebra.	Into the brim of the pelvis, at the junction of the os pubis with the ilium.	To bend the loins forwards.
	2. Psoas magnus.	From the bodies and transverse processes of the last dorsal, and all the lumbar vertebræ.	Into the os femoris, a little below the trochanter minor.	To bend the thigh forwards.

(*) These muscles are to be found only in the neck and loins; which have been described, as the *inter-transversales dorsi* being rather small tendons than muscles.

(†) This and the following pair of muscles derive their name of *psoas* from ψοα, *lumbus*, on account of their situation at the anterior part of the loins.

Name.	*Origin.*	*Insertion.*	*Use.*
3. Iliacus internus.	From the inner lip, hollow part, and edge of the os ilium.	In common with the psoas magnus.	To assist the psoas magnus.
4. Quadratus lumborum (*).	From the posterior part of the spine of the ilium.	Into the transverse processes of the four uppermost lumbar vertebræ, the inferior edge of the last rib, and the side of the lowermost dorsal vertebra.	To support the spine, or to draw it to one side.
5. Coccygæus.	From the posterior and inner edge of the spine of the ischium.	Into the lower part of the os sacrum, and almost the whole length of the os coccygis laterally.	To draw the os coccygis forwards and inwards (†).

(*) So called from its shape, which is that of an irregular square.

(†) Some of the fibres of this muscle are united with those of the levator ani, ſo that it assists in closing the lower part of the pelvis.

	Name.	*Origin.*	*Insertion.*	*Use.*
——on the scapula and upper part of the os humeri,	1. Deltoides (*).	From the clavicle, processus acromion, and spine of the scapula.	Into the anterior and middle part of the os humeri.	To raise the arm.
	2. Supra-spinatus.	From the basis, spine, and upper costa of the scapula.	Into a large tuberosity at the head of the os humeri.	To raise the arm.
	3. Infra-spinatus.	From the base and spine of the scapula.	Into the upper and middle part of the tuberosity.	To roll the os humeri outwards.
	4. Teres minor (†).	From the inferior costa of the scapula.	Into the lower part of the tuberosity.	To assist the infra spinatus.
	5. Teres major.	From the inferior angle, and inferior costa of the scapula.	Into the ridge at the inner side of the groove formed for the long head of the biceps.	To assist in the rotatory motion of the arm.
	6. Subscapularis.	From the basis, superior and inferior costa of the scapula.	Into the upper part of a small tuberosity at the head of the os humeri.	To roll the arm inwards.

(*) So named from its supposed resemblance to the Greek Δ reversed.
(†) This and the following pair are called *teres*, from their being of a long and round shape.

	Name.	Origin.	Insertion.	Use.
	7. Coraco-brachialis (*).	From the coracoid process of the scapula.	Into the middle and inner side of the os humeri.	To roll the arm forwards and upwards.
Muscles on the os humeri, - - -	1. Biceps flexor cubiti.	By two heads, one from the coracoid process, and the other, or long head, from the upper and outer edge of the glenoid cavity of the scapula.	Into the tuberosity at the upper end of the radius.	To bend the fore-arm.
	2 Brachialis internus.	From the os humeri, below, and at each side of the tendon of the deltoides.	Into a small tuberosity at the fore part of the coronoid process of the ulna.	To assist in bending the fore-arm.
	3. Triceps extensor cubiti.	By three heads; the first, from the inferior costa of the scapula; the second, from the upper and outer part	Into the upper and outer part of the olecranon.	To extend the fore-arm.

(*) This muscle affords a passage to the musculo-cutaneous nerve.

	Name.	Origin.	Insertion.	Use.
		of the os humeri; and the third, from the back part of that bone.		
—— on the fore-arm, - -	1. Supinator longus.	From the outer ridge and anterior surface of the os humeri, a little above its outer condyle.	Into the radius near its styloid process.	To assist in turning the palm of the hand upwards.
	2. Extensor carpi radialis longus.	Immediately below the origin of the supinator longus.	Into the upper part of the metacarpal bone of the fore-finger.	To extend the wrist.
	3. Extensor carpi radialis brevis.	From the outer and lower part of the outer condyle of the os humeri, and the upper part of the radius.	Into the upper part of the metacarpal bone of the middle finger.	To assist the extensor longus.
	4. Extensor digitorum communis.	From the outer condyle of the os humeri.	Into the back part of all the bones of the fore finger.	To extend the fingers

Name.	*Origin.*	*Insertion.*	*Use.*
5. Extensor minimi digiti.	From the outer condyle of the os humeri.	Into the bones of the little finger.	To extend the little finger.
6. Extensor carpi ulnaris.	From the outer condyle of the os humeri.	Into the metacarpal bone of the little finger.	To assist in extending the wrist.
7. Anconæus (*).	From the outer condyle of the os humeri.	Into the outer edge of the ulna.	To extend the fore arm.
8. Flexor carpi ulnaris.	From the inner condyle of the os humeri, and anterior edge of the olecranon (†).	Into the os pisiforme.	To assist in bending the hand.
9. Palmaris longus.	From the inner condyle of the os humeri.	Into the internal annular ligament, and aponeurosis palmaris (‡).	To bend the hand.

(*) So called from *αγκων, cubitus.*

(†) Between the two origins of this muscle we find the ulnor-nerve going to the fore arm.

(‡) The aponeurosis palmaris is a tendinous membrane that extends over the palm of the hand. Some anatomists have supposed it to be a production of the tendon of this muscle, but without sufficient grounds; for in some subjects we find the palmaris longus inserted wholly into the annular ligament, so as to be perfectly distinct from this aponeurosis; and it now and then happens, that no palmaris longus is to be found, whereas this expansion is never deficient.

Name.	*Origin.*	*Insertion.*	*Use.*
10. Flexor carpi radialis.	From the inner condyle of the os humeri.	Into the metacarpal bone of the fore finger.	To bend the hand.
11. Pronator radii teres.	From the outer condyle of the os humeri, and coronoid process of the ulna.	Into the anterior and convex edge of the radius near its middle.	To roll the hand inwards.
12. Flexor sublimis perforatus (*).	From the inner condyle of the os humeri, inner edge of the coronoid process of the ulna, and upper and anterior part of the radius.	Into the second bone of each finger.	To bend the second joint of the finger.
13. Supinator radii brevis.	From the outer condyle of the os humeri, and posterior surface and outer edge of the ulna.	Into the anterior, inner, and upper part of the radius.	To roll the radius outwards.

(*) This muscle is named *perforatus*, on account of the four tendons in which it terminates, being perforated by those of another muscle, the perforans.

Name.	*Origin.*	*Insertion.*	*Use.*
14. Abductor pollicis longus.	From the middle and back part of the ulna, interoſſeous ligament, and radius.	By two tendons into the os trapezium, and first bone of the thumb.	To stretch the first bone of the thumb outwards.
15. Extenſor minor pollicis.	From the back part of the ulna, and interoſſeous ligament and radius.	Into the convex part of the second bone of the thumb.	To extend the second bone of the thumb obliquely outwards.
16. Extensor major pollicis.	From the back of the ulna and interoſſeous ligament.	Into the third and last bone of the thumb.	To stretch the thumb obliquely backwards.
17. Indicator.	From the middle of the ulna.	Into the metacarpal bone of the fore-finger.	To extend the fore-finger.
18. Flexor profundus perforans.	From the upper and fore part of the ulna, and interosseous ligament.	Into the fore part of the last bone of each of the fingers.	To bend the last joint of the fingers.
19. Flexor longus pollicis.	From the upper and fore part of the radius.	Into the last joint of the thumb.	To bend the last joint of the thumb.

	Name.	*Origin.*	*Insertion.*	*Use.*
	20. Pronator radii quadratus.	From the inner and lower part of the ulna.	Into the radius, opposite to its origin.	To roll the radius inwards, and of course to assist in the pronation of the hand.
MUSCLES on the hand,	1. Lumbricales (*).	From the tendons of the perforans.	Into the tendons of the extensor digitorum communis.	To bend the first, and to extend the two last joints of the fingers (†).
	2. Abductor brevis pollicis.	From the fore part of the internal annular ligament, os scaphoides, and one of the tendons of the abductor longus pollicis.	Into the outer side of the 2d bone of the thumb, near its root.	To move the thumb from the fingers.
	3. Opponens pollicis.	From the inner and anterior part of the internal annular ligament, and from the os scaphoides.	Into the first bone of the thumb.	To move the thumb inwards, and to turn it upon its axis.

(*) So named from their being shaped somewhat like the lumbricus or earth-worm.

(†) Fallopius was the first who remarked the two opposite uses of this muscle. Their extending power is owing to their connection with the extensor communis.

Name.	*Origin.*	*Insertion.*	*Use.*
4. Flexor brevis pollicis.	From the os trapezöides, internal annular ligament, os magnum, and os unciforme	Into the ossa sesamoidea and second bone of the thumb.	To bend the second joint of the thumb.
5. Abductor pollicis.	From the metacarpal bone of the middle finger.	Into the basis of the second bone of the thumb.	To move the thumb towards the fingers.
6. Abductor indices.	From the inner side of the first bone of the thumb, and from the os trapezium.	Into the first bone of the fore finger posteriorly.	To move the fore finger towards the thumb.
7. Palmaris brevis.	From the internal annularligament, and aponeurosis palmaris.	Into the os pisiforme, and the skin covering the abductor minimi digiti.	To contract the palm of the hand.
8. Abductor minimi digiti.	From the internal annular ligament and os pisiforme.	Into the side of the first bone of the little finger.	To draw the little finger from the rest.
9. Flexor parvus minimi digiti.	From the os unciforme and internal annular ligament.	Into the first bone of the little finger.	To bend the little finger.

	Name.	*Origin.*	*Insertion.*	*Use.*
	10. Abductor metacarpi minimi digiti.	From the os unciforme and internal annular ligament.	Into the metacarpal bone of the little finger.	To move that bone towards the rest.
	11. Interossei interni.	Situated between the metacarpal bones.	Into the roots of the fingers.	To extend the fingers and move them towards the thumb (*).
	12. Interossei externi.	Situated between the metacarpal bones on the back of the hand.	Into the roots of the fingers.	To extend the fingers; but the first draws the middle finger inwards, the second draws it outwards, and the third draws the ring finger inwards.
Muscles at the back part of the pelvis, and upper part of the thigh, - -	1. Glutæus (†) maximus.	From the spine of the ilium, posterior sacro-ischiatic liga-	Into the upper part of the *linea aspera* of the os femoris.	To extend the thigh and draw it outwards.

(*) The third interosseus internus (for there are four of the externi and three of the interni) differs from the rest in drawing the middle finger from the thumb.

(†) From γλουτος, *nates*.

Name.	Origin.	Insertion.	Use.
	ments, os sacrum, and os coccygis.		
2. Glutæus medius.	From the spine and superior surface of the ilium.	Into the outer and back part of the great trochanter of the os femoris.	To draw the thigh outwards and a little backwards, and when it is bended, to roll it.
3. Glutæus minimus.	From the outer surface of the ilium and the border of its great niche.	Into the upper and anterior part of the great trochanter.	To assist the former.
4. Pyriformis (*).	From the anterior part of the os sacrum.	Into a cavity at the root of the trochanter major.	To roll the thigh outwards.
5. Gemini (†).	By two portions, one from the outer surface of the spine of the ischium; the other from the	Into the same cavity as the pyriformis.	To roll the thigh outwards, and likewise to confine the tendon of the obturator internus, when

(*) So named from its pear-like shape.

(†) The two portions of this muscle having been described as two distinct muscles by some anatomists, have occasioned it to be named *gemini*. The tendon of the obturator internus runs between these two portions.

	Name.	*Origin.*	*Insertion.*	*Use.*
		tuberosity of the ischium and posterior sacro-ischiatic ligament.		the latter is in action.
	6. Obturator internus.	From the superior half of the inner border of the foramen thyroideum.	Into the same cavity with the former.	To roll the thigh outwards.
	7. Quadratus (*) femoris.	From the tuberosity of the ischium.	Into a ridge between the trochanter major and trochanter minor.	To move the thigh outwards.
—— on the thigh (†), - - - -	1. Biceps flexor cruris.	By two heads; one from the tuberosity of the ischium,	Into the upper and back part of the fibula (‡).	To bend the leg.

(*) This muscle is not of the square shape its name would seem to indicate.

(†) The muscles of the leg and thigh are covered by a broad tendinous membrane called *fascia lata*, that surrounds them in the manner of a sheath. It is sent off from the tendons of the glutæi and other muscles, and dipping down between the muscles it covers, adheres to the linea aspera, and spreading over the joint of the knee, gradually disappears on the leg. It is thickest on the inside of the thigh.

(‡) The tendon of this muscle forms the *outer ham-string*.

Name.	*Origin.*	*Insertion.*	*Use.*
	the other from the linea aspera near the insertion of the glutæus maximus.		
2. Semitendinosus.	From the tuberosity of the ischium.	Into the upper and inner part of the tibia.	To bend and draw the leg inwards.
3. Semi-membranosus (*).	From the tuberosity of the ischium.	Into the upper and back part of the head of the tibia.	To bend the leg.
4. Tensor vaginæ femoris.	From the superior and anterior spinous process of the ilium	Into the inner side of the fascia lata, which covers the outside of the thigh.	To stretch the fascia.
5. Sartorius.	From the superior and anterior spinous process of the ilium.	Into the upper and inner part of the tibia.	To bend the leg inwards (†).
6. Rectus.	By two tendons; one from the anterior and inferior spi-	Into the upper and fore-part of the patella.	To extend the leg.

(*) So named on account of its origin, which is by a broad flat tendon three inches long.
(†) Spigelius was the firſt who gave this the name of *sartorius*, or the taylor's muscle, from its use in crossing the legs.

Name.	*Origin.*	*Insertion.*	*Use.*
	nous process of the ilium; the other from the posterior edge of the cotyloid cavity.		
7. Gracilis.	From the fore-part of the ischium and pubis.	Into the upper and inner part of the tibia.	To bend the leg.
8. Vastus externus (*).	From the anterior and lower part of the great trochanter, and the outer edge of the linea aspera.	To the upper and outer part of the patella.	To extend the leg.
9. Vastus internus.	From the inner edge of the linea aspera, beginning between the fore-part of the os femoris and the root of the lesser trochanter.	Into the upper and inner part of the patella.	To extend the leg.

(*) The vastus externus, vastus internus, and cruræus, are so intimately connected with each other, that some anatomists have been induced to consider them as a *triceps*, or single muscle with three heads.

Name.	Origin.	Insertion.	Use.
10. Cruræus (*).	From the outer and anterior part of the lesser trochanter.	Into the upper part of the patella.	To extend the leg.
11. Pectinalis.	From the anterior edge of the os pubis, or pectinis, as it is sometimes called.	Into the upper and fore part of the linea aspera.	To draw the thigh inwards, upwards, and to roll it a little outwards.
12. Abductor longus femoris (†).	From the upper and fore part of the os pubis.	Near the middle and back part of the linea aspera.	To draw the thigh inwards, upwards, and to roll it a little outwards.
13. Abductor brevis femoris.	From the fore part of the ramus of the os pubis.	Into the inner and upper part of the linea aspera.	
14. Abductor magnus femoris.	From the lower and fore part of the ramus of the os pubis.	Into the whole length of the linea aspera.	

(*) Under the cruræus we sometimes meet with two small muscles, to which Albinus has given the name of *sub-cruræi*. They terminate on each side of the patella, and prevent the capsular ligament from being pinched. When they are wanting, which is very often the case, some of the fibres of the cruræus are found adhering to the capsula.

(†) This and the two following muscles have been usually, but improperly, considered as forming a single muscle with three heads, and on that account named *triceps femoris*.

	Name.	*Origin.*	*Insertion.*	*Use.*
	15. Obturator externus.	From part of the obturator ligament, and the inner half of the circumference of the foramen thyroideum.	Into the os femoris near the root of the great trochanter.	To move the thigh outwards in an oblique direction, and likewise to bend and draw it inwards.
MUSCLES on the leg,	1. Gastrocnemius (*) externus.	By two heads; one from the inner condyle, the other from the outer condyle of the os femoris.	By a great round tendon, common to this and the following muscle.	To extend the foot.
	2. Gastrocnemius (+) internus.	By two heads; one from the back part of the head of the fibula, the other from the upper and back part of the tibia.	By a large tendon (the *tendo achillis*) common to this and the former muscle, into the lower and back part of the os calcis.	To extend the foot.

(*) Γαστροκνημια, *sura*, "the calf of the leg."
(+) This muscle is by some anatomists named *soleus*, on account of its being shaped like the sole-fish.

Name.	*Origin.*	*Insertion.*	*Use.*
3. Plantaris (*).	From the upper and posterior part of the outer condyle of the os femoris.	Into the inside of the back part of the os calcis.	To assist in extending the foot.
4. Popliteus (†).	From the outer condyle of the thigh.	Into the upper and inner part of the tibia.	To assist in bending the leg and rolling it inwards.
5. Flexor longus digitorum pedis (‡).	From the upper and inner part of the tibia.	By four tendons, which, after passing through the perforations in those of the flexor digitorum brevis, are inserted into the last bone of all the toes except the great toe.	To bend the last joint of the toe.

(*) This muscle has gotten the name of *plantaris*, from its being supposed to furnish the aponeurosis that covers the sole of the foot; but it does not in the least contribute to the formation of that tendinous expansion.

(†) So called on account of its situation at the ham *(poples)*.

(‡) This muscle, about the middle of the foot, unites with a fleshy mass, which, from its having first been described by Sylvius, is usually called *massa carnea* JACOBI SYLVII.

Name.	*Origin.*	*Insertion.*	*Use.*
6. Flexor longus pollicis pedis.	From the back part, and a little below the head of the fibula.	Into the last bone of the great toe.	To bend the great toe.
7. Tibialis posticus.	From the back part and outer edge of the tibia, and likewise from the interosseous ligament and adjacent part of the fibula.	Into the inner and upper part of the os naviculare and side of the os cuneiforme medium.	To move the foot inwards.
8. Peroneus longus.	From the outer side of the head of the tibia, and also from the upper, anterior, and outer part of the *perone* or fibula, to which it adheres for a considerable way down.	Into the metatarsal bone of the great toe.	To move the foot outwards.
9. Peroneus brevis.	From the outer and fore-part of the fibula.	Into the metatarsal bone of the little toe.	To assist the last described muscle.

	Name.	Origin.	Insertion.	Use.
	10. Extensor longus digitorum pedis.	From the upper, outer, and fore part of the tibia, interosseous ligament, and inner edge of the fibula.	By four tendons into the first joint of the smaller toes.	To extend the toes.
	11. Peroneus tertius.	From the fore-part of the lower half of the fibula, and from the interosseous ligament.	Into the metatarsal bone of the little toe.	To the bend the foot.
	12. Tibialis anticus.	From the upper and fore part of the tibia.	Into the os cuneiforme internum.	To bend the foot.
	13. Extensor proprius pollicis pedis.	From the upper and fore part of the tibia.	Into the convex surface of the bones of the great toe.	To extend the great toe.
Muscles on the foot,	1. Extensor brevis digitorum pedis.	From the upper and anterior part of the os calcis.	By four tendons; one of which joins the tendon of the externus longus pollicis, and the other three the tendons of the extensor digitorum longus.	To extend the toes.

Name.	*Origin.*	*Insertion.*	*Use.*
2. Flexor brevis digitorum pedis.	From the lower part of the os calcis.	By four tendons, which, after affording a passage to those of the flexor longus, are inserted into the second phalanx of each of the small toes.	To bend the second joint of the toes.
3. Abductor pollicis pedis.	From the inner and lower part of the os calcis.	Into the first joint of the great toe.	To move the great toe from the other toes.
4. Abductor minimi digiti.	From the outer tubercle of the os calcis, the root of the metatarsal bone of the little toe, and also from the aponeurosis plantaris.	Into the outer side of the first joint of the little toe.	To draw the little toe outwards.
5. Lumbricales pedis.	From the tendons of the flexor longus digitorum pedis.	Into the tendinous expansion at the upper part of the toes.	To draw the toes inwards.

Name.	*Origin.*	*Insertion.*	*Use.*
6. Flexor brevis pollicis pedis.	From the inferior and anterior part of the os calcis, and also from the inferior part of the os caneiformeexternum.	By two tendons into the first joint of the great toe.	To bend the first joint of the great toe.
7. Abductor pollicis pedis.	From near the roots of the metatarsal bones of the 2d, 3d, and 4th toes.	Into the outer os sesamoideum, or first joint of the great toe.	To draw the great toe nearer to the rest, and also to bend it.
8. Transversalis pedis.	From the outer and under part of the anterior end of the metatarsal bone of the little toe.	Into the inner os sesamoideum, and anterior end of the metatarsal bone of the great toe.	To contract the foot.
9. Flexor brevis minimi digiti pedis.	From the basis of the metatarsal bone of the little toe.	Into the first joint of the little toe.	To bend the little toe.
10. Interossei pedis interni (*).	Situated between the metatarsal bones.		
——— externi (†).			

(*) The interossei interni are three in number; their use is to draw the smaller toes towards the great toe.
(†) The interossei externi are four in number; the first serves to move the fore-toe towards the great toe; the rest move the toes outwards. All the interossei assist in extending the toes.

EXPLANATION OF PLATES XXIII. AND XXIV.

PLATE XXIII.

FIG. 1. The MUSCLES immediately under the common teguments on the anterior part of the body are represented on the right side; and on the left side the MUSCLES are seen which come in view when the exterior ones are taken away.

A, The frontal muscle. B, The tendinous aponeurosis which joins it to the occipital; hence both named *occipito-frontalis*. C, Attollens aurem. D, The ear. E, Anterior auris. F F, Orbicularis palpebrarum. G, Levator labii superioris alæque nasi. H, Levator anguli oris. I, Zygomaticus minor. K, Zygomaticus major. L, Masseter. M, Orbicularis oris. N, Depressor labii inferioris. O, Depressor anguli oris. P, Buccinator. Q Q, Platysma myoides. R R, Sterno-cleido-mastoidæus. S, Part of the trapezius. T, Part of the scaleni.

SUPERIOR EXTREMITY.—U, Deltoides. V, Pectoralis major. W, Part of the latissimus dorsi. X X, Biceps flexor cubiti. Y Y, Part of the brachialis externus. Z Z, The beginning of the tendinous aponeurosis (from the biceps), which is spread over the muscles of

ANATOMY.

Plate XXIII

the fore-arm. a a, Its strong tendon inserted into the tubercle of the radius. b b, Part of the brachialis internus. c, Pronator radii teres. d, Flexor carpi radialis. e, Part of the flexor carpi ulnaris. f, Palmaris longus. g, Aponeurosis palmaris. 3, Palmaris brevis. 1, Ligamentum carpi annulare. 2 2, Abductor minimi digiti. h, Supinator radii longus. i, The tendons of the thumb. k, Abductor pollicis. l, Flexor pollicis longus. m m, The tendons of the flexor sublimis perforatus, profundus perforans, and lumbricales.—The sheaths are entire in the right hand,—in the left cut open to show the tendons of the flexor profundus perforating the sublimis.

Muscles not referred to—in the left superior extremity.—n, Pectoralis minor, seu serratus anticus minor. o, The two heads of (x x) the biceps. p, Coraco-brachialis. q q, The long head of the triceps extensor cubiti. r r, Teres major. ſ ſ, Subscapularis. t t, Extensores radiales. u, Supinator brevis. v, The cut extremity of the pronator teres. w, Flexor sublimis perforatus. x, Part of the flexor profundus. y, Flexor pollicis longus. z, Part of the flexor pollicis brevis. 4, Abductor minimi digiti. 5, The four lumbricales.

Trunk.—6, Serrated extremities of the serratus anticus major. 7 7, Obliquus externus abdominis. 8 8, The linea alba. 9, The umbilicus. 10, Pyramidalis. 11 11, The spermatic cord. On the left side it is covered by the cremaster. 12 12, Rectus abdominis. 13, Obliquus internus. 14 14, &c. Intercostal muscles.

INFERIOR EXTREMITIES.—*a a*, The gracilis. *b b*, Parts of the triceps. *c c*, Pectialis. *d d*, Psoas magnus. *e e*, Iliacus internus. *f*, Part of the glutæus medius. *g*, Part of the glutæus minimus. *h*, Cut extremity of the rectus cruris. *i i*, Vastus externus, *k*, Tendon of the rectus cruris. *l l*, Vastus internus. * Sartorius muscle. * * Fleshy origin of the tensor vaginæ fæmoris or membranosus. Its tendinous aponeurosis covers (*i*) the vastus externus in the right side. *m m*, Patella. *n n*, Ligament or tendon from it to the tibia. *o*, Rectus cruris. *p*, Cruræus. *q q*, The tibia. *r r*, Part of the Gemellus or gastrocnemius externus.* *sss*, Part of the soleus or gastrocnemius internus. *t*, Tibialis anticus. *u*, Tibialis posticus. *v v*, Peronæi muscles. *w w*, Extensor longus digitorum pedis. *x x*, Extensor longus pollicis pedis. *y*, Abductor pollicis pedis.

FIG. 2. The MUSCLES, GLANDS, &c. of the Left Side of the face and neck, after the common Teguments and Platysma myoides have been taken off.

a, The frontal muscle. b, Temporalis and temporal artery. c, Orbicularis palpebrarum. d, Levator labii superioris alæque nasi. e, Levator anguli oris. f, Zygomaticus. g, Depressor labii inferioris. h, Depressor anguli

ANATOMY

Plate XXIV

oris. i, Buccinator. k, Masseter. l l, Parotid gland. m, Its duct. n, Sterno-cleido-mastoidæus. o, Part of the trapezius. p, Sterno-hyoidæus. q, Sterno-thyroidæus. r, Omo-hyoidæus. f, Levator scapulæ. t t, Scaleni. u, Part of the splenius.

FIG. 3. The MUSCLES of the Face and Neck in view after the exterior ones are taken away.

a a, Corrugator supercilii. b, Temporalis. c, Tendon of the levator palpebræ superioris. d, Tendon of the orbicularis palpebrarum. e, Masseter. f, Buccinator. g, Levator anguli oris. h, Depressor labii superioris alæque nasi. i, Orbicularis oris. k, Depressor anguli oris. l, Muscles of the os hyoides. m, Sterno-cleido-mastoidæus.

FIG. 4. Some of the MUSCLES of the Os Hyoides and Submaxillary Gland.

a, Part of the masseter muscle. b, Posterior head of the digrastic. c, Its anterior head. d d, Sterno-hyoidæus. e, Omo-hyoidæus. f, Stylo-hyoidæus. g, Submaxillary gland in situ.

FIG. 5. The Submaxillary Gland and Duct.

a, Musculus mylo-hyoidæus. b, Hyo-glossus. c, Submaxillary gland extra situ. d, Its duct.

PLATE XXIV.

FIG. 1. The MUSCLES immediately under the common teguments on the posterior part

of the body, are represented in the right side; and on the left side the MUSCLES are seen which come in view when the exterior ones are taken away.

HEAD.—A A, Occipito-frontalis. B, Attollens aurem. C, Part of the orbicularis palpebrarum. D, Masseter. E, Pterygoidæus internus.

TRUNK.—Right side. F F F, Trapezius seu cucullaris. G G G G, Latissimus dorsi. H, Part of the obliquus externus abdominis.

TRUNK.—Left side. I, Splenius. K, Part of the complexus. L, Levator scapulæ. M, Rhomboides. N N, Serratus posticus inferior. O, Part of the longissimus dorsi. P, Part of the sacro-lumbalis. Q, Part of the semi-spinalis dorsi. R, Part of the serratus anticus major. S, Part of the obliquus internus abdominis.

SUPERIOR EXTREMITY.—Right side. T, Deltoides. U, Triceps extensor cubiti. V, Supinator longus. W W, Extensores carpi radialis longior and brevior. X X, Extensor carpi ulnaris. Y Y, Extensor digitorum communis. Z, Abductor indicis. 1 2 3, Extensores pollicis.

SUPERIOR EXTREMITY.—Left side. a, Supra spinatus. b, Infra-spinatus. c, Teres minor. d, Teres major. e, Triceps extensor cubiti. f f, Extensores carpi radiales. g, Supinator brevis. h, Indicator. 1 2 3, Extensores pollicis. i, Abductor minimi digiti. k, Interossei.

INFERIOR EXTREMITY.—Right side. l, Glutæus maximus. m, Part of the Glutæus medius. n, Tensor vaginæ femoris. o, Gracilis. p p, Abductor femoris magnus. q, Part of the vastus internus. r, Semimembranosus. s, Semitendinosus. t, Long head of the biceps flexor cruris. u u, Gastrocnemius externus seu gemellus. v, Tendo Achillis. w, Soleus seu gastrocnemius internus. x x, Peronæus longus and brevis. y, Tendons of the flexor longus digitorum pedis;—and under them * flexor brevis digitorum pedis. z, Abductor minimi digiti pedis.

Inferior Extremity.—Left side. *m*, *n*, *o*, *p*, *q*, *r*, *s*, *t*, *v*, *w w*, *x x*, *y*, *z*, Point the same parts as in the right side. *a*, Pyriformis. *b b*, Gemini. *c c*, Obturator internus. *d*, Quadratus femoris. *e*, Coccygæus. *f*, The short head of the biceps flexor cruris. *g g*, Plantaris. *h*, Poplitæus. *i*, Flexor longus pollicis pedis.

Fig. 2. The Palm of the Left Hand after the common Teguments are removed, to show the Muscles of the Fingers.

a, Tendon of the flexor carpi radialis. b, Tendon of the flexor carpi ulnaris. c, Tendons of the flexor sublimis perforatus, profundus perforans and lumbricales. d, Abductor pollicis. e e, Flexor pollicis longus. f, Flexor pollicis brevis. g, Palmaris brevis. h, Abductor minimi digiti. i, Ligamentum carpiannulare. k, A probe put under the tendons of the flexor digitorum sublimis; which are perforated by l, the flexor digitorum profundus. m m m m, Lumbricales. n, Abductor pollicis.

FIG. 3. A Fore-view of the foot and Tendons of the Flexores Digitorum.

a, Cut extremity of the tendo Achillis. b, Upper part of the astragalus. c, Os calcis. d, Tendon of the tibialis anticus. e, Tendon of the extensor pollicis longus. f, Tendon of the peronæus brevis. g, Tendons of the flexor digitorum longus, with the nonus Vesalii. h h, The whole of the flexor digitorum brevis.

FIG. 4. MUSCLES of the Anus.

a a, An out line of the buttocks, and upper part of the thighs. b, The testes contained in the scrotum. c c, Sphincter ani. d, Anus. e, Levator ani. f f, Erector penis. g g, Accelerator urinæ. h, Corpus cavernosum urethræ.

FIG. 5. MUSCLES of the Penis.

a a, b, d, e e, f f, h, point the same as in fig. 4. c, Sphincter ani. g g, Transversalis penis.

PART III. OF THE ABDOMEN, OR LOWER BELLY.

THE abdomen or lower belly, extends from the lower extremity of the sternum, or the hollow, usually called the pit of the stomach, and more properly *scrobiculus cordis*, to the lower part of the trunk.

It is distinguished into three divisions called *regions;* of these the upper one, which is called the *epigastric region*, begins immediately under the sternum, and extends to within two fingers breadth of the navel, where the middle or *umbilical region* begins, and reaches to the same distance below the navel. The third, which is called the *hypogastric*, includes the rest of the abdomen, as far as the os pubis.

Each of these regions is subdivided into three others; two of which compose the sides, and the other the middle part of each region.

The middle part of the upper region is called *epigastrium*, and its two sides *hypochondria.* The middle part of the next region is the umbilical region, properly so called, and its two sides are the flanks, or iliac regions. Lastly, the middle part of the lower region retains the name of hypogastrium, and its sides are called inguina or groins. The back part of the abdomen bears the name of lumbar region.

These are the divisions of the lower belly, which are necessary to be held in remembrance, as they frequently occur in surgical and anatomical writing. We will now proceed to examine the contents of the abdomen; and after having pointed out the names and arrangement of the several viscera contained in it, describe each of them separately.

After having removed the skin, adipose membrane, and abdominal muscles, we discover the peritonæum or membrane that envelopes all the viscera of the lower belly. This being opened, the first part that presents itself is the omentum or cawl, floating on the surface of the intestines, which are likewise seen every where loose and moist, and making a great number of circumvolutions through the whole cavity of the abdomen. The stomach is placed in the epigastrium, and under the stomach is the pancreas. The liver fills the right hypochondrium, and the spleen is situated in the left. The kidneys are seen about the middle of the lumbar region, and the urinary bladder and parts of generation are seated in the lower division of the belly.

SECT. I. *Of the Peritonæum.*

THE peritonæum is a strong simple membrane, by which all the viscera of the abdomen are surrounded, and in some measure supported. Many anatomical writers, particularly Winslow, have described it as being composed of two distinct membranous laminæ; but their description seems to be erroneous. What perhaps appeared to be a second lamina, being found to be simply a cellular coat, which sends off productions to the blood-vessels passing out of the abdominal cavity. The aorta and vena cava likewise derive a covering from the same membrane, which seems to be a part of the cellular membrane we have already described.

The peritonæum, by its productions and reduplications, envelopes the greatest part of the abdominal viscera. It is soft, and capable of considerable extension; and is kept smooth and moist by a vapour which is constantly exhaling from its inner surface, and is returned again into the circulation by the absorbents.

This moisture not only contributes to the softness of the peritonæum, but prevents the attrition, and other ill effects which would otherwise probably be occasioned, by the motion of the viscera upon each other.

When this fluid is supplied in too great a quantity, or the absorbents become incapable of carrying it off, it accumulates, and constitutes an ascites or dropsy of the belly; and when by any means the exhalation is discontinued, the peritonæum thickens, becomes diseased, and the viscera are sometimes found adhering to each other.

The peritonæum is not a very vascular membrane. In a sound state it seems to be endued with little or no feeling, and the nerves that pass through it appear to belong to the abdominal muscles.

Sect. II. *Of the Omentum.*

The omentum, epiploon, or cawl, is a double membrane, produced from the peritonæum. It is interlarded with fat, and adheres to the stomach, spleen, duodenum, and colon; from thence hanging down loose and floating on the surface of the intestines. Its size is different in different subjects. In some it descends as low as the pelvis, and it is commonly longer at the left side than the right.

This part, the situation of which we have just now described, was the only one known to the ancients under the name of *epiploon;*

but at present we distinguish three omenta, viz. *omentum magnum colico gastricum*, *omentum parvum hepatico gastricum*, and *omentum colicum.* They all agree in being formed of two very delicate laminæ, separated by a thin layer of cellular membrane.

The omentum magnum colico gastricum, of which we have already spoken, derives its arteries from the splenic and hepatic. Its veins terminate in the vena portæ. Its nerves, which are very few, come from the splenic and hepatic plexus.

The omentum parvum hepatico gastricum, abounds less with fat than the great epiploon. It begins at the upper part of the duodenum, extends along the lesser curvature of the stomach as far as the œsophagus, and terminates about the neck of the gall-bladder, and behind the left ligament of the liver, so that it covers the lesser lobe; near the beginning of which we may observe a small opening, first described by Winslow, through which the whole pouch may easily be distended with air.* The vessels of the omentum parvum are derived chiefly from the coronary stomachic arteries and veins.

The omentum colicum begins at the fore part of the cœcum and right side of the colon. It appears as a hollow conical appendage to these intestines, and usually terminates at the back of the omentum magnum. It seems to

* This membranous bag, though exceedingly thin and transparent, is found capable of supporting mercury, thrown into it by the same channel.

be nothing more than a membranous coat of the cæcum and colon, assuming a conical shape when distended with air.

The uses of the omentum are not yet satisfactorily determined. Perhaps by its softness and looseness it may serve to prevent those adhesions of the abdominal viscera, which have been found to take place when the fat of the omentum has been much wasted. Some authors have supposed, that it assists in the preparation of bile; but this idea is founded merely on conjecture.

SECT. III. *Of the Stomach.*

THE stomach is a membranous and muscular bag, in shape not unlike a bag-pipe, lying across the upper part of the abdomen, and inclining rather more to the left than the right side.

It has two orifices, one of which receives the end of the œsophagus, and is called the *cardia*, and sometimes the left and upper orifice of the stomach; though its situation is not much higher than the other, which is styled the right and inferior orifice, and more commonly the *pylorus;* both these openings are more elevated than the body of the stomach.

The aliment passes down the œsophagus into the stomach through the cardia, and after having undergone the necessary digestion, passes out at the pylorus where the intestinal canal commences.

The stomach is composed of four tunics or coats, which are so intimately connected together that it requires no little dexterity in the anatomist to demonstrate them. The exterior one is membranous, being derived from the peritonæum.—The second is a muscular tunic, composed of fleshy fibres which are in the greatest number about the two orifices.—The third is called the nervous coat, and within this is the villous or velvet-like coat which composes the inside of the stomach.

The two last coats being more extensive than the two first, form the folds, which are observed every where in the cavity of this viscus, and more particularly about the pylorus; where they seem to impede the too hasty exclusion of the aliment, making a considerable plait, called *valvula pylori*.

The inner coat is constantly moistened by a mucus, which approaches to the nature of the saliva, and is called the gastric juice; this liquor has been supposed to be secreted by certain minute glands* seated in the nervous tunic, whose excretory ducts open on the surface of the villous coat.

The arteries of the stomach called the gastric arteries are principally derived from the cæliac; some of its veins pass to the splenic, and others to the vena portæ; and its nerves are chiefly from the eighth pair or par vagum.

* Heister, speaking of these glands, very properly says, "in *porcis* facile, in *homine* raro observantur;" for although many anatomical writers have described their appearance and figure, yet they do not seem to have been hitherto satisfactorily demonstrated in the human stomach; and the gastric juice is now more generally believed to be derived from the exhalent arteries of the stomach.

The account given of the tunics of the stomach may be applied to the whole alimentary canal; for both the œsophagus and intestines are, like this viscus, composed of four coats.

Before we describe the course of the aliment and the uses of the stomach, it will be necessary to speak of other parts which assist in the process of digestion.

SECT. IV. *Of the Oesophagus.*

THE œsophagus or gullet is a membranous and muscular canal, extending from the bottom of the mouth to the upper orifice of the stomach.—Its upper part where the aliment is received is shaped somewhat like a funnel, and is called the *pharynx*.

From hence it runs down close to the bodies of the vertebræ as far as the diaphragm, in which there is an opening through which it passes, and then terminates in the stomach about the eleventh or twelfth vertebra of the back.

The œsophagus is plentifully supplied with arteries from the external carotid, bronchial, and superior intercostal arteries; its veins empty themselves into the vena azygos, internal jugular, and mammary veins, &c.

Its nerves are derived chiefly from the eighth pair.

We likewise meet with a mucus in the œsophagus, which every where lubricates its inner surface, and tends to assist in deglutition. —This mucus seems to be secreted by very minute glands, like the mucus in other parts of the alimentary canal.

SECT. V. *Of the Intestines.*

THE intestines form a canal, which is usually six times longer than the body to which it belongs. This canal extends from the pylorus, or inferior orifice of the stomach, to the anus.

It will be easily understood, that a part of such great length must necessarily make many circumvolutions, to be confined with so many other viscera within the cavity of the lower belly.

Although the intestines are in fact, as we have observed, only one long and extensive canal, yet different parts have been distinguished by different names.

The intestines are first distinguished into two parts, one of which begins at the stomach, and is called the *thin* or *small intestines*, from the small size of the canal, when compared with the other part, which is called the *large intestines*, and includes the lower portion of the canal down to the anus.

Each of these parts has its subdivisions.—The small intestines being distinguished into duodenum, jejunum, and ilium, and the larger portion into cæcum, colon, and rectum.

The small intestines fill the middle and fore parts of the belly, while the large intestines fill the sides and both the upper and lower parts of the cavity.

The duodenum, which is the first of the small intestines, is so called, because it is about 12 inches long. It begins at the pylorus and terminates in the jejunum, which is a part of the canal observed to be usually more empty than the other intestines.—This appearance gives it its name, and likewise serves to point out where it begins.

The next division is the ilium, which of itself exceeds the united length of the duodenum and jejunum, and has received its name from its numerous circumvolutions. The large circumvolution of the ilium covers the first of the large intestines called the *cæcum*,* which seems properly to belong to the colon, being a kind of pouch of about four fingers in width, and nearly of the same length, having exteriorly a little appendix, called *appendix cæci.*

The cæcum is placed in the cavity of the os ilium on the right side, and terminates in the colon, which is the largest of all the intestines.

This intestine ascends by the right kidney to which it is attached, passes under the hollow part of the liver, and the bottom of the stomach, to the spleen, to which it is likewise secured, as it is also to the left kidney; and from thence passes down towards the os sacrum, where, from its straight course, the canal begins to take the name of *rectum.*

There are three ligamentous bands extending through the whole length of the colon,

* Anatomists have differed with respect to this division of the intestines.—The method here followed is now generally adopted; but there are authors who allow the name of *cæcum* only to the little appendix, which has likewise been called the *vermiform appendix,* from its resemblance to a worm in size and length.

which, by being shorter than its two inner coats, serve to increase the plaits on the inner surface of this gut.

The *anus* which terminates the intestinum rectum, is furnished with three muscles; one of these is composed of circular fibres, and from its use in shutting the passage of the anus is called *sphincter ani.*

The other two are the *levatores ani*, so called, because they elevate the anus after dejection. When these by palsy, or any other disease lose the power of contracting, the anus prolapses; and when the sphincter is affected by similar causes, the fæces are voided involuntarily.

It has been already observed, that the intestinal canal is composed of four tunics; but it remains to be remarked, that here, as in the stomach, the two inner tunics being more extensive than the other two, form the plaits which are to be seen in the inner surface of the intestines, and are called *valvulæ conniventes.*

Some authors have considered these plaits as tending to retard the motion of the fæces, in order to afford more time for the separation of the chyle; but there are others who attribute to them a different use: they contend, that these valves, by being naturally inclined downwards, cannot impede the descent of the fæces, but that they are intended to prevent their return upwards.

They are probably destined for both these uses; for although these folds incline to their lower side, yet the inequalities they occasion in the canal are sufficient to retard, in some measure, the progressive motion of the fæces, and to afford a greater surface for the absorption of chyle, and their natural position seems to oppose itself to the return of the aliment.

Besides these *valvulæ conniventes*, there is one more considerable than the rest, called the *valve of the colon;* which is found at that part of the canal where the intestinum ilium is joined to the colon. This valve permits the alimentary pulp to pass downwards, but serves to prevent its return upwards; and it is by this valve, that glysters are prevented from passing into the small intestines.*

Of the little vermiform appendix of the cæcum, it will be sufficient to say, that its uses have never yet been ascertained. In birds we meet with two of these appendices.

The intestines are lubricated by a constant supply of mucus, which is probably secreted by very minute follicles.† This mucus promotes the descent of the alimentary pulp, and in some measure defends the inner surface of

* This is not invariably the case, for the contents of a glyster have been found not only to reach the small intestines, but to be voided at the mouth. Such instances, however, are not common.

† Some writers have distinguished these glands into miliary, lenticular, &c.—Brunner and Peyer were the first anatomists who described the glands of the intestines, and their descriptions were chiefly taken from animals, these glandular appearances not seeming to have been hitherto satisfactorily pointed out in the human subject.—It is now pretty generally believed, that the mucus which every where lubricates the alimentary canal, is exhaled from the minute ends of arteries; and that these extremities first open into a hollow vesicle, from whence the deposited juice of several branches flows out through one common orifice.

the intestines from the irritation to which it would, perhaps, otherwise be continually exposed from the aliment; and which, when in a certain degree, excites a painful disorder called *colic*, a name given to the disease, because its most usual seat is in the intestinum colon.

The intestines are likewise frequently distended with air, and this distention sometimes occasions pain, and constitutes the flatulent colic.

The arteries of the intestines are continuations of the mesenteric arteries, which are derived in two considerable branches from the aorta.—The redundant blood is carried back into the vena portarum.

In the rectum the veins are called *hemorrhoidal*, and are there distinguished into internal and external: the first are branches of the inferior mesenteric vein, but the latter pass into other veins. Sometimes these veins are distended with blood from obstructions, from weakness of their coats, or from other causes, and what we call the *hæmorrhoids* takes place. In this disease they are sometimes ruptured; and the discharge of blood which consequently follows, has probably occasioned them to be called *hæmorrhoidal veins*.

The nerves of the intestines are derived from the eighth pair.

SECT. VI. *Of the Mesentery.*

THE name of the *mesentery* implies its situtuation amidst the intestines. It is in fact a part of the peritonæum, being a reduplication * of that membrane from each side of the lumbar vertebræ, to which it is firmly attached, so that it is formed of two laminæ, connected to each other by cellular membrane.

The intestines, in their different circumvolutions, form a great number of arches, and the mesentery accompanies them through all these turns; but by being attached only to the hollow part of each arch, it is found to have only a third of the extent of the intestines.

That part of this membrane which accompanies the small intestines is the *mesentery*, properly so called; but those parts of it which are attached to the colon and rectum are distinguished by the names of *meso-colon* and *meso-rectum*.

There are many conglobate glands dispersed through this double membrane, through which the lacteals and lymphatics pass in their way to the thoracic duct. The blood-vessels of the mesentery were described in speaking of the intestines.

* He who only reads of the reduplication of membranes, will perhaps not easily understand how the peritonæum and pleura are reflected over the viscera in their several cavities; for one of these serves the same purposes in the thorax that the other does in the abdomen. This disposition, for the discovery of which we are indebted to modern anatomists, constitutes a curious part of anatomical knowledge: but the student, unaided by experience, and assisted only by what the limits of this work would permit us to say on the occasion, would probably imbibe only confused ideas of the matter; and it will perfectly answer the present purpose, if he considers the mesentery as a membrane attached by one of its sides to the lumbar vertebræ, and by the other to the intestines.

This membrane, by its attachment to the vertebræ, serves to keep the intestines in their natural situation. The idea usually formed of the colic called *miserere*, is perfectly erroneous; it being impossible that the intestines can be twisted, as many suppose they are, in that disease, their attachment to the mesentery effectually preventing such an accident—but a disarrangement sometimes takes place in the intestinal canal itself, which is productive of disagreeable and sometimes fatal consequences.—This is by an introsusception of the intestine, an idea of which may be easily formed, by taking the finger of a glove, and involving one part of it within the other.

If inflammation takes place, the stricture in this case is increased, and the peristaltic motion of the intestines (by which is meant the progressive motion of the fæces downwards) is inverted, and what is called the *iliac passion* takes place. The same effects may be occasioned by a descent of the intestine, or of the omentum either with it or by itself, and thus constituting what is called an *hernial rupture;* a term by which in general is meant the falling down or protrusion of any part of the intestine or omentum, which ought naturally to be contained within the cavity of the belly.

To convey an idea of the manner in which such a descent takes place, it will be necessary to observe, that the lower edge of the tendon of the musculus obliquus externus, is stretched from the fore-part of the os ilium or haunch-bone of the os pubis, and constitutes what is called *Poupart's* or *Fallopius's li-*

gament, forming an opening, through which pass the great crural artery and vein. Near the os pubis the same tendinous fibres are separated from each other, and form an opening on each side, called the *abdominal ring*, through which the spermatic vessels pass in men, and the ligamenta uteri in women. In consequence of violent efforts, or perhaps of natural causes, the intestines are found sometimes to pass through these openings; but the peritonæum which incloses them when in their natural cavity, still continues to surround them even in their descent. This membrane does not become torn or lacerated by the violence, as might be easily imagined; but its dilatibility enables it to pass out with the viscus, which it incloses as it were in a bag, and thus forms what is called the *hernial sac*.

If the hernia be under Poupart's ligament, it is called *femoral;* if in the groin, *inguinal;** and *scrotal*, if in the scrotum. Different names are likewise given to the hernia as the contents of the sac differ, whether of omentum only or intestine, or both:—but these definitions more properly belong to the province of surgery.

Sect. VII. *Of the Pancreas.*

The pancreas is a conglomerate gland placed behind the bottom of the stomach, towards the first vertebra of the loins; shaped

* The hernia congenita will be considered with the male organs of generation, with which it is intimately connected.

like a dog's tongue, with its point stretched out towards the spleen, and its other end extending towards the duodenum. It is about eight fingers breadth in length, two or three in width, and one in thickness.

This viscus, which is of a yellowish colour, somewhat inclined to red, is covered with a membrane which it derives from the peritonæum. Its arteries, which are rather numerous than large, are derived chiefly from the splenic and hepatic, and its veins pass into the veins of the same name.—Its nerves are derived from the intercostal.

The many little glands of which it has been observed the pancreas is composed, all serve to secrete a liquor called the *pancreatic juice*, which in its colour, consistence, and other properties, does not seem to differ from the saliva. Each of these glands sends out a little excretory duct, which, uniting with others, help to form larger ducts; and all these at last terminate in one common excretory duct (first discovered by Virtsungus in 1642), which runs through the middle of the gland, and is now usually called *ductus pancreaticus Virtsungi.* This canal opens into the intestinum duodenum, sometimes by the same orifice with the biliary duct, and sometimes by a distinct opening. The liquor it discharges being of a mild and insipid nature, serves to dilute the alimentary pulp, and to incorporate it more easily with the bile.

Sect. VIII. *Of the Liver.*

The liver is a viscus of considerable size, and of a reddish colour; convex superiorly and anteriorly where it is placed under the ribs and diaphragm, and of an unequal surface posteriorly. It is chiefly situated in the right hypochondrium, and under the false ribs; but it likewise extends into the epigastric region, where it borders upon the stomach. It is covered by a production of the peritonæum, which serves to attach it by three of its reduplications to the false ribs. These reduplications are called *ligaments*, though very different in their texture from what are called by the same name in other parts of the body. The umbilical cord, too, which in the fœtus is pervious, gradually becomes a simple ligament after birth; and, by passing to the liver, serves likewise to secure it in its situation.

At the posterior part of this organ where the umbilical vessels enter, it is found divided into two lobes. Of these, the largest is placed in the right hypochondrium; the other, which covers part of the stomach, is called the *little lobe*. All the vessels which go to the liver pass in at the fissure we have mentioned; and the production of the peritonæum, which invests the liver, was described by Glisson, an English anatomist, as accompanying them in their passage, and surrounding them like a glove; hence this production has been commonly known by the name of *capsula of Glisson:* but it appears to be chiefly a continuation of the cellular membrane which covers the vena portæ ventralis.

The liver was considered by the ancients as an organ destined to prepare and perfect the blood; but later discoveries have proved, that this opinion was wrong, and that the liver is a glandular substance formed for the secretion of the bile.

The blood is conveyed to the liver by the hepatic artery and the vena portæ. This is contrary to the mode of circulation in other parts, where veins only serve to carry off the redundant blood: but in this viscus the hepatic artery, which is derived from the cæliac, is principally destined for its nourishment; and the vena portæ, which is formed by the union of the veins from most of the abdominal viscera, furnishes the blood from which the bile is chiefly to be separated; so that these two series of vessels serve very distinct purposes. The vena portæ, as it is ramified through the liver, performs the office both of a vein and an artery; for like the former it returns the blood from the extremities of arteries, while as the latter it prepares it for secretion.

The nerves of the liver are branches of the intercostal and par vagum. The bile, after being separated from the mass of blood, in a manner of which mention will be made in another place, is conveyed out of this organ by very minute excretory ducts, called *poribiliarii;* these uniting together like the excretory ducts in the pancreas, gradually form larger ones, which at length terminate in a considerable canal called *ductus hepaticus.*

SECT. IX. *Of the Gall-bladder.*

THE gall-bladder is a little membranous bag, shaped like a pear, and attached to the posterior and almost inferior part of the great lobe of the liver.

It has two tunics; of which the exterior one is a production of the peritonæum. The interior, or villous coat, is supplied with a mucus that defends it from the acrimony of the bile. These two coverings are intimately connected by means of cellular membrane, which from its firm glistening appearance has generally been spoken of as a muscular tunic.

The gall-bladder is supplied with blood-vessels from the hepatic arteries. These branches are called the *cystic arteries*, and the cystic veins carry back the blood.

Its nerves are derived from the same origin as those of the liver.

The neck of the gall-bladder is continued in the form of a canal called *ductus cysticus*, which soon unites with the ductus hepaticus we described as the excretory duct of the liver; and forming one common canal, takes the name of *ductus coledochus communis*, through which both the cystic and hepatic bile are discharged into the duodenum. This canal opens into the intestine in an oblique direction, first passing through the exterior tunic, and then piercing the other coats after running between each of them a very little way. This œconomy serves two useful purposes;—to promote the discharge of bile and to prevent its return.

The bile may be defined to be a natural liquid soap, somewhat unctuous and bitter, and of a yellowish colour, which easily mixes with water, oil, and vinous spirits, and is capable of dissolving resinous substances. From some late experiments made by M. Cadet,* it appears to be formed of an animal oil, combined with the alkaline base of sea-salt, a salt of the nature of milk, and a calcareous earth which is slightly ferruginous.

Its definition seems sufficiently to point out the uses for which it is intended.† It blends the alimentary mass, by dividing and attenuating it; corrects the too great disposition to acescency, which the aliment acquires in the stomach; and finally, by its acrimony, tends to excite the peristaltic motion of the intestines.

After what has been said, it will be conceived that there are two sorts of bile; one of which is derived immediately from the liver through the hepatic duct, and the other from the gall-bladder. These two biles, however, do not essentially differ from each other. The hepatic bile indeed is milder, and more liquid than the cystic, which is constantly thicker and yellower; and by being bitterer, seems to possess greater activity than the other.

Every body knows the source of the hepatic bile, that it is secreted from the mass of blood by the liver; but the origin of the cystic bile

* Mem. de l' Acad. des Sciences, 1767.

† The ancients, who were not acquainted with the real use of the liver, considered the bile as an excrementitious and useless fluid.

has occasioned no little controversy amongst anatomical writers. There are some who contend, that it is separated in the substance of the liver, from whence it passes into the gall-bladder through particular vessels. In deer, and in some other quadrupeds, as well as in several birds and fishes, there is an evident communication, by means of particular vessels, between the liver and the gall-bladder. Bianchi, Winslow, and others, have asserted the existence of such vessels in the human subject, and named them *hepaticystic ducts;* but it is certain that no such ducts exist.—In obstructions of the cystic duct, the gall-bladder has been found shrivelled and empty: so that we may consider the gall-bladder as a reservoir of hepatic bile; and that it is an established fact that the whole of the bile contained in the gall-bladder is derived from the liver; that it passes from the hepatic to the cystic duct, and from that to the gall-bladder. The difference in the colour, consistence, and taste of the bile, is merely the consequence of stagnation and absorption. When the stomach is distended with aliment, this reservoir undergoes a certain degree of compression, and the bile passes out into the intestinal canal; and in the efforts to vomit, the gall-bladder seems to be constantly affected, and at such times discharges itself of its contents.

Sometimes the bile concretes in the gall-bladder, so as to form what are called *gall-*

*stones.** When these concretions pass into the cystic duct, they sometimes occasion exquisite pain, by distending the canal in their way to the duodenum; and by lodging in the ductus choledochus communis, and obstructing the course of the bile, this fluid will be absorbed, and by being carried back into the circulation occasion a temporary jaundice.

SECT. X. *Of the Spleen.*

THE spleen is a soft and spongy viscus, of a bluish colour, and about five or six fingers breadth in length, and three in width, situated in the left hypochondrium, between the stomach and the false ribs. That side of it which is placed on the side of the ribs is convex; and the other, which is turned toward the stomach, is concave.

The splenic artery, which is a branch from the cæliac, supplies this viscus with blood, and a vein of the same name carries it back into the vena portæ.

Its nerves are derived from a particular plexus called the *splenic*, which is formed by branches of the intercostal nerve, and by the eighth pair, or par vagum.

The ancients, who supposed two sorts of bile, considered the spleen as the receptacle of what they called *atra bilis*. Havers, who

* These concretions sometimes remain in the gall-bladder without causing any uneasiness. Dr. Heberden relates, that a gall-stone weighing two drams was found in the gall-bladder of the late Lord Bath, though he had never complained of the jaundice, nor of any disorder which he could attribute to that cause. *Med. Trans.* Vol. ii.

wrote professedly on the bones, determined its use to be that of secreting the synovia; and the late Mr. Hewson imagined, that it concurred with the thymus and lymphatic glands of the body in forming the red globules of the blood. All these opinions seem to be equally fanciful. The want of an excretory duct has occasioned the real use of this viscus to be still doubtful. Perhaps the blood undergoes some change in it, which may assist in the preparation of the bile. This is the opinion of the generality of modern physiologists; and the great quantity of blood with which it is supplied, together with the course of its veins into the vena portæ, seem to render this notion probable.

Sect. XI. *Of the Glandulæ Renales, Kidneys, and Ureters.*

The glandulæ renales, which were by the ancients supposed to secrete the atra bilis, and by them named *capsulæ atrabilares*, are two flat bodies of an irregular figure, one on each side between the kidney and the aorta.

In the fœtus they are as large as the kidneys: but they do not increase afterwards in proportion to those parts; and in adults and old people they are generally found shrivelled, and much wasted. They have their arteries and veins. Their arteries usually arise from the splenic or the emulgent, and sometimes from the aorta; and their veins go to the neighbouring veins, or to the vena cava. Their nerves are branches of the intercostal.

The use of these parts is not yet perfectly known. In the fœtus the secretion of urine must be in a very small quantity, and a part of the blood may perhaps then pass through these channels, which in the adult is carried to the kidneys to supply the matter of urine.

The kidneys are two in number, situated one on the right and the other on the left side in the lumbar region, between the last false rib and the os ilium, by the sides of the vertebræ. Each kidney in its figure resembles a sort of bean, which from its shape is called *kidney-bean*. The concave part of each kidney is turned towards the aorta and vena cava ascendens. They are surrounded by a good deal of fat, and receive a coat from the peritonæum; and when this is removed, a very fine membrane is found investing their substance and the vessels which ramify through them.

Each kidney has a considerable artery and vein, which are called the *emulgent*. The artery is a branch from the aorta, and the vein passes into the vena cava. Their nerves, which every where accompany the blood-vessels, arise from a considerable plexus, which is derived from the intercostal.

In each kidney, which in the adult is of a pretty firm texture, there are three substances to be distinguished.* The outer part is glandular or cortical, beyond this is the vascular

* The kidneys in the fœtus are distinctly lobulated; but in the adult they become perfectly firm, smooth, and regular.

or tubular substance, and the inner part is papillary or membranous.

It is in the cortical part of the kidney that the secretion is carried on; the urine being here received from the minute extremities of the capillary arteries, is conveyed out of this cortical substance by an infinite number of very small cylindrical canals or excretory vessels, which constitute the tubular part. These tubes, as they approach the inner substance of the kidney gradually unite together; and thus forming larger canals, at length terminate in ten or twelve little protuberances called *papillæ*, the orifices of which may be seen without the assistance of glasses. These papillæ open into a small cavity or reservoir called the *pelvis of the kidney*, and formed by a distinct membranous bag which embraces the papillæ. From this pelvis the urine is conveyed through a membranous canal which passes out from the hollow side of the kidney, a little below the blood-vessels, and is called *ureter*.

The ureters are each about as large as a common writing-pen. They are somewhat curved in their course from the kidneys, like the letter *ſ*, and at length terminate in the posterior and almost inferior part of the bladder, at some distance from each other. They pass into the bladder in the same manner as the ductus choledochus communis passes into the intestinum duodenum, not by a direct passage, but by an oblique course between the two coats; so that the discharge of urine into the bladder is promoted, whilst its return is prevented. Nor does this mode of structure prevent the passage of fluids only from the bladder into the ureters, but likewise air:—for air thrown into the bladder inflates it, and it continues to be distended if a ligature is passed round its neck; which seems to prove sufficiently that it cannot pass into the ureters.

Sect. XII. *Of the Urinary Bladder.*

The urinary bladder is a membranous and muscular bag of an oblong roundish shape, situated in the pelvis, between the os pubis and intestinum rectum in men, and between the os pubis and uterus in women. Its upper and widest part is usually called the *bottom*, its narrow part the *neck* of the bladder; the former only is covered by the peritonæum.

The bladder is formed of three coats, connected together by means of cellular membrane. The external or peritonæal, is only a partial one, covering the upper and back part of the bladder. The middle, or muscular coat, is composed of irritable, and of course muscular fibres, which are most collected around the neck of the bladder, but not so as to form a distinct muscle, or sphincter, as the generality of anatomists have hitherto supposed.

The inner coat, though much smoother, has been said to resemble the villous tunic of the intestines, and like that is provided with a mucus, which defends it against the acrimony of the urine.

It will be easily conceived from what has been said, that the kidneys are two glandular bodies, through which a saline and excrementitious fluid called *urine* is constantly filtering from the mass of blood.

While only a small quantity of urine is collected in the bladder, it excites no kind of uneasiness; but when a greater quantity is accumulated, so that the bladder is distended in a certain degree, it excites in us a certain sensation, which brings on as it were a voluntary contraction of the bladder to promote its discharge.—But this contraction is not effected by the muscular fibres of the bladder alone: for all the abdominal muscles contract in obedience to our will, and press downwards all the viscera of the lower belly; and these powers being united, at length overcome the resistance of the fibres surrounding the neck of the bladder, which dilates and affords a passage to the urine through the urethra.

The frequency of this evacuation depends on the quantity of urine secreted; on the degree of acrimony it possesses; on the size of the bladder, and on its degree of sensibility.

The urine varies much in its colour and contents. These varieties depend, on age, sex, climate, diet, and other circumstances. In infants it is generally a clear watery fluid, without smell or taste. As we advance in life, it acquires more colour and smell, and becomes more impregnated with salts. In old people it becomes still more acrid and fetid.

In a healthy state it is nearly of a straw colour.—After being kept for some time, it deposites a tartarous matter, which is found to be composed chiefly of earth and salt, and soon incrusts the sides of the vessel in which it is contained. While this separation is taking place, appearances like minute fibres or threads of a whitish colour may be seen in the middle of the urine, and an oily scum observed floating on its surface. So that the most common appearances of the urine are sufficient to ascertain that it is a watery substance, impregnated with earthy, saline, and oily particles.

The urine is not always voided of the same colour and consistence: for these are found to depend on the proportion of its watery part to that of its other constituent principles.—Its colour and degree of fluidity seem to depend on the quantity of saline and inflammable particles contained in it: so that an increased proportion of those parts will constantly give the urine a higher colour, and add to the quantity of sediment.

The variety in the appearance of the urine, depends on the nature and quantity of solid and fluid aliment we take in; and it is likewise occasioned by the different state of the urinary vessels, by which we mean the channels through which it is separated from the blood, and conveyed through the pelvis into the ureters. The causes of calculous concretions in the urinary passages, are to be looked for in the natural constitution of the body, mode of life, &c.

It having been observed, that after drinking any light wine or Spa water, it very soon passed off by urine, it has been supposed by some, that the urine is not altogether conveyed to the bladder by the ordinary course of circulation, but that there must certainly exist some other shorter means of communication, perhaps by certain vessels between the stomach and the bladder, or by a retrograde motion in the lymphatics. But it is certain, that if we open the belly of a dog, press out the urine from the bladder, pass a ligature round the emulgent arteries, and then sew up the abdomen, and give him even the most diuretic liquor to drink, the stomach and other channels will be distended with it, but not a drop of urine will be found to have passed into the bladder; or the same thing happens when a ligature is thrown round the two ureters. This experiment then seems to be a sufficient proof, that all the urine we evacuate, is conveyed to the kidneys through the emulgent arteries, in the manner we have described.—It is true, that wine and other liquors promote a speedy evacuation of urine: but the discharge seems to be merely the effect of the stimulus they occasion; by which the bladder and urinary parts are solicited to a more copious discharge of the urine, which was before in the body, and not immediately of that which was last drank; and this increased discharge, if the supply is kept up, will continue: nor will this appear wonderful, if we consider the great capacity of the vessels that go to the kidneys; the constant supply of fresh blood that is essential to health; and the rapidity with which it is incessantly circulated through the heart to all parts of the body.

Sect. XIII. *Of Digestion.*

We are now proceeding to speak of *digestion*, which seems to be introduced in this place with propriety, after a description of the abdominal viscera, the greater part of which contribute to this function. By *digestion* is to be understood, the changes the aliment undergoes for the formation of chyle:—these changes are effected in the mouth, stomach, and small intestines.

The mouth, of which every body has a general knowledge, is the cavity between the two jaws, formed anteriorly and laterally by the lips, teeth, and cheeks, and terminating posteriorly in the throat.

The lips and cheeks are made up of fat and muscles, covered by the cuticle, which is continued over the whole inner surface of the mouth, like a fine and delicate membrane.—Besides this membrane, the inside of the mouth is furnished with a spongy and very vascular substance called the *gums*, by means of which the teeth are secured in their sockets. A similar substance covers the roof of the mouth, and forms what is called the *velum pendulum palati*, which is fixed to the extremity of the arch formed by the ossa maxillaria and ossa palati, and terminates in a soft, small, and conical body, named *uvula;* which appears, as it were, suspended from the middle of the arch over the basis of the tongue.

The velum pendulum palati performs the office of a valve between the cavity of the mouth and the pharynx, being moved by several muscles.*

The tongue is composed of several muscles† which enable it to perform a variety of motions for the articulation of the voice; for the purposes of mastication; and for conveying the aliment into the pharynx. Its upper part is covered with papillæ, which constitute the organ of taste, and are easily to be distinguished; it is covered by the same membrane that lines the inside of the mouth, and which makes at its inferior part towards its basis a reduplication called *frænum.*

Posteriorly, under the velum palati, and at the basis of the tongue, is the pharynx: which is the beginning of the œsophagus, stretched out every way, so as to resemble the top of a funnel, through which the aliment passes into the stomach.

The mouth has a communication with the nostrils at its posterior and upper part: with the ears, by the Eustachian tubes; with the lungs, by means of the larynx; and with the stomach, by means of the œsophagus.

The pharynx is constantly moistened by a fluid, secreted by two considerable glands called the *tonsils*, one on each side of the velum palati. These glands, from their supposed re-

* These are the circumflexus palati, levator palati mollis, palato-pharyngæus, constrictor isthmi faucium and azygos uvulæ. See pages 191, 192, 193.

† These are, the genio-glossus, hyo-glossus, lingualis, and stylo-glossus. See page 191.

semblance to almonds, have likewise been called *amygdalus*.

The mouth is moistened by a considerable quantity of saliva. This fluid is derived from the *parotid glands ;* a name which by its etymology points out their situation to be near the ears. They are two in number, one on each side under the os malæ : and they are of the conglomerate kind; being formed of many smaller glands, each of which sends out a very small excretory duct, which unites with the rest, to form one common channel, that runs over the cheek, and piercing the buccinator muscle, opens into the mouth on each side, by an orifice into which a bristle may be easily introduced.—Besides these, the maxillary glands, which are placed near the inner surface of the angle of the lower jaw on each side ; the sublingual glands, which are situated at the root of the tongue ; the glands of the palate, which are seated in the velum palati ; and those of the cheeks, lips, &c. together with many other less considerable ones,—pour the saliva into the mouth through their several excretory ducts.

The saliva, like all the other humors of the body, is found to be different in different people: but in general, it is a limpid and insipid fluid, without smell in healthy subjects ; and these properties would seem to prove that it contains very few saline or inflammable particles.

The uses of the saliva seem to be to moisten and lubricate the mouth, and to assist in reducing the aliment into a soft pulp before it is conveyed into the stomach.

The variety of functions which are constantly performed by the living body, must necessarily occasion a continual waste and dissipation of its several parts. A great quantity is every day thrown off by the insensible perspiration and other discharges; and were not these losses constantly recruited by a fresh supply of chyle, the body would soon effect its own dissolution. But nature has very wisely favoured us with organs fitted to produce such a supply; and has at the same time endued us with the sensations of hunger and thirst, that our attention may not be diverted from the necessary business of nutrition. The sensation of hunger is universally known; but it would perhaps be difficult to describe it perfectly in words. It may, however, be defined to be a certain uneasy sensation in the stomach, which induces us to wish for solid food; and which likewise serves to point out the proper quantity, and time for taking it. In describing the stomach, mention was made of the gastric juice, as every where lubricating its inner coat. This humor mixes itself with the aliment in the stomach, and helps to prepare it for its passage into the intestines; but when the stomach is perfectly empty, this same fluid irritates the coats of the stomach itself, and produces the sensation of hunger.

A certain proportion of liquid aliment is required to assist in the process of digestion, and to afford that moisture to the body, of which there is such a constant dissipation.—Thirst induces us to take this necessary supply of drink; and the seat of this sensation is in the tongue, fauces, and œsophagus, which from their great sensibility are required to be kept moist: for though the fauces are naturally moistened by the mucus and salival juices; yet the blood, when deprived of its watery part or rendered acrimonious by any natural causes, never fails particularly to affect these parts, and the whole alimentary canal, and to occasion thirst.—This is the common effect of fevers and of hard labour, by both which too much of the watery part of the blood is dissipated.

It has been observed, that the aliment undergoes some preparation in the mouth before it passes into the stomach; and this preparation is the effect of mastication. In treating of the upper and lower jaws, mention was made of the number and arrangement of the teeth. The upper jaw was described as being immoveable; but the lower jaw was spoken of as being capable of elevation and depression, and of a grinding motion. The aliment, when first carried into the mouth, is pressed between the teeth of the two jaws by a very strong and frequent motion of the lower jaw; and the tongue and the cheeks assisting in this process, continue to replace the food between the teeth till it is perfectly divided, and reduced to the consistence of pulp. The incisores and canini divide it first into smaller pieces, but it is between the surfaces of the dentes molares by the grinding motion of the jaw that the mastication is completed.

During this process the salival glands being gently compressed by the contraction of the muscles that move the lower jaw, pour out their saliva: this helps to divide and break down the food, which at length becomes a kind of pulp, and is then carried over the basis of the tongue into the fauces. But to effect this passage into the œsophagus, it is necessary that the other openings which were mentioned as having a communication with the mouth as well as the pharynx, should be closed; that none of the aliment, whether solid or liquid, may pass into them, whilst the pharynx alone is dilated to receive it:—And such a disposition actually takes place in a manner we will endeavour to describe.

The trachea arteria, or windpipe, through which the air is conveyed to the lungs, is placed before the œsophagus—in the act of swallowing; therefore, if the *larynx* (for so the upper part of the trachea is called) is not closed, the aliment will pass into it in its way to the œsophagus. But this is prevented by a small and very elastic cartilage, called *epiglottis*, which is attached only to the fore-part of the larynx; so that the food in its passage to the œsophagus presses down this cartilage, which then covers the glottis or opening of the larynx; and at the same time the velum palati being capable of some degree of motion, is drawn backwards by its muscles, and closes the openings into the nose and the Eustachian tubes.—This, however, is not all. The larynx, which being composed of cartilaginous rings, cannot fail in its ordinary state to compress the membranous canal of the œsophagus, is in the act of deglution carried forwards and upwards by muscles destined for that purpose; and consequently drawing the fore-part of the pharynx with it, that opening is fully dilated. When the aliment has reached the pharynx, its descent is promoted by its own proper weight, and by the muscular fibres of the œsophagus, which continue to contract from above downwards, until the aliment has reached the stomach. That these fibres have no inconsiderable share in deglutition, any person may experience, by swallowing with his head downwards, when the descent of the aliment cannot possibly be effected by its weight.

It is necessary that the nostrils and the lungs should communicate with the mouth, for the purposes of speech and respiration: but if the most minute part of our food happens to be introduced into the trachea, it never fails to produce a violent cough, and sometimes the most alarming symptoms. This is liable to happen when we laugh or speak in the act of deglutition: the food is then said to have passed the wrong way. And indeed this is not improperly expressed: for death would soon follow, if the quantity of aliment introduced into the trachea should be sufficient to obstruct the respiration only during a very short time; or if the irritating particles of food should not soon be thrown up again by means of the cough, which in these cases very seasonably increases in proportion to the degree of irritation.

If the velum palati did not close the passage to the nostrils, deglutition would be performed with difficulty, and perhaps not at all; for the aliment would return through the nose, as is sometimes the case in drinking. Children, from a deficiency in this velum palati, have been seen to die a ſew hours after birth; and they who from disease or any other causes have not this part perfect, swallow with difficulty.

The aliment, after having been sufficiently divided by the action of the teeth, and attenuated by the saliva, is received into the stomach, where it is destined to undergo a more considerable change.

The properties of the aliment not being much altered at its first entrance into the stomach, and before it is thoroughly blended with the gastric juice, is capable of irritating the inner coat of the stomach to a certain degree, and occasions a contraction of its two orifices.—In this membranous bag, surrounded by the abdominal viscera, and with a certain degree of natural heat, the aliment undergoes a constant agitation by means of the abdominal muscles and of the diaphragm, and likewise by a certain contraction or expansion of the muscular fibres of the stomach itself. By this motion, every part of the food is exposed to the action of the gastric juice, which gradually divides and attenuates it, and prepares it for its passage into the intestines.

Some observations lately published by Mr. Hunter in the Philosophical Transactions, tend to throw considerable light on the principles of digestion. There are few dead bodies in which the stomach, at its great end, is not found to, be in some degree digested *. Animals, or parts of animals, possessed of the living principle, when taken into the stomach, are not in the least affected by the action of that viscus; but the moment they lose the living principle, they become subject to its digestive powers. This seems to be the case with the stomach, which is enabled to resist the action of its juices in the living body: but when deprived of the living principle, it is then no longer able to resist the powers of that menstruum, which it had itself formed for the digestion of its contents; the process of digestion appearing to be continued after death. This is confirmed by what happens in the stomachs of fishes: they frequently swallow, without mastication, fish which are larger than the digesting parts of their stomach can contain; and in such cases, that part which is taken into the stomach is more

* The Abbé Spallanzani, who has lately written upon digestion, finds, from a variety of experiments, made upon quadrupeds, birds, and fishes, that digestion goes on for some time after death, though far less considerable than in living animals; but heat is necessary in many animals, or at least promotes it in a much greater degree. He found also, that when the stomach was cut out of the body, it had somewhat of the power of digestion, though this was trifling when compared with that which took place when the stomach was left in the body. In not one of the animals was the great curvature of the stomach dissolved, or much eroded after death. There was often a little erosion, especially in different fishes; in which, when he had cleared the stomach of its contents, the internal coat was wanting. In other animals there was only a slight excoriation; and the injury in all of them was at the inferior part, or great curvature. The coats of the stomach suffer less after death than flesh, or part of the stomach of similar animals put into it: the author assigns as a reason for this, that these bodies are invested on all sides by the gastric fluid, whereas it only acts on the internal surface of the stomach.

or less dissolved, while that part which remains in the œsophagus is perfectly sound; and here, as well as in the human body, the digesting part of the stomach is often reduced to the same state as the digested part of the food. These appearances tend to prove, that digestion is not effected by a mechanical power, by contractions of the stomach, or by heat; but by a fluid secreted in the coats of the stomach, which is poured into its cavity, and there animalizes the food, or assimilates it to the nature of blood.

From some late experiments by M. Sage, * it appears, that inflammable air has the property of destroying and dissolving the animal texture: and as we swallow with the substances which serve us for food a great quantity of atmospherical air, M. Sage thinks it possible, that dephlogisticated, which is its principle, may be converted in the stomach into inflammable air, or may modify into inflammable air a portion of the oily substance which is the principle of aliments. In this case, would not the inflammable air (he asks), by dissolving our food, facilitate its conversion into chyle?

Be this as it may, the food after having remained one, two, or three hours in the stomach, is converted into a greyish pulp, which is usually called *chymus*, a word of Greek etymology, signifying *juice*, and some few milky or chylous particles begin to appear.—But the

* Hist. de l'Academie royale des Sciences, &c. pour 1784. mem. 15.

term of its residence in this bag is proportioned to the nature of the aliment, and to the state of the stomach and its juices. The thinner and more perfectly digested parts of the food pass by a little at a time into the duodenum, through the pylorus, the fibres of which relax to afford it a passage; and the grosser and less digested particles remain in the stomach, till they acquire a sufficient fluidity to pass into the intestines, where the nature of the *chymus* is perfectly changed. The bile and pancreatic juice which flow into the duodenum, and the mucus, which is every where distilled from the surface of the intestines, mix themselves with the alimentary pulp, which they still farther attenuate and dissolve, and into which they seem to infuse new properties.

Two matters very different from each other in their nature and destination, are the result of this combination.—One of these, which is composed of the liquid parts of the aliment, and of some of its more solid particles, extremely divided and mixed with the juices we have described, constitutes a very mild, sweet, and whitish fluid, resembling milk, and distinguished by the name of *chyle*. This fluid is absorbed by the lacteal veins, which convey it into the circulation, where, by being assimilated into the nature of blood, it affords that supply of nutrition, which the continual waste of the body is found to require.—The other is the remains of the alimentary mass deprived of all its nutritious particles, and containing only such parts as were rejected by the absorbing mouths of the lacteals. This grosser part, called the *fæces*, passes on through the course of the intestines, to be voided at the anus, as will be explained hereafter; for this process in the œconomy cannot be well understood till the motion of respiration has been explained. But the structure of the intestines is a subject which may be properly described in this place, and deserves to be attended to.

It has been already observed, that the intestinal canal is five or six times as long as the body, and that it forms many circumvolutions in the cavity of the abdomen, which it traverses from the right to the left, and again from the left to the right; in one place descending, and in another extending itself upwards. It was noticed likewise, that the inner coat of the intestines, by being more capacious than their exterior tunics, formed a multitude of plates placed at a certain distance from each other, and called *valvulæ conniventes.* Now this disposition will be found to afford a farther proof of that divine wisdom, which the anatomist and physiologist cannot fail to discover in all their pursuits.—For if the intestinal canal was much shorter than it naturally is; if instead of the present circumvolutions it passed in a direct course from the stomach; and if its inner surface was smooth and destitute of valves; the aliment would consequently pass with great rapidity to the anus, and sufficient time would be wanting to assimilate the chyle, and for the necessary absorption of it into the lacteals: so that the body would be deprived of the supply of nutrition, which is so essential to life and health; but the length and circumvolutions of the intestines, the inequality of their internal surface, and the course of the aliment through them, all concur to perfect the separation of the chyle from the fæces, and to afford the necessary nourishment to the body.

SECT. XIV. *Of the Course of the Chyle, and of the Lymphatic System.*

AN infinite number of very minute vessels, called the *lacteal veins*, arise like net-work from the inner surface of the intestines, (but principally from the *jejunum* and *ilium*), which are distended to imbibe the nutritious fluid or chyle. These vessels, which were discovered by Asellius in 1622, * pass obliquely through the coats of the intestine, and running along the mesentery, unite as they advance, and form larger branches, all of which pass through the mesenteric or conglobate glands, which are very numerous in the human subject. As they

* We are informed by Galen, that the lacteals had been seen in kids by Erasistratus, who considered them as arteries carrying a milky fluid : but from the remote time in which he lived, they do not seem to have been noticed till they were discovered in a living dog by Asellius, who denominated them *lacteals*, and considered them as serving to convey the chyle from the intestines to the liver ; for before the discovery of the thoracic duct, the use of the liver was universally supposed to be that of converting the chyle into blood. But the discovery of the thoracic duct by Pecquet, not long after, corrected this error. Pecquet very candidly confesses, that this discovery accidentally arose from his observing a white fluid, mixed with the blood, flowing out of the vena cava, after he had cut off the heart of a living dog ; which he suspected to be chyle, and afterwards traced to its source from the thoracic duct : this duct had been seen near an hundred years before in a horse by Eustachius, who speaks of it as a vein of a particular structure, but without knowing any thing of its termination or use.

run between the intestines and these glands, they are styled *venæ lacteæ primi generis:* but after leaving these glands, they are found to be less numerous, and being increased in size, are then called *venæ lacteæ secundi generis*, which go to deposite their contents in the *thoracic duct*, through which the chyle is conveyed into the blood.

This *thoracic duct* begins about the lower part of the first vertebra lumborum, from whence it passes up by the side of the aorta, between that and the vena azygos, close to the vertebræ, being covered by the pleura. Sometimes it is found divided into two branches; but they usually unite again into one canal, which opens into the left subclavian vein, after having run a little way in an oblique course between its coats. The subclavian vein communicates with the vena cava, which passes to the right auricle of the heart.

The lower part of this duct being usually larger than any other part of it, has been named *receptaculum chyli*, or *Pecquet's receptacle* in honour of the anatomist who first discovered it in 1651. In some quadrupeds, in turtle and in fish, this enlargement * is more considerable in proportion to the size of the duct, than it usually is in the human subject, where it is not commonly found large enough to merit the name of *receptaculum*.

Opportunities of observing the lacteals in the human subject do not often occur; but they may be easily demonstrated in a dog or

* Hewson's Exp. Inq. Part II.

any other quadruped that is killed two or three hours after feeding upon milk, for then they appear filled with white chyle.

But these *lacteals* which we have described, as passing from the intestines through the mesentery to the thoracic duct, compose only a part of a system of vessels which perform the office of *absorption*, and which constitute, with their common trunk the thoracic duct, and the conglobate glands that are dispersed through the body, what may be styled the *lymphatic system.* So that what is said of the structure of one of these series of vessels may very properly be applied to that of the other.

The *lymphatic veins** are minute pellucid tubes, which, like the lacteals, direct their course towards the centre of the body, where they pour a colourless fluid into the thoracic duct. The lymphatics from all the lower parts of the body gradually unite as they approach this duct, into which they enter by three or four very large trunks, that seem to form the lower extremity of this canal, or *receptaculum*

* The arteries in their course through the body becoming gradually too minute to admit the red globules of the blood, have then been styled *capillary* or *lymphatic arteries.* The vessels which are here described as constituting the lymphatic system, were at first supposed to be continued from those arteries, and to convey back the lymph, either into the red veins or the thoracic duct; the office of absorption having been attributed to the *red veins.* But we know that the *lymphatic veins* are not continuations of the *lymphatic arteries*, but that they constitute the *absorbent system.* There are still, however, some very respectable names among the anatomists of the present age, who contend, that the red veins act likewise as absorbents:—but it seems to have been clearly proved, that the red veins do absorb nowhere but in the cavernous cells of the penis, the erection of which is occasioned by a distention of those cells with arterial blood.

chyli, which may be considered as the great trunk of the lymphatic system. The lacteals open into it near the same place; and the lymphatics, from a large share of the upper parts of the body, pour their lymph into different parts of this duct as it runs upwards, to terminate in the left subclavian vein. The lymphatics from the right side of the neck, thorax, and right arm, &c. terminate in the right subclavian vein.

As the lymphatics commonly lie close to the large blood-vessels, a ligature passed round the crural artery in a living animal, by including the lymphatics, will occasion a distention of these vessels below the ligature, so as to demonstrate them with ease; and a ligature passed round the thoracic duct, instantly after killing an animal, will, by stopping the course of its contents into the subclavian vein, distend not only the lacteals, but also the lymphatics in the abdomen and lower extremities, with their natural fluids. *

The coats of these vessels are too thin to be separated from each other; but the mercury they are capable of sustaining, proves them to be very strong; and their great power of contraction, after undergoing considerable distention, together with the irritability with which Baron Haller found them to be endued†, seems

* In the dead body they may be easily demonstrated by opening the artery ramifying through any viscus, as in the spleen, for instance, and then throwing in air; by which the lymphatics will be distended. One of them may then be punctured, and mercury introduced into it through a blow-pipe.

† Sur le movement du sang Ex. 295, 298.

to render it probable, that, like the blood-vessels, they have a muscular coat.

The lymphatics are nourished after the same manner as all the other parts of the body. For even the most minute of these vessels are probably supplied with still more minute arteries and veins. This seems to be proved by the inflammation of which they are susceptible; and the painful swellings which sometimes take place in lymphatic vessels, prove that they have nerves as well as blood-vessels.

Both the lacteals, lymphatics, and thoracic duct, are furnished with valves, which are much more common in these vessels than in the red veins. These valves are usually in pairs, and serve to promote the course of the chyle and lymph towards the thoracic duct, and to prevent its return. Mention has been made of the glands, through which the lacteals pass in their course through the mesentery; and it is to be observed, that the lymphatics pass through similar glands in their way to the thoracic duct. These glands are all of a conglobate kind, but the changes which the chyle and lymph undergo in their passage through them, have not yet been ascertained.

The *lymphatic vessels* begin from surfaces and cavities in all parts of the body as *absorbents*. This is a fact now universally allowed; but how the fluids they absorb are poured into those cavities, is a subject of controversy. The contents of the abdomen, for instance, were described as being constantly moistened by a very thin watery fluid. The same thing takes place in the pericardium, pleura, and all the other cavities of the body, and this watery fluid is the *lymph*. But whether it is exhaled into those cavities through the minute ends of arteries, or transuded through their coats, are the points in dispute. We cannot here be permitted to relate the many ingenious arguments that have been advanced in favour of each of these opinions; nor is it perhaps of consequence to our present purpose to enter into the dispute. It will be sufficient if the reader can form an idea of what the lymph is, and of the manner in which it is absorbed.

The *lymph*, from its transparency and want of colour, would seem to be nothing but water; and hence the first discoverers of these vessels styled them *ductus aquosi*: but experiments prove, that the lymph of an healthy animal coagulates by being exposed to the air, or a certain degree of heat, and likewise by being suffered to rest; seeming to agree in this property with that part of the blood called the *coagulable lymph*.—This property of the lymph leads to determine its use, in moistening and lubricating the several cavities of the body in which it is found; and for which, by its gelatinous principle, it seems to be much better calculated than a pure and watery fluid would be, for such it has been supposed to be by some anatomists.

The mouths of the *lymphatics* and *lacteals*, by acting as capillary tubes, seem to absorb the *lymph* and *chyle* somewhat in the same manner as a capillary tube of glass, when put into a bason of water, is enabled to attract the water into it to a certain height; but it is probable that they likewise possess a living power, which assists in performing this office. In the human body the *lymph*, or the *chyle*, is probably conveyed upon this principle as far as the first pair of valves, which seem to be placed not far from the orifice of the absorbing vessel, whether *lymphatic* or *lacteal;* and the fluid will then be propelled forwards, by a continuation of the absorption at the orifice. But this does not seem to be the only inducement to its progress towards the thoracic duct; these vessels have probably a muscular coat, which may serve to press the fluid forwards from one pair of valves to another; and as the large lymphatic vessels and the thoracic duct are placed close to the large arteries, which have a considerable pulsation, it is reasonable to suppose, that they derive some advantages from this situation.

Sect. XV. *Of the Generative Organs; of Conception*, &c.

§. 1. *The Male Organs.*

The male organs of generation have been usually divided into the parts which serve to prepare the semen from the blood, and those which are distended to convey it into the womb. But it seems to be more proper to distinguish them into the *preparing*, the *containing*, and the *expelling* parts, which are the different offices of the *testes*, the *vesiculæ seminales*, and the *penis;* and this is the order in which we propose to describe them.

The testes are two glandular bodies, serving to secrete the semen from the blood. They are originally formed and lodged within the cavity of the abdomen; and it is not till after the child is born, or very near that time, that they begin to pass into the groin, and from thence into the scrotum.* By this disposition they are very wisely protected from the injuries to which they would be liable to be exposed, from the different positions of the child at the time of parturition.

The testicles in this state are loosely attached to the psoæ muscles, by means of the peritonæum by which they are covered; and they are at this time of life connected in a very particular manner to the parietes of the abdomen, and likewise to the scrotum, by means of a substance which Mr. Hunter calls the *ligament* or *gubernaculum testis*, because it connects the testis with the scrotum, and directs its course in its descent. This guber-

* It sometimes happens in dissecting ruptures, that the intestine is found in the same sac, and in contact with the testis. This appearance was at first attributed to a supposed laceration of the peritonæum; but later observations, by pointing out the situation of the testicles in the fœtus, have led to prove, that the testis, as it descends into the scrotum, carries with it a portion or elongation of the peritonæum, which becomes its tunica vaginalis, or a kind of sac, in which the testicle is lodged, as will be explained in the course of this section. The communication between this sac and the cavity of the abdomen, is usually soon cut off; but in some subjects it continues open during life; and when an hernia or descent of the intestine takes place in such a subject, it does not push down a portion of the peritonæum before it, as it must otherwise necessarily do, but passes at once through this opening, and comes in contact with the naked testicle, constituting that particular species of rupture called *hernia congenita.*

naculum is of a pyramidal form, with its bulbous head fixed to the lower end of the testis and epididymis, and loses its lower and slender extremity in the cellular membrane of the scrotum. It is difficult to ascertain what the structure and composition of this gubernaculum is, but it is certainly vascular and fibrous; and, from certain circumstances, it would seem to be in part composed of the cremaster muscle, running upwards to join the lower end of the testis.

We are not to suppose that the testicle, when descended into the scrotum, is to be seen loose as a piece of gut or omentum would be in a common hernial sac. We have already observed, that during its residence in the cavity of the abdomen it is attached to the peritonæum, which descends with it; so that when the sac is completed in the scrotum, the testicle is at first attached only to the posterior part of it, while the fore part of it lies loose, and for some time affords a communication with the abdomen. The spermatic chord, which is made up of the spermatic artery and vein, and of the vas deferens or excretory duct of the testis, is closely attached behind to the posterior part of this elongation of the peritonæum. But the fore part of the peritoneal sac, which is at first loose and not attached to the testicle, closes after a certain time, and becomes united to the posterior part, and thus perfectly surrounds the testicle as it were in a purse.

The testicles of the fœtus differ only in their size and situation from those of the adult. In their passage from the abdomen they descend through the abdominal rings into the scrotum, where they are supported and defended by various integuments.

What the immediate cause of this descent is, has not yet been satisfactorily determined. It has been ascribed to the effects of respiration, but the testicles have sometimes been found in the scrotum before the child has breathed; and it does not seem to be occasioned by the action of the cremaster muscle, because the same effect would be liable to happen to the hedge-hog, and some other quadrupeds, whose testicles remain in the abdomen during life.

The scrotum, which is the external or common covering of both testicles, is a kind of sac formed by the common integuments, and externally divided into two equal parts by a prominent line called *raphe*.

In the inner part of the scrotum we meet with a cellular coat called *dartos*,* which by its duplicature divides the scrotum into two equal parts, and forms what is called *septum scroti*, which corresponds with the raphe. The collapsion which is so often observed to take place in the scrotum of the healthy subject, when excited by cold or by the stimulus of venery, seems to be very properly attribut-

* The dartos has usually been considered as a muscle, and is described as such both by Douglas and Winslow. But there being no part of the scrotum of the human subject which can be said to consist of muscular fibres, Albinus and Haller have very properly omitted to describe the dartos as a muscle, and consider it merely as a cellular coat.

ed to the contractile motion of the skin, and not to any muscular fibres, as is the case in dogs and some other quadrupeds.

The scrotum, then, by means of its septum, is found to make two distinct bags, in which the testicles, invested by their proper tunics, are securely lodged and separated from each other. These coats are the cremaster, the tunica vaginalis, and the tunica albuginea. The first of these is composed of muscular fibres, and is to be considered only as a partial covering of the testis; for it surrounds only the spermatic chord, and terminates upon the upper and external parts of the tunica vaginalis testis, serving to draw up and suspend the testicle.* The tunica vaginalis testis has already been described as being a thin production of the peritonæum, loosely adhering every where to the testicle, which it includes as it were in a bag. The tunica albuginea is a firm, white, and very compact membrane of a glistening appearance, which immediately invests the body of the testis and the epididymus; serving in some measure to connect them to each other, but without extending itself at all to the spermatic chord. This tunica albuginea serves to confine the growth of the testis and epididymus within certain limits, and by giving them a due degree of firmness, enables them to perform their proper functions.

* The cremaster muscle is composed of a few fibres from the obliquus internus abdominis, which uniting with a few from the transversalis, descend upon the spermatic chord, and are insensibly lost upon the tunica vaginalis of the testicle. It serves to suspend and draw up the testicle.

Having removed this last tunic, we discover the substance of the testicle itself, which appears to be made up of an infinite number of very elastic filaments, which may be best distinguished after macerating the testicle in water. Each testicle is made up of the spermatic artery and vein, and the excretory vessels or tubuli seminiferi. There are likewise a great number of absorbent vessels, and some branches of nerves to be met with in the testicles.

The spermatic arteries arise one on each side from the aorta, generally about an inch below the emulgents. The right spermatic vein commonly passes into the vena cava; but the left spermatic vein usually empties itself into the emulgent on that side; and it is supposed to take this course into the emulgent, that it may avoid passing over the aorta, which it would be obliged to do in its way to the vena cava.

The blood is circulated very slowly through the spermatic artery, which makes an infinite number of circumvolutions in the substance of the testicle, where it deposites the semen, which passes through the tubuli seminiferi. These tubuli seminiferi are seen running in short waves from the tunica albuginea to the axis of the testicle; and are divided into distinct portions by certain thin membranous productions, which originate from the tunica albuginea. They at length unite, and by an infinite number of convolutions form a sort of appendix to the testis called *epididymis*,* which is a vascular body of an oblong shape, situate upon the superior part of each testicle. These tubuli of the epididymis at length form an excretory duct called *vas deferens*, which ascends towards the abdominal rings, with the other parts that make up the spermatic chord, and then a separation takes place; the nerves and blood-vessels passing on to their several terminations, and the vas deferens going to deposite its semen in the vesiculæ seminales, which are two soft bodies of a white and convoluted appearance externally, situated obliquely between the rectum and the lower part of the bladder, and uniting together at the lower extremity. From these reservoirs,†

* The testicles were named *didymi* by the ancients, and the name of this part was given to it on account of its situation upon the testicle.

† That the bags called *vesiculæ seminales* are reservoirs of semen, is a circumstance which has been by anatomists universally believed. Mr. J. Hunter, however, from several circumstances, has been induced to think this opinion erroneous.

He has examined these vesiculæ in people who have died suddenly, and he found their contents to be different in their properties from the semen. In those who had lost one of the testicles, or the use of one of them, by disease, both the vesiculæ were full, and their contents similar. And in a *lusus naturæ*, where there was no communication between the vasa deferentia and vesiculæ, nor between the vesiculæ and penis, the same thing took place.

From these observations, he thinks we have a presumptive proof, That the semen can be absorbed in the body of the testicle and in the epididymis, and that the vesiculæ secrete a mucus which they are capable of absorbing when it cannot be made use of: That the semen is not retained in reservoirs after it is secreted, and kept there till it is used; but that it is secreted at the time, in consequence of certain affections of the mind stimulating the testicles to this action.

He corroborates his observations by the appearance on dissection in other animals; and here he finds, That the shape and which are plentifully supplied with blood-vessels and nerves, the semen is occasionally discharged through two short passages, which open into the urethra close to a little eminence called *verumontanum*.

contents of the vesiculæ vary much in different animals, while the semen in most of them he has examined is nearly the same: That the vasa deferentia in many animals do not communicate with the vesiculæ: That the contents of the vesiculæ of castrated and perfect animals are similar, and nearly equal in quantity, in no way resembling the semen as emitted from the animal *in coitu*, or what is found in the vas deferens after death. He observes likewise, that the bulb of the urethra of perfect males is considerably larger than in castrated animals.

From the whole, he thinks the following inferences may be fairly drawn: That the bags called *vesiculæ seminales* are not seminal reservoirs, but glands secreting a peculiar mucus; and that the bulb of the urethra is properly speaking the receptacle of the semen, in which it is accumulated previous to ejection.

But although he has endeavoured to prove that the vesiculæ do not contain the semen, he has not been able to ascertain their particular use. He thinks, however, we may be allowed upon the whole to conclude, that they are, together with other parts, subservient to the purposes of generation.

Although the author has treated this subject very ably, and made many ingenious observations, some things may be objected to what he has advanced; of which the following are a few: That those animals who have bags called *vesiculæ seminales* perform copulation quickly; whereas others that want them, as in the dog kind, are tedious in copulation: That in the human body, at least, there is a free communication between the vasa deferentia and vesiculæ; and in animals where the author has observed no communication between the vasa deferentia and vesiculæ, there may be a communication by vessels not yet discovered, and which may be compared to the hepato-cystic ducts in fowls and fishes: That the fluid in the end of the vasa deferentia and the vesiculæ seminales are similar, according to the author's own observation: That the vesiculæ in some animals increase and decrease with the testicle at particular seasons: That in birds and certain fishes, there is a dilatation of the ends of the vasa deferentia, which the author himself allows to be a reservoir for the semen.

With respect to the circumstance of the bulb of the urethra answering the purpose of a reservoir, the author has mentioned no facts which tend to establish this opinion. See *Observations on certain Parts of the Animal Oeconomy*.

Near this eminence we meet with the prostate, which is situated at the neck of the bladder, and is described as being of a glandular structure. It is shaped somewhat like a heart with its small end foremost, and invests the origin of the urethra. Internally it appears to be of a firm substance, and composed of several follicles, secreting a whitish viscid fluid, that is discharged by ten or twelve excretory ducts into the urethra, on each side of the openings of the vesiculæ seminales at the same time, and from the same causes that the semen is expelled. As this latter fluid is found to be exceedingly limpid in the vesiculæ seminales of the dead subject, it probably owes its whiteness and viscidity to this liquor of the prostate.

The penis, which is to be considered as the vehicle or active organ of procreation, is composed of two columns, the corpora cavernosa, and corpus spongiosum. The corpora cavernosa, which constitute the greatest part of the penis, may be described as two cylindrical ligamentous tubes, each of which is composed of an infinite number of minute cells of a spongy texture, which communicate with each other. These two bodies are of a very pliant texture, and capable of considerable distention; and being united laterally to each other, occasion by this union a space above and another below. The uppermost of these spaces is filled by the blood-vessels, and the lower one, which is larger than the other, by the urethra and its corpus spongiosum. These two cavernous bodies are at first only separated by a partition of tendinous fibres, which allow them to communicate with each other; but they afterwards divaricate from each other like the branches of the letter Y, and diminishing gradually in size, are attached, one on each side, by means of the ligamentum suspensorium penis to the ramus ischii, and to the inferior portion of the os pubis.

The corpus spongiosum penis, or corpus spongiosum urethræ, as it is styled by some authors, begins as soon as the urethra has passed the prostate, with a thick origin almost like a heart, first under the urethra, and afterwards above it, becoming gradually thinner, and surrounding the whole canal of the urethra, till it terminates in a considerable expansion, and constitutes what is called the *glans penis*, which is exceedingly vascular, and covered with papillæ like the tongue. The cuticle which lines the inner surface of the urethra, is continued over the glans in the same manner as it is spread over the lips.

The penis is invested by the common integuments, but the cutis is reflected back every where from the glans as it is in the eye-lids; so that it covers this part, when the penis is in a relaxed state, as it were with a hood, and from this use is called *prepuce*.

The prepuce is tied down to the under part of the glans by a small ligament called *frænum*, which is in fact only a continuation of the cuticle and cutis. There are many simple sebaceous follicles called *glandulæ odoriferæ*, placed round the basis of the glans; and the fluid they secrete serves to preserve the exquisite sensibility of this part of the penis, and to prevent the ill effects of attrition from the prepuce.

The urethra may be defined to be a membranous canal, passing from the bladder through the whole extent of the penis. Several very small openings, called *lacunæ*, communicate with this canal, through which a mucus is discharged into it; and besides these, there are two glands, first described by Cowper, as secreting a fluid for lubricating the urethra, and called *Cowper's glands*;* and Littre † speaks of a gland situated near the prostate, as being destined for the same use.

The urethra being continued from the neck of the bladder, is to be considered as making part of the urinary passage; and it likewise affords a conveyance to the semen, which we have observed is occasionally discharged into it from the vesiculæ seminales. The direction of this canal being first under and then before the pubis, occasions a winding in its course from the bladder to the penis not unlike the turns of the letter *S*.

The penis has three pair of muscles, the erectores, acceleratores, and transversales. They push the blood from the crura to the fore part of the corpora cavernosa. The first originate from the tuberosity of the ischium, and terminate in the corpora cavernosa. The acceleratores arise from the sphincter, and by

* Both Heister and Morgagni observe, that they have sometimes not been able to find these glands; so that they do not seem to exist in all subjects.

† Memoires de l' Acad. Royale des Sciences, 1700.

their insertion serve to compress the bulbous part of the urethra; and the transversales are destined to afford a passage to the semen, by dilating the canal of the urethra.

The arteries of the penis are chiefly derived from the internal iliacs. Some of them are supposed to terminate by pabulous orifices within the corpora cavernosa and corpus spongiosum; and others terminate in veins, which at last make up the vena magna dorsi penis, and other smaller veins, which are in general distributed in like order with the arteries.

Its nerves are large and numerous. They arise from the great sciatic nerve, and accompany the arteries in their course through the penis.

We have now described the anatomy of this organ; and there only remains to be explained, how it is enabled to attain that degree of firmness and distention which is essential to the great work of generation.

The greatest part of the penis has been spoken of as being of a spongy and cellular texture, plentifully supplied with blood-vessels and nerves, and as having muscles to move it in different directions. Now, the blood is constantly passing into its cells through the small branches of the arteries which open into them, and is from thence as constantly returned by the veins, so long as the corpora cavernosa and corpus spongiosum continue to be in a relaxed and pliant state. But when, from any nervous influence, or other means, which it is not necessary here to define or explain, the erectores penis, ejaculatores seminis, levatores ani, &c. are induced to contract, the veins undergo a certain degree of compression, and the passage of the blood through them is so much impeded, that it collects in them in a greater proportion than they are enabled to carry off, so that the penis gradually enlarges; and being more and more forcibly drawn up against the os pubis, the vena magna itself is at length compressed, and the penis becomes fully distended. But as the causes which first occasioned this distention subside, the penis gradually returns to its state of relaxation.

§. 2. *Female Organs of Generation.*

ANATOMICAL writers usually divide the female organs of generation into *external* and *internal.* In the first division they include the *mons veneris*, *labia pudendi*, *perinæum*, *clitoris*, *nymphæ*, and *carunculæ myrtiformes;* and in the latter, the *vagina*, with the *uterus* and its appendages.

The *mons veneris*, which is placed on the upper part of the symphysis pubis, is internally composed of adipose membranes, which makes it soft and prominent: it divides into two parts called *labia pudendi*, which descending towards the rectum, from which they are divided by the perinæum, form what is called the *fourchette*. The perinæum is that fleshy space which extends about an inch and an half from the fourchette to the anus, and from thence about two inches to the coccyx.

The labia pudendi being separated, we observe a sulcus called *fossa magna;* in the upper part of which is placed the clitoris, a small round spongy body, in some measure resembling the male penis, but impervious, composed of two corpora cavernosa, arising from the tuberosities of the ossa ischii; furnished with two pair of muscles, the erectores clitoridis, and the sphincter or constrictor ostii vaginæ; and terminating in a glans, which is covered with its prepuce. From the lower part, on each side of the fossa, pass the nymphæ, two membranous and spongy folds which seem destined for useful purposes in parturition, by tending to enlarge the volume of the vagina as the child's head passes through it. Between these, about the middle of the fossa magna, we perceive the orifice of the vagina or os externum, closed by folds and wrinkles; and about half an inch above this, and about an inch below the clitoris, appears the meatus urinarius or orifice of the urethra, much shorter, though somewhat larger, than in men, with a little prominence at its lower edge, which facilitates the introduction of the catheter.

The os externum is surrounded internally by several membranous folds called *carunculæ myrtiformes*, which are partly the remains of a thin membrane called *hymen*, that covers the vagina in children. In general the hymen is sufficiently open to admit the passage of the menses, if it exists at the time of their appearance; sometimes, however, it has been found perfectly closed.

The vagina, situated between the urethra and the rectum, is a membranous cavity, surrounded especially at its external extremity with a spongy and vascular substance, which is covered by the sphincter ostii vaginæ. It terminates in the uterus, about half an inch above the os tincæ, and is wider and shorter in women who have had children than in virgins.

All these parts are plentifully supplied with blood-vessels and nerves. Around the nymphæ there are sebaceous follicles, which pour out a fluid to lubricate the inner surface of the vagina; and the meatus urinarius, like the urethra in the male subject, is constantly moistened by a mucus, which defends it against the acrimony of the urine.

The *uterus* is a hollow viscus, situated in the hypogastric region, between the rectum and bladder. It is destined to receive the first rudiments of the fœtus, and to assist in the developement of all its parts, till it arrives at a state of perfection, and is fitted to enter into the world, at the time appointed by the wise Author of nature.

The uterus, in its unimpregnated state, resembles a pear in shape, somewhat flattened, with its fundus or bottom part turned towards the abdomen, and its cervix or neck surrounded by the vagina. The entrance into its cavity forms a little protuberance, which has been compared to the mouth of a tench, and is therefore called *os tincæ*.

The substance of the uterus, which is of a considerable thickness, appears to be composed of muscular and small ligamentous fibres, small branches of nerves, some lymphatics, and with arteries and veins innumerable. Its nerves are chiefly derived from the intercostal, and its arteries and veins from the hypogastric and spermatic. The membrane which lines its cervix, is a continuation of the inner membrane of the vagina; but the outer surface of the body of the uterus is covered with the peritonæum, which is reflected over it, and descends from thence to the intestinum rectum. This duplicature of the peritonæum, by passing off from the sides of the uterus to the sides of the pelvis, is there firmly connected, and forms what are called *ligamenta uteri lata;* which not only serve to support the uterus, but to convey nerves and blood-vessels to it.

The *ligamenta uteri rotunda* arise from the sides of the fundus uteri, and passing along within the fore-part of the ligamenta lata, descend through the abdominal rings, and terminate in the substance of the mons veneris. The substance of these ligaments is vascular, and although both they and the ligamenta lata admit the uterus in the virgin state, to move only about an inch up and down, yet in the course of pregnancy they admit of considerable distention, and after parturition return nearly to their original state with surprising quickness.

On each side of the inner surface of the uterus, in the angle near the fundus, a small orifice is to be discovered, which is the beginning of one of the tubæ Fallopianæ. Each of these tubes, which are two in number, passing through the substance of the uterus, is extended along the broad ligaments, till it reaches the edge of the pelvis, from whence it reflects back; and turning over behind the ligaments, about an inch of its extremity is seen hanging loose in the pelvis, near the ovarium. These extremities, having a jagged appearance, are called *fimbriæ*, or *morsus diaboli*. Each tuba Fallopiana is usually about three or four inches long. Their cavities are at first very small, but become gradually larger, like a trumpet, as they approach the fimbriæ.

Near the fimbriæ of each tuba Fallopiana, about an inch from the uterus, is situated an oval body called *ovarium*, of about half the size of the male testicle. Each of these ovaria is covered by a production of the peritonæum, and hangs loose in the pelvis. They are of a flat and angular form, and appear to be composed of a white and cellular substance, in which we are able to discover several minute vesicles filled with a coagulable lymph, of an uncertain number, commonly exceeding 12 in each ovary. In the female of riper years, these vesicles become exceedingly turgid, and a kind of yellow coagulum is gradually formed within one of them, which increases for a certain time. In conception, one of these mature ova is supposed to be impregnated with the male semen, and to be squeezed out of its nidus into the Fallopian tube; after which the ruptured part forms a substance which in some animals is of a yellow colour, and is therefore called *corpus luteum;* and it is observable, that the number of these scars or fissures in the ovarium, constantly corresponds with the number of fœtuses excluded by the mother.

§. 3. *Of Conception.*

MAN, being ever curious and inquisitive, has naturally been led to inquire after the origin of his existence; and the subject of generation has employed the philosophical world in all ages: but in following nature up to her minute recesses, the philosopher soon finds himself bewildered, and his imagination often supplies that which he so eagerly wishes to discover, but which is destined perhaps never to be revealed to him. Of the many theories which have been formed on this subject, that of the ancient philosophers seems to have been the most simple: they considered the male semen as alone capable of forming the fœtus, and believed that the female only afforded it a lodging in the womb, and supplied it with nourishment after it was perfectly formed. This opinion, however, soon gave place to another, in which the female was allowed a more considerable share in conception.

This second system considered the fœtus as being formed by the mixture of the seminal liquor of both sexes, by a certain arrangement of its several particles in the uterus. But in the 16th century, vesicles or eggs were discovered in the ovaria or female testicles; the fœtus had been found sometimes in the abdomen, and sometimes in the Fallopian tubes;

and the two former opinions were exploded in favour of a new doctrine. The ovaria were compared to a bunch of grapes, being supposed to consist of vesicles, each of which had a stalk; so that it might be disengaged without hurting the rest, or spilling the liquor it contained. Each vesicle was said to include a little animal, almost complete in all its parts; and the vapour of the male semen being conveyed to the ovarium, was supposed to produce a fermentation in the vesicle, which approached the nearest to maturity; and thus inducing it to disengage itself from the ovarium, it passed into the tuba Fallopiana, through which it was conveyed to the uterus. Here it was supposed to take root like a vegetable seed, and to form, with the vessels originating from the uterus, what is called the *placenta;* by means of which the circulation is carried on between the mother and the fœtus.

This opinion, with all its absurdities, continued to be almost universally adopted till the close of the same century, when Lieuwenhoeck, by means of his glasses, discovered certain opake particles, which he described as so many animalcula, floating in the seminal fluid of the male.

This discovery introduced a new schism among the philosophers of that time, and gave rise to a system which is not yet entirely exploded. According to this theory the male semen passing into the tubæ Fallopianæ, one of the animalcula penetrates into the substance of the ovarium, and enters into one of its vesicles or ova. This impregnated ovum is then squeezed from its husk, through the coats of the ovarium, and being seized by the fimbriæ, is conducted through the tube to the uterus, where it is nourished till it arrives at a state of perfection. In this system there is much ingenuity; but there are certain circumstances supposed to take place, which have been hitherto inexplicable. A celebrated modern writer, M. Buffon, endeavours to restore, in some measure, the most ancient opinion, by allowing the female semen a share in this office; asserting, that animalcula or organic particles are to be discovered in the seminal liquor of both sexes: he derives the female semen from the ovaria, and he contends that no ovum exists in those parts. But in this idea he is evidently mistaken; and the opinion now most generally adopted is, that an impregnation of the ovum, by the influence of the male semen, is essential to conception.* That the ovum is to be impregnated, there can be no doubt; but as the manner in which such an impregnation is supposed to take place, and the means by which the ovum afterwards gets into the Fallopian tube, and from thence into the uterus, are still founded chiefly on hypothesis, we will not attempt to extend farther the investigation of a subject concerning which so little can be advanced with certainty.

* The learned Abbè Spallanzani has thrown much light on this curious subject, and has proved by a variety of experiments, that the animalcule exists entire in the female ovum and that the male seed is only necessary to vivify and put it in motion.—His experiments and observations are worthy the attentive perusal of every physiologist.

§. 4. *Of the Fœtus in Utero.*

Opportunities of dissecting the human gravid uterus occurring but seldom, the state of the embryo* immediately after conception cannot be perfectly known.

When the ovum descends into the uterus, it is supposed to be very minute; and it is not till a considerable time after conception that the rudiments of the embryo begin to be ascertained.

About the third or fourth week the eye may discover the first lineaments of the fœtus; but these lineaments are as yet very imperfect, it being only about the size of a house-fly. Two little vessels appear in an almost transparent jelly; the largest of which is destined to become the head of the fœtus, and the other smaller one is reserved for the trunk. But at this period no extremities are to be seen; the umbilical cord appears only as a very minute thread, and the placenta does not as yet absorb the red particles of the blood. At six weeks, not only the head but the features of the face begin to be developed. The nose appears like a small prominent line, and we are able to discover another line under it, which is destined for the separation of the lips. Two black points appear in the place of eyes, and two minute holes mark the ears. At the sides of

* The rudiments of the child are usually distinguished by this name till the human figure can be distinctly ascertained, and then it has the appellation of *fœtus*.

the trunk, both above and below, we see four minute protuberances, which are the rudiments of the arms and legs. At the end of eight weeks the body of the fœtus is upwards of an inch in length, and both the hands and feet are to be distinguished. The upper extremities are found to increase faster than the lower ones, and the separation of the fingers is accomplished sooner than that of the toes.

At this period the hûman form may be decisively ascertained;—all the parts of the face may be distinguished, the shape of the body is clearly marked out, the haunches and the abdomen are elevated, the fingers and toes are separated from each other, and the intestines appear like minute threads.

At the end of the third month, the fœtus measures about three inches; at the end of the fourth month, five inches; in the fifth month, six or seven inches; in the sixth month, eight or nine inches; in the seventh month, eleven or twelve inches; in the eighth month, fourteen or fifteen inches; and at the end of the ninth month, or full time, from eighteen to twenty-two inches. But as we have not an opportunity of examining the same fœtus at different periods of pregnancy, and as their size and length may be influenced by the constitution and mode of life of the mother, calculations of this kind must be very uncertain.

The fœtus during all this time assumes an oval figure, which corresponds with the shape of the uterus. Its chin is found reclining on its breast with its knees drawn up towards its chin, and its arms folded over them. But it seems likely, that the posture of some of these parts is varied in the latter months of pregnancy, so as to cause those painful twitches which its mother usually feels from time to time. In natural cases, its head is probably placed towards the os tincæ from the time of conception to that of its birth; though formerly it was considered as being placed towards the fundus uteri till about the eighth or ninth month, when the head, by becoming specifically heavier than the other parts of the body, was supposed to be turned downwards.

The capacity of the uterus increases in proportion to the growth of the fœtus, but without becoming thinner in its substance, as might naturally be expected. The nourishment of the fœtus, during all this time, seems to be derived from the placenta, which appears to be originally formed by that part of the ovum which is next the fundus uteri. The remaining part of the ovum is covered by a membrane called *spongy chorion*;* within which is another called *true chorion*, which includes a third termed *amnios*:† this contains a watery

* Dr. Hunter has described this as a lamella from the inner surface of the uterus. In the latter months of pregnancy it becomes gradually thinner and more connected with the chorion: he has named it *membrana caduca*, or *decidua*, as it is cast off with the placenta. Signior Scarpa, with more probability, considers it as being composed of an inspissated coagulable lymph.

† In some quadrupeds, the urine appears to be conveyed from the bladder through a canal called *urachus* to the *allantois*, which is a reservoir, resembling a long and blind gut, situated between the chorion and amnios. The human fœtus seems to have no such reservoir, though some writers have supposed that it does exist. From the top of the bladder a few longitudinal fibres are extended to the umbilical chord; and these fibres have been considered as the urachus, though without having been ever found pervious.

fluid which is the *liquor amnii*,* in which the fœtus floats till the time of its birth. On the side next the fœtus, the placenta is covered by the amnios and true chorion; on the side next the mother it has a production continued from the spongy chorion. The amnios and chorion are remarkably thin and transparent, having no blood-vessels entering into their composition. The spongy chorion is opake and vascular.

In the first months of pregnancy, the involucra bear a large proportion to their contents; but this proportion is afterwards reversed, as the fœtus increases in bulk.

The placenta, which is the medium through which the blood is conveyed from the mother to the fœtus, and the manner in which this conveyance takes place, deserve next to be considered.

The placenta is a broad, flat, and spongy substance, like a cake, closely adhering to the inner surface of the womb, usually near the fundus, and appearing to be chiefly made up of the ramifications of the umbilical arteries and vein, and partly of the extremities of the uterine vessels. The arteries of the uterus discharge their contents into the substance of

* The liquor amnii coagulates like the lymph. It has been supposed to pass into the œsophagus, and to afford nourishment to the fœtus; but this does not seem probable. Children have come into the world without an œsophagus, or any communication between the stomach and the mouth; but there has been no well attested instance of a child's having been born without a placenta; and it does not seem likely, that any of the fluid can be absorbed through the pores of the skin, the skin in the fœtus being every where covered with a great quantity of mucus.

this cake; and the veins of the placenta, receiving the blood either by a direct communication of vessels, or by absorption, at length form the umbilical vein, which passes on to the sinus of the vena portæ, and from thence to the vena cava, by means of the canalis venosus, a communication that is closed in the adult. But the circulation of the blood through the heart is not conducted in the fœtus as in the adult: in the latter, the blood is carried from the right auricle of the heart through the pulmonary artery, and is returned to the left auricle by the pulmonary vein; but a dilatation of the lungs is essential to the passage of the blood through the pulmonary vessels, and this dilatation cannot take place till after the child is born and has respired. This deficiency, however, is supplied in the fœtus by the immediate communication between the right and left auricle, through an oval opening, in the septum which divides the two auricles, called *foramen ovale*. The blood is likewise transmitted from the pulmonary artery to the aorta, by means of a duct called *canalis arteriosus*, which, like the canalis venosus, and foramen ovale, gradually closes after birth.

The blood is returned again from the fœtus through two arteries called the *umbilical arteries*, which arise from the iliacs. These two vessels taking a winding course with the vein, form with that, and the membranes by which they are surrounded, what is called the *umbilical chord*. These arteries, after ramifying through the substance of the placenta, discharge their blood into the veins of the uterus;

Plate XXV

Fig. 1.

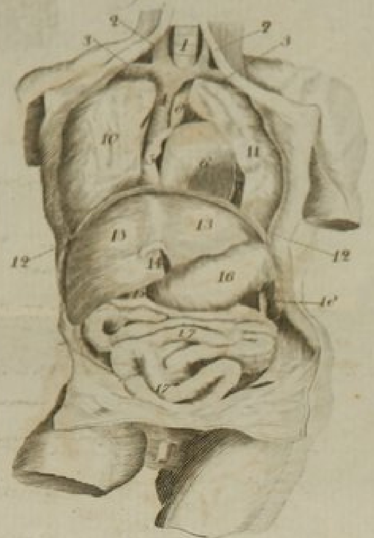


Fig. 2.

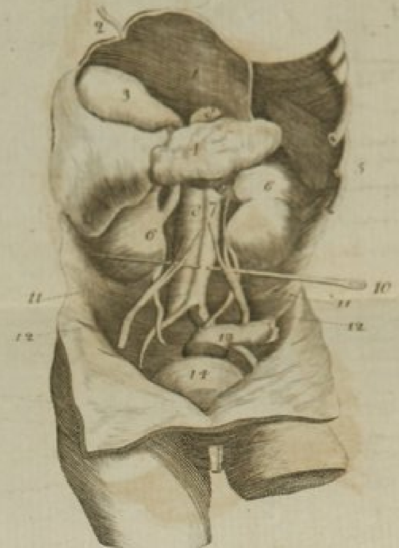


Fig. 3.

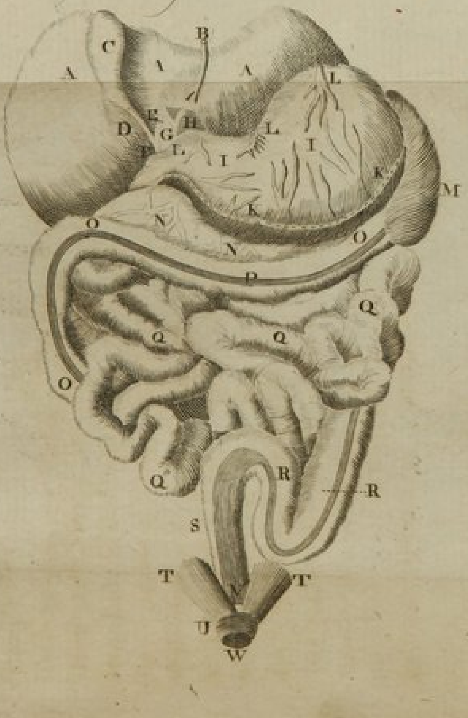


Fig. 4.

Fig. 5.

Scot Philad.

in the same manner as the uterine arteries discharged their blood into the branches of the umbilical vein. So that the blood is constantly passing in at one side of the placenta and out at the other; but in what particular manner it gets through the placenta is a point not yet determined.

EXPLANATION OF PLATES XXV. XXVI. AND XXVII.

PLATE XXV.

FIG. 1. Shows the Contents of the Thorax and Abdomen in situ.

1. Top of the trachea, or wind-pipe. 2 2, The internal jugular veins. 3 3, The subclavian veins. 4, The vena cava descendens. 5, The right auricle of the heart. 6, The right ventricle. 7, Part of the left ventricle. 8, The aorta descendens. 9, The pulmonary artery. 10, The right lung, part of which is cut off to show the great blood-vessels. 11, The left lung entire. 12 12, The anterior edge of the diaphragm. 13 13, The two great lobes of the liver. 14, The ligamentum rotundum. 15, The gall-bladder. 16, The stomach. 17 17, The jejunum and ilium. 18, The spleen.

Fig. 2. Shows the Organs subservient of the Chylopoietic Viscera,—with those of Urine and Generation.

1 1, The under side of the two great lobes of the liver. a, Lobulus Spigelii. 2, The ligamentum rotundum. 3, The gall-bladder. 4, The pancreas. 5, The spleen. 6 6, The kidneys. 7, The aorta descendens. 8, Vena cava ascendens. 9 9, The renal veins covering the arteries. 10, A probe under the spermatic vessels and a bit of the inferior mesenteric artery, and over the ureters. 11 11, The ureters. 12 12, The iliac arteries and veins. 13, The rectum intestinum. 14, The bladder of urine.

Fig. 3. Shows the Chylopoietic Viscera, and Organs subservient to them, taken out of the Body entire.

A A, The under side of the two great lobes of the liver. B, Ligamentum rotundum. C, The gall-bladder. D, Ductus cysticus. E, Ductus hepaticus. F, Ductus communis choledochus. G, Vena portarum. H, Arteria hepatica. I I, The stomach. K K, Venæ and arteriæ gastro-epiploicæ, dextræ & sinistræ. L L, Venæ & arteriæ coronariæ ventriculi. M, The spleen. N N, Mesocolon, with its vessels. O O O, Intestinum colon. P, One of the ligaments of the colon, which is a bundle of longitudinal muscular fibres. Q Q Q Q, Jejunum and ilium. R R, Sigmoid flexure of the colon with the ligament continued, and over S, The rectum intestinum. T T, Levatores ani. U, Sphincter ani. V, The place to which the prostate gland is connected. W, The anus.

FIG. 4. Shows the Heart of a Fœtus at the full time, with the Right Auricle cut open to show the Foramen Ovale, or passage between both Auricles.

a, The right ventricle. b, The left ventricle. c c, The outer side of the right auricle stretched out. d d, The posterior side, which forms the anterior side of the septum. e, The foramen ovale, with the membrane or valve which covers the left side. f, Vena cava inferior passing through g, A portion of the diaphragm.

FIG. 5. Shows the Heart and Large Vessels of a Fœtus at the full time.

a, The left ventricle. b, The right ventricle. c, A part of the right auricle. d, Left auricle. e e, The right branch of the pulmonary artery. f, Arteria pulmonalis. g g, The left branch of the pulmonary artery, with a number of its largest branches dissected from the lungs. h, The canalis arteriosus. i, The arch of the aorta. k k, The aorta descendens. l, The left subclavian artery. m, The left carotid artery. n, The right carotid artery. o, The right subclavian artery. p, The origin of the right carotid and right subclavian arteries in one common trunk. q, The vena cava superior or descendens. r, The right common subclavian vein. s, The left common subclavian vein.

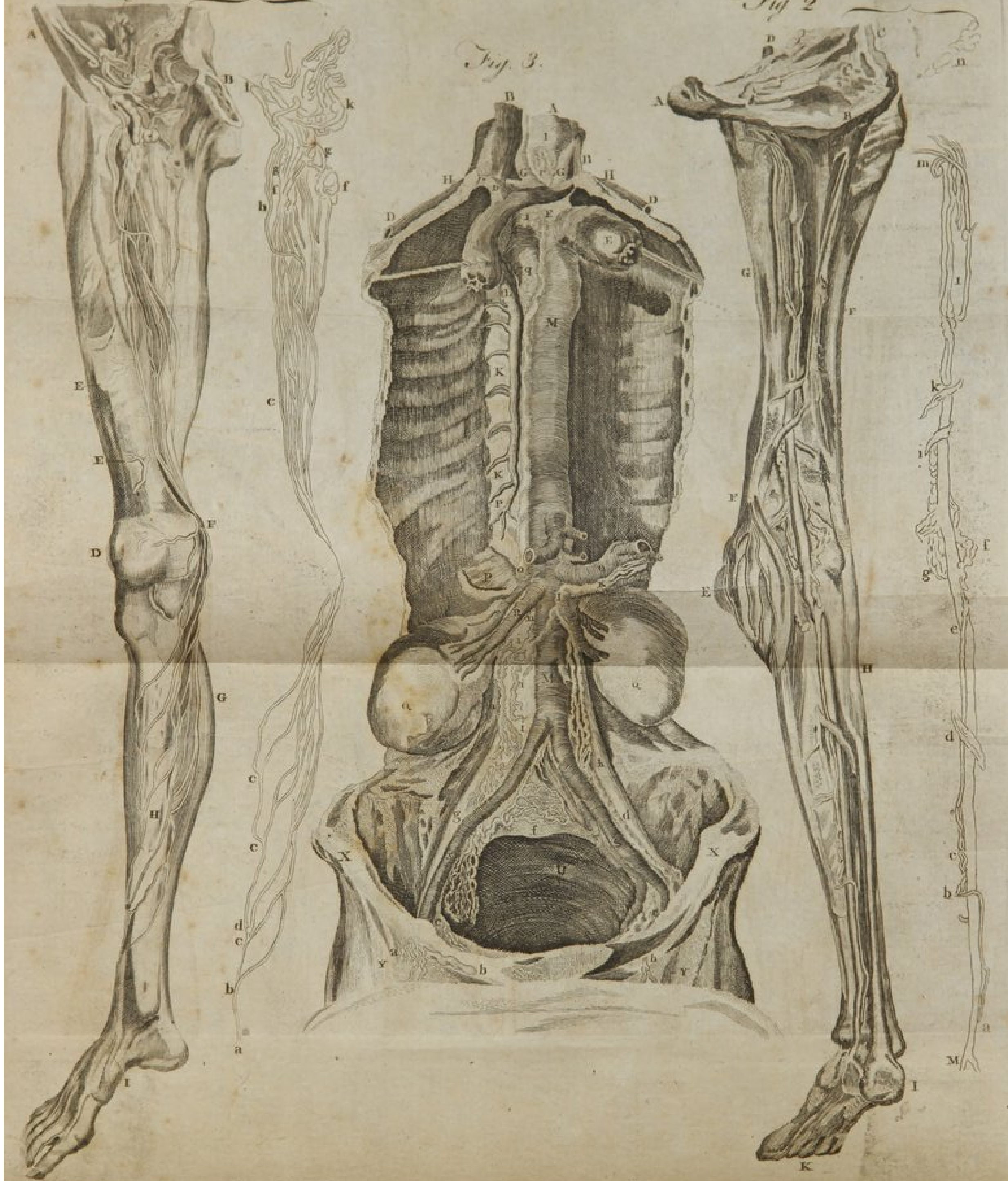
N. B. All the parts described in this figure are to be found in the adult, except the canalis arteriosus.

PLATE XXVI.

FIG. 1. Exhibits the more superficial Lymphatic Vessels of the Lower Extremity.

A, The spine of the os ilium. B, The os pubis. C, The iliac artery. D, The knee. E, E, F, Branches of the crural artery. G, The musculus gastrocnemius. H, The tibia. I, The tendon of the musculus tibialis anticus. On the out-lines, a, A lymphatic vessel belonging to the top of the foot. b, Its first division into branches. c, c, c, Other divisions of the same lymphatic vessel. d, A small lymphatic gland. e, The lymphatic vessels which lie between the skin and the muscles of the thigh. f, f, Two lymphatic glands at the upper part of the thigh below the groin. g, g, Other glands. h, A lymphatic vessel which passes by the side of those glands without communicating with them; and, bending towards the inside of the groin at (i), opens into the lymphatic gland (k). l, l, Lymphatic glands in the groin, which are common to the lymphatic vessels of the genitals and those

ANATOMY Plate XXVI



of the lower extremity. m, n, A plexus of lymphatic vessels passing on the inside of the iliac artery.

FIG. 2. Exhibits a Back View of the lower Extremity, dissected so as to show the deeper-seated Lymphatic Vessels which accompany the Arteries.

A, The os pubis. B, The tuberosity of the ischium. C, That part of the os ilium which was articulated with the os sacrum. D, The extremity of the iliac artery appearing above the groin. E, The knee. F F, The two cut surfaces of the triceps muscle, which was divided to show the lymphatic vessels that pass through its perforation along with the crural artery. G, The edge of the musculus gracilis. H, The gastrocnemius and soleus, much shrunk by being dried, and by the soleus being separated from the tibia to expose the vessels. I, The heel. K, The sole of the foot. L, The superficial lymphatic vessels passing over the knee, to get to the thigh. On the out-lines; M, The posterior tibial artery. a, A lymphatic vessel accompanying the posterior tibial artery. b, The same vessel crossing the artery. c, A small lymphatic gland, through which this deep-seated lymphatic vessel passes. d, The lymphatic vessel passing under a small part of the soleus, which is left attached to the bone, the rest being removed. e, The lymphatic vessel crossing the popliteal artery. f, g, h, Lymphatic glands in the ham, through which the lymphatic vessel passes. i, The lymphatic vessel passing with the crural artery, through the perforation of the triceps muscle. k, The lymphatic vessel, after it has passed the perforation of the triceps, dividing into branches which embrace the artery (l). m, A lymphatic gland belonging to the deep-seated lymphatic vessel. At this place those vessels pass to the fore part of the groin, where they communicate with the superficial lymphatic vessels. n, A part of the superficial lymphatic vessel appearing on the brim of the pelvis.

FIG. 3. Exhibits the Trunk of the Human Subject, prepared to show the Lymphatic Vessels and the Ductus Thoracicus.

A, The neck. B B, The two jugular veins. C, The vena cava superior. D D D D, The subclavian veins. E, The beginning of the aorta, pulled to the left side by means of a ligature, in order to show the thoracic duct behind it. F, The branches arising from the curvature of the aorta. G G, The two carotid arteries. H H, The first ribs. I I, The trachea. K K, The spine. L L, The vena azygos. M M, The descending aorta. N, The cœliac artery, dividing into three branches. O, The superior mesenteric artery. P, The right crus diaphragmatis. Q Q, The two kidneys. R, The right emulgent artery. S S, The external iliac arteries. g d, The musculi psoæ. T, The internal iliac artery.

U, The cavity of the pelvis. X X, The spine of the os ilium. Y Y, The groins. *a*, A lymphatic gland in the groin, into which lymphatic vessels from the lower extremity are seen to enter. *b b*, The lymphatic vessels of the lower extremities passing under Poupart's ligament. *c c*, A plexus of the lymphatic vessels lying on each side of the pelvis. *d*, The psoas muscle with lymphatic vessels lying upon its inside. *e*, A plexus of lymphatics, which having passed over the brim of the pelvis at *(c)*, having entered the cavity of the pelvis, and received the lymphatic vessels belonging to the viscera contained in that cavity, next ascends, and passes behind the iliac artery to *(g)*. *f*, Some lymphatic vessels of the left side passing over the upper part of the os sacrum, to meet those of the right side. *g*, The right psoas, with a large plexus of lymphatics lying on its inside. *h h*, The plexus lying on each side of the spine. *i i i*, Spaces occupied by the lymphatic glands. *k*, The trunk of the lacteals, lying on the under side of the superior mesenteric artery. *l*, The same dividing into two branches, one of which passes on each side of the aorta; that of the right side being seen to enter the thoracic duct at *(m)*. *m*, The thoracic duct beginning from the large lymphatics. *n*, The duct passing under the lower part of the crus diaphragmatis, and under the right emulgent artery. *o*, The thoracic duct penetrating the thorax. *p*, Some lymphatic vessels joining that duct in the thorax. *q*, The thoracic duct passing under the curvature of the aorta to get to the left subclavian vein. The aorta being drawn aside to show the duct. *r*, A plexus of lymphatic vessels passing upon the trachea from the thyroid gland to the thoracic duct.

PLATE XXVII.

FIG. 1. Represents the Under and Posterior Side of the Bladder of Urine, &c.

a, The bladder. b b, The insertion of the ureters. c c, The vasa deferentia, which convey the semen from the testicles to d d, The vesiculæ seminales,—and pass through e, The prostate gland, to discharge themselves into f, The beginning of the urethra.

FIG. 2. A transverse Section of the Penis.

g g, Corpora cavernosa penis. h, Corpus cavernosum urethræ. i, Urethra. k, Septum penis. l l, The septum between the corpus cavernosum urethræ and that of the penis.

FIG. 3. A longitudinal Section of the Penis.

m m, The corpora cavernosa penis, divided by o, The septum penis. n, The corpus cavernosum glandis, which is the continuation of that of the urethra.

ANATOMY

Plate XXVII

Fig. 1

Fig. 4

Fig. 2

Fig. 5

Fig. 6

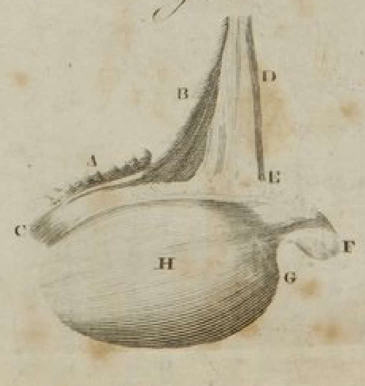


Fig. 3

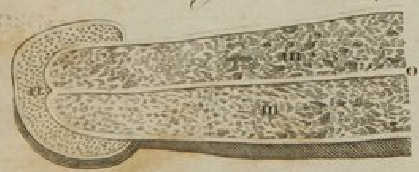


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Fig. 4. Represents the Female Organs of Generation.

a, That side of the uterus which is next the os sacrum. 1, Its fundus. 2, Its cervix. b b, The Fallopian or uterine tubes, which open into the cavity of the uterus;—but the other end is open within the pelvis, and surrounded by c c, The fimbriæ. d d, The ovaria. e, The os internum uteri, or mouth of the womb. f f, The ligamenta rotunda, which passes without the belly, and is fixed to the labia pudendi. g g, The cut edges of the ligamenta lata, which connects the uterus to the pelvis. h, The inside of the vagina. i, The orifice of the urethra, k, The clitoris surrounded by (l,) The præputium. m m, The labia pudendi. n n, The nymphæ.

Fig. 5. Shews the Spermatic Ducts of the Testicle filled with Mercury.

A, The vas deferens. B, Its beginning, which forms the posterior part of the epididymis. B, The middle of the epididymis, composed of serpentine ducts. D, The head or anterior part of the epididymis unravelled. e e e e, The whole ducts which compose the head of the epididymis unravelled. f f, The vasa deferentia. g g, Rete testis. h h, Some rectilineal ducts which send off the vasa deferentia. i i, The substance of the testicle.

FIG. 6. The right Testicle entire, and the Epididymis filled with Mercury.

A, The beginning of the vas deferens. B, The vas deferens ascending towards the abdomen. C, The posterior part of the epididymis, named *globus minor*. D, The spermatic vessels inclosed in cellular substance. E, The body of the epididymis. F, Its head, named *globus major*. G, Its beginning from the testicle. H, The body of the testicle, inclosed in the tunica albuginea.

PART IV. OF THE THORAX.

THE THORAX, OR CHEST, is that cavity of the trunk which extends from the clavicles, or the lower part of the neck, to the diaphragm, and includes the vital organs, which are the heart and lungs; and likewise the trachea and œsophagus.—This cavity is formed by the ribs and vertebræ of the back, covered by a great number of muscles, and by the common integuments, and anteriorly by two glandular bodies called the *breasts*. The spaces between the ribs are filled up by muscular fibres, which from their situation are called *intercostal muscles*.

Sect. I. *Of the Breasts.*

The *breasts* may be defined to be two large conglomerate glands, mixed with a good deal of adipose membrane. The glandular part is composed of an infinite number of minute arteries, veins, and nerves,

The arteries are derived from two different trunks; one of which is called the *internal*, and the other the *external*, *mammary artery*. The first of these arises from the subclavian, and the latter from the axillary.

The veins every where accompany the arteries and are distinguished by the same name. The nerves are chiefly from the vertebral pairs. Like all other conglomerate glands, the breasts are made up of a great many small distinct glands, in which the milk is secreted from the ultimate branches of arteries. The excretory ducts of these several glands gradually uniting as they approach the nipple, form the tubuli lactiferi, which are usually more than a dozen in number, and open at its apex, but have little or no communication, as has been supposed, at the root of the nipple. These ducts, in their course from the glands, are surrounded by a ligamentary elastic substance, which terminates with them in the nipple. Both this substance, and the ducts which it contains, are capable of considerable extension and contraction; but in their natural state are moderately corrugated, so as to prevent an involuntary flow of milk, unless the distending force be very great from the accumulation of too great a quantity.

The whole substance of the nipple is very spongy and elastic: its external surface is uneven, and full of small tubercles. The nipple is surrounded with a disk or circle of a different colour, called the *areola;* and on the inside of the skin, under the areola, are many sebaceous glands, which pour out a mucus to defend the areola and nipple: for the skin upon these parts is very thin; and the nervous papillæ lying very bare, are much exposed to irritation.

The breasts are formed for the secretion of milk, which is destined for the nourishment of the child for some time after its birth. This secretion begins to take place soon after delivery, and continues to flow for many months in very large quantities, if the woman suckles her child.

The operation of suction depends on the principles of the air-pump, and the flow of milk through the lactiferous tubes is facilitated by their being stretched out.

The milk, examined chemically, appears to be composed of oil, mucilage, and water, and of a considerable quantity of sugar. The generality of physiologists have supposed that, like the chyle, it frequently retains the properties of the aliment and medicines taken into the stomach; but from some late experiments,* this supposition appears to be ill-founded.

SECT. II. *Of the Pleura.*

THE cavity of the thorax is every where lined by a membrane of a firm texture called *pleura.* It is composed of two distinct portions or bags,

* Journ. de Med. 1781.

which, by being applied to each other laterally, form a septum called *mediastinum;* which divides the cavity into two parts, and is attached posteriorly to the vertebræ of the back, and anteriorly to the sternum. But the two laminæ of which this septum is formed, do not every where adhere to each other; for at the lower part of the thorax they are separated, to afford a lodgment to the heart; and at the upper part of the cavity, they receive between them the thymus.

The pleura is plentifully supplied with arteries and veins from the internal mammary and the intercostals. Its nerves, which are very inconsiderable, are derived chiefly from the dorsal and intercostal nerves.

The surface of the pleura, like that of the peritonæum and other membranes lining cavities, is constantly bedewed with a serous moisture* which prevents adhesion of the viscera.

The mediastinum, by dividing the breast into two cavities, obviates many inconveniences, to which we should otherwise be liable. It prevents the two lobes of the lungs from compressing each other when we lie on one side; and consequently contributes to the freedom of respiration, which is disturbed by the least pressure on the lungs. If the point of a sword penetrates between the ribs into the cavity of the thorax, the lungs on that side cease to perform their office; because the air being ad-

* When this fluid is exhaled in too great a quantity, or is not properly carried off, it accumulates and constitutes the hydrops pectoris.

mitted through the wound, prevents the dilatation of that lobe; while the other lobe, which is separated from it by the mediastinum, remains unhurt, and continues to perform its function as usual.

SECT. II. *Of the Thymus.*

THE *thymus* is a glandular substance, the use of which is not perfectly ascertained, its excretory duct not having yet been discovered. It is of an oblong figure, and is larger in the fœtus and in young children than in adults, being sometimes nearly effaced in very old subjects. It is placed in the upper part of the thorax, between the two laminæ of the mediastinum; but at first is not altogether contained within the cavity of the chest, being found to border upon the upper extremity of the sternum.

SECT. IV. *Of the Diaphragm.*

THE cavity of the thorax is separated from that of the abdomen, by a fleshy and membranous substance called the *diaphragm* or *midriff*. The greatest part of it is composed of muscular fibres; and on this account systematic writers usually place it very properly among the muscles. Its middle part is tendinous, and it is covered by the pleura above, and by the peritonæum below. It seems to have been improperly named *septum transversum*, as it does not make a plane transverse division of the two cavities, but forms a kind of vault, the fore-part of which is attached to the sternum. Laterally it is fixed to the last of the true ribs, and to all the false ribs; and its lower and posterior part is attached to the vertebræ lumborum, where it may be said to be divided into two portions or crura.*

The principal arteries of the diaphragm are derived from the aorta, and its veins pass into the vena cava. Its nerves are chiefly derived from the cervical pairs. It affords a passage to the vena cava through its tendinous part, and to the œsophagus through its fleshy portion. The aorta passes down behind it between its crura.

The diaphragm not only serves to divide the thorax from the abdomen, but by its muscular structure is rendered one of the chief agents in respiration. When its fibres contract, its convex side, which is turned towards the thorax, becomes gradually flat, and by increasing the cavity of the breast, affords room for a complete dilatation of the lungs, by means of the air which is then drawn into them by the act of inspiration. The fibres of the diaphragm then relax; and as it resumes its former state, the cavity of the thorax becomes gradually diminished, and the air is driven out again from the lungs by a motion contrary to the former one, called *exspiration.*

* Anatomical writers have usually described the diaphragm as being made up of two muscles united by a middle tendon; and these two portions or crura form what they speak of as the *inferior muscle*, arising from the sides and fore-part of the vertebræ.

It is in some measure, by means of the diaphragm, that we void the fæces at the anus, and empty the urinary bladder. Besides these offices, the acts of coughing, sneezing, speaking, laughing, gaping, and sighing, could not take place without its assistance ; and the gentle pressure which all the abdominal viscera receive from its constant and regular motion, cannot fail to assist in the performance of the several functions which were ascribed to those viscera.

Sect. V. *Of the Trachea.*

The trachea or windpipe, is a cartilaginous and membranous canal, through which the air passes into the lungs. Its upper part, which is called the *larynx*, is composed of five cartilages. The uppermost of these cartilages is placed over the glottis or mouth of the larynx, and is called *epiglottis*, which has been before spoken of, as closing the passage to the lungs in the act of swallowing. At the sides of the glottis are placed the two arytenoide cartilages, which are of a very complex figure, not easy to be described. The anterior and larger part of the larynx is made up of two cartilages ; one of which is called *thyroides* or *scutiformis*, from its being shaped like a buckler ; and the other *cricoides* or *annularis*, from its resembling a ring. Both these cartilages may be felt immediately under the skin, at the fore-part of the throat, and the thyroides, by its convexity, forms an eminence called *po-*

mum adami, which is usually more considerable in the male than in the female subject.

All these cartilages are united to each other by means of very elastic, ligamentous fibres; and are enabled by the assistance of their several muscles, to dilate or contract the passage of the larynx, and to perform that variety of motion which seems to point out the larynx as the principal organ of the voice; for when the air passes out through a wound in the trachea, it produces no sound.

These cartilages are moistened by a mucus which seems to be secreted by minute glands situated near them. The upper part of the trachea is covered anteriorly and laterally by a considerable body, which is supposed to be of a glandular structure, and from its situation near the thyroid cartilage is called the *thyroid gland;* though its excretory duct has not yet been discovered, or its use ascertained.

The glottis is interiorly covered by a very fine membrane, which is moistened by a constant supply of a watery fluid. From the larynx the canal begins to take the name of *trachea* or *aspera arteria*, and extends from thence as far down as the third or fourth vertebra of the back, where it divides into two branches which are the right and left bronchial tube. Each of these bronchi* ramifies

* The right bronchial tube is usually found to be somewhat shorter and thicker than the left; and M. Portal, who has published a memoir on the action of the lungs on the aorta in respiration, obferves that the left bronchial tube is closely connected by the aorta; and from some experiments he is induced to conclude, that in the first respirations the air only enters into the right lobe of the lungs. *Memoires de l' Academie Royale des Sciences*, 1769.

through the substance of that lobe of the lungs to which it is distributed, by an infinite number of branches, which are formed of cartilages separated from each other like those of the trachea, by an intervening membranous and ligamentary substance. Each of these cartilages is of an angular figure; and as they become gradually less and less in their diameter, the lower ones are in some measure received into those above them, when the lungs, after being inflated, gradually collapse by the air being pushed out from them in exspiration. As the branches of the bronchi become more minute, their cartilages become more and more angular and membranous, till at length they are found to be perfectly membranous, and at last become invisible.

The trachea is furnished with fleshy or muscular fibres; some of which pass through its whole extent longitudinally, while the others are carried round it in a circular direction; so that by the contraction or relaxation of these fibres, it is enabled to shorten or lengthen itself, and likewise to dilate or contract the diameter of its passage.

The trachea and its branches, in all their ramifications, are furnished with a great number of small glands which are lodged in their cellular substance, and discharge a mucous fluid on the inner surface of these tubes.

The cartilages of the trachea, by keeping it constantly open, afford a free passage to the air which we are obliged to be incessantly respiring; and its membranous part, by being capable of contraction and dilatation, enables us to receive and expel the air in a greater or less quantity, and with more or less velocity, as may be required in singing or in declamation. This membranous structure of the trachea posteriorly, seems likewise to assist in the descent of the food, by preventing that impediment to its passage down the œsophagus, which might be expected if the cartilages were complete rings.

The trachea receives its arteries from the carotid and subclavian arteries, and its veins pass into the jugulars. Its nerves arise from the recurrent branch of the eighth pair, and from the cervical plexus.

Sect. VI. *Of the Lungs.*

The lungs fill the greater part of the cavity of the breast. They are of a soft and spongy texture, and are divided into two lobes, which are separated from each other by the mediastinum, and are externally covered by a production of the pleura. Each of these is divided into two or three lesser lobes; and we commonly find three in the right side of the cavity, and two in the left.

To discover the structure of the lungs, it is required to follow the ramifications of the bronchi, which were described in the last section. These becoming gradually more and more minute, at length terminate in the cellular spaces or vesicles, which make up the greatest part of the substance of the lungs, and readily communicate with each other.

The lungs seem to possess but little sensibility. Their nerves, which are small and few in number, are derived from the intercostal and eighth pair. This last pair having reached the thorax, sends off a branch on each side of the trachea, called the *recurrent*, which reascends at the back part of the trachea, to which it furnishes branches in its ascent, as well as to the œsophagus, but it is chiefly distributed to the larynx and its muscles. By dividing the recurrent and superior laryngeal nerves at their origin, an animal is deprived of its voice.

There are two series of arteries which carry blood to the lungs: these are the arteriæ bronchiales, and the pulmonary artery.

The arteriæ bronchiales begin usually by two branches; one of which commonly arises from the right intercostal, and the other from the trunk of the aorta: but sometimes there are three of these arteries, and in some subjects only one. The use of these arteries is to serve for the nourishment of the lungs, and their ramifications are seen creeping every where on the branches of the bronchi. The blood is brought back from them by the bronchial vein into the vena azygos.

The pulmonary artery and vein are not intended for the nourishment of the lungs; but the blood in its passage through them is destined to undergo some changes, or to acquire certain essential properties (from the action of the air), which it has lost in its circulation through the other parts of the body. The pulmonary artery receives the blood from the right ventricle of the heart, and dividing into two branches, accompanies the bronchi every where, by its ramifications through the lungs; and the blood is afterwards conveyed back by the pulmonary vein, which gradually forming a considerable trunk, goes to empty itself into the left ventricle of the heart; so that the quantity of blood which enters into the lungs, is perhaps greater than that which is sent in the same proportion of time through all the other parts of the body.

SECT. VII. *Of Respiration.*

RESPIRATION constitutes one of those functions which are properly termed *vital*, as being essential to life; for to live and to breathe are in fact synonymous terms. It consists in an alternate contraction and dilatation of the thorax, by first inspiring air into the lungs, and then expelling it from them in exspiration.

It will perhaps be easy to distinguish and point out the several phenomena of respiration; but to explain their physical cause will be attended with difficulty, for it will naturally be inquired, how the lungs, when emptied of the air, and contracted by exspiration, become again inflated, they themselves being perfectly passive? How the ribs are elevated in opposition to their own natural situation? and why the diaphragm is contracted downwards towards the abdomen? Were we to assert that the air, by forcing its way into the cavity of the lungs, dilated them, and consequently elevated the ribs, and pressed down the diaphragm, we should speak erroneously. What induces the first inspiration, it is not easy to ascertain; but after an animal has once respired, it would seem likely that the blood, after exspiration, finding its passage through the lungs obstructed, becomes a stimulus, which induces the intercostal muscles and the diaphragm to contract, and enlarge the cavity of the thorax, in consequence perhaps of a certain nervous influence, which we will not here attempt to explain. The air then rushes into the lungs; every branch of the bronchial tubes, and all the cellular spaces into which they open, become fully dilated; and the pulmonary vessels being equally distended, the blood flows through them with ease. But as the stimulus which first occasioned this dilatation ceases to operate, the muscles gradually contract, the diaphragm rises upwards again, and diminishes the cavity of the chest; the ribs return to their former state; and as the air passes out in exspiration, the lungs gradually collapse, and a resistance to the passage of the blood again takes place. But the heart continuing to receive and expel the blood, the pulmonary artery begins again to be distended, the stimulus is renewed, and the same process is repeated, and continues to be repeated, in a regular succession, during life: for though the muscles of respiration, having a mixed motion, are (unlike the heart) in some measure dependent on the will, yet no human being, after having once respired, can live many moments without it. In an attempt to hold one's breath, the blood soon begins to distend the veins, which are unable to empty their contents into the heart; and we are able only, during a very little time, to resist the stimulus to inspiration. In drowning, the circulation seems to be stopped upon this principle; and in hanging, the pressure made on the jugular veins, may co-operate with the stoppage of respiration in bringing on death.

Till within these few years physiologists were entirely ignorant of the use of respiration. It was at length discovered in part by the illustrious Dr. Priestley. He found that the air exspired by animals was phlogisticated; and that the air was fitter for respiration, or for supporting animal life, in proportion as it was freer from the phlogistic principle. It had long been observed, that the blood in passing through the lungs acquired a more florid colour. He therefore suspected, that it was owing to its having imparted phlogiston to the air: and he satisfied himself of the truth of this idea, by experiments, which showed, that the crassamentum of extravasated blood, phlogisticated air in proportion as it lost its dark colour. He farther found, that blood thus reddened had a strong attraction for phlogiston; insomuch that it was capable of taking it from phlogisticated air, thereby becoming of a darker colour. From hence it appeared that the blood, in its circulation through the arterial system, imbibes a considerable quantity of phlogiston, which is discharged from it to the air in the lungs.

This discovery has since been prosecuted by two very ingenious physiologists, Dr. Crawford and Mr. Elliot. It had been shown by professors Black and Irvine, that different bodies have different capacities for containing fire. For example, that oil and water, when equally hot to the sense and the thermometer, contain different proportions of that principle; and that unequal quantities of it are required, in order to raise those substances to like temperatures. The inquiries of Dr. Crawford and Mr. Elliot tend to prove, that the capacities of bodies for containing fire are diminished by the addition of phlogiston, and increased by its separation: the capacity of calx of antimony, for example, being greater than that of the antimony itself. Common air contains a great quantity of fire; combustible bodies very little. In combustion, a double elective attraction takes place; the phlogiston of the body being transferred to the air, the fire contained in the air to the combustible body. But as the capacity of the latter is not increased so much as that of the former is diminished, only part of the extricated fire will be absorbed by the body. The remainder therefore will raise the temperature of the compound; and hence we may account for the heat attending combustion. As the use of respiration is to dephlogisticate the blood, it seems probable, that a like double elective attraction takes place in this process; the phlogiston of the blood being transferred to the air, and the fire contained in the air to the blood; but with this difference, that the capacities being equal, the whole of the extricated fire is absorbed by the latter. The blood in this state circulating through the body, imbibes phlogiston, and of course gives out its fire; part only of which is absorbed by the parts furnishing the phlogiston, the remainder, as in combustion, becoming sensible; and is therefore the cause of the heat of the body, or what is called animal heat.

In confirmation of this doctrine it may be observed, that the venous blood contains less fire than the arterial; combustible bodies less than incombustible ones; and that air contains less of this principle, according as it is rendered, by combination with phlogiston, less fit for respiration.*

In ascending very high mountains, respiration is found to become short and frequent, and sometimes to be attended with a spitting of blood. These symptoms seem to be occasioned by the air being too rare and thin to dilate the lungs sufficiently; and the blood gradually accumulating in the pulmonary vessels, sometimes bursts through their coats, and is brought up by coughing. This has likewise been accounted for in a different way, by supposing that the air contained in the blood, not receiving an equal pressure from that of the atmosphere, expands, and at length ruptures the very minute branches of the pulmonary vessels; upon the same principle that fruits and animals put under the receiver of an air-pump, are seen to swell as the outer air becomes exhausted. But Dr. Darwin of Litch-

* See Crawford's Experiments and Observations on Animal Heat, and Elliot's Philosophical Observations.

field has lately published some experiments, which seem to prove, that no air or elastic vapour does exist in the blood-vessels, as has been generally supposed; and he is induced to impute the spitting of blood, which has sometimes taken place in ascending high mountains, to accident, or to violent exertions; as it never happens to animals that are put into the exhausted receiver of an air-pump, where the diminution of pressure is many times greater than on the summit of the highest mountains.

SECT. VIII. *Of the Voice.*

RESPIRATION has already been described as affording us many advantages; and next to that of life, its most important use seems to be that of forming the voice and speech. The ancients, and almost all the moderns, have considered the organ of speech as a kind of musical instrument, which may be compared to a flute, to an hautboy, to an organ, &c. and they argue after the following manner.

The trachea, which begins at the root of the tongue, and goes to terminate in the lungs, may be compared to the pipe of an organ, the lungs dilating like bellows during the time of inspiration; and as the air is driven out from them in exspiration, it finds its passage straitened by the cartilages of the larynx, against which it strikes. As these cartilages are more or less elastic, they occasion in their turn more or less vibration in the air, and thus produce the sound of the voice; the variation in the sound and tone of which depends on the state of the glottis, which, when straitened, produces an acute tone, and a grave one when dilated.

The late M. Ferein communicated to the French Academy of Sciences a very ingenious theory on the formation of the voice. He considered the organ of the voice as a *string*, as well as a *wind*, instrument; so that what art has hitherto been unable to construct, and what both the fathers Mersenne and Kircher so much wished to see, M. Ferein imagined he had at length discovered in the human body. He observes, that there are at the edges of the glottis certain tendinous chords, placed horizontally across it, which are capable of considerable vibration, so as to produce sound, in the same manner as it is produced by the strings of a violin or a harpsichord: and he supposes that the air, as it passes out from the lungs, acts as a bow on these strings, while the efforts of the breast and lungs regulate its motion, and produce the variety of tones. So that according to this system the variation in the voice is not occasioned by the dilatation or contraction of the glottis, but by the distention or relaxation of these strings, the sound being more or less acute in proportion as they are more or less stretched out. Another writer on this subject supposes, that the organ of voice is a double instrument, which produces in unison two sounds of a different nature; one by means of the air, and the other by means of the chords of the glottis. Neither of these systems, however, are universally adopted. They are both liable to insuperable difficulties; so that the manner in which the voice is formed has never yet been satisfactorily ascertained: we may observe, however, that the sound produced by the glottis is not articulated. To effect this, it is required to pass through the mouth, where it is differently modified by the action of the tongue, which is either pushed against the teeth, or upwards towards the palate; detaining it in its passage, or permitting it to flow freely, by contracting or dilating the mouth.

Sect. IX. *Of Dejection.*

By dejection we mean the act of voiding the fæces at the anus; and an account of the manner in which this is conducted was reserved for this part of the work, because it seemed to require a knowledge of respiration to be perfectly understood.

The intestines were described as having a peristaltic motion, by which the fæces were gradually advancing towards the anus. Now, whenever the fæces are accumulated in the intestinum rectum in a sufficient quantity to become troublesome, either by their weight or acrimony, they excite a certain uneasiness which induces us to go to stool.—To effect this, we begin by making a considerable inspiration; in consequence of which the diaphragm is carried downwards towards the lower belly; the abdominal muscles are at the same time contracted in obedience to the will; and the intestines being compressed on all sides, the resistance of the *sphincter* is overcome, and the fæces pass out at the anus; which is afterwards drawn up by its longitudinal fibres, which are called *levatores ani*, and then by means of its *sphincter* is again contracted: but it sometimes happens, as in dysenteries for instance, that the fæces are very liquid, and have considerable acrimony; and then the irritation they occasion is more frequent, so as to promote their discharge without any pressure from the diaphragm or abdominal muscles; and sometimes involuntarily, as is the case when the sphincter becomes paralytic.

Sect. X. *Of the Pericardium, and of the Heart and its Auricles.*

The two membranous bags of the pleura, which were described as forming the mediastinum, recede one from the other, so as to afford a lodgment to a firm membranous sac, in which the heart is securely lodged; this sac, which is the *pericardium*, appears to be composed of two tunics, united to each other by cellular membrane.—The outer coat, which is thick, and in some places of tendinous complexion, is a production of the mediastinum; the inner coat, which is extremely thin, is reflected over the auricles and ventricles of the heart, in the same manner as the tunica conjunctiva, after lining the eye-lids, is reflected over the eye.

This bag adheres to the tendinous part of the diaphragm, and contains a coagulable lymph, the *liquor pericardii*, which serves to lubricate the heart and facilitate its motions; and seems to be secreted and absorbed in the same manner as it is in the other cavities of the body.

The arteries of the pericardium are derived from the phrenic, and its veins pass into veins of the same name; its nerves are likewise branches of the phrenic.

The size of the pericardium is adapted to that of the heart, being usually large enough to contain it loosely. As its cavity does not extend to the sternum, the lungs cover it in inspiration; and as it every where invests the heart, it effectually secures it from being injured by lymph, pus, or any other fluid, extravasated into the cavities of the thorax.

The heart is a hollow muscle of a conical shape, situated transversely between the two laminæ of the mediastinum, at the lower part of the thorax; having its basis turned towards the right side, and its point or apex towards the left.—Its lower surface is somewhat flattened towards the diaphragm. Its basis, from which the great vessels originate, is covered with fat, and it has two hollow and fleshy appendages, called *auricles*.—Round these several openings, the heart seems to be of a firm ligamentous texture, from which all its fibres seem to originate; and as they advance from thence towards the apex, the substance of the heart seems to become thinner.

The heart includes two cavities or *ventricles*, which are separated from each other by a fleshy septum; one of these is called the *right*, and the other the *left*, *ventricle;* though perhaps, with respect to their situation, it would be more proper to distinguish them into the *anterior* and *posterior ventricles*.

The heart is exteriorly covered by a very fine membrane; and its structure is perfectly muscular or fleshy, being composed of fibres which are described as passing in different directions; some as being extended longitudinally from the basis to the apex; others, as taking an oblique or spiral course; and a third sort as being placed in a transverse direction.* —Within the two ventricles we observe several furrows; and there are likewise tendinous strings, which arise from fleshy *columnæ* in the two cavities, and are attached to the valves of the auricles: That the use of these and the other valves of the heart may be understood, it must be observed, that four large vessels pass out from the basis of the heart, viz. two arteries and two veins: and that each of these vessels is furnished with a thin membranous production, which is attached all round to the borders of their several orifices, from whence hanging loosely down they appear to be divided into two or three distinct portions. But as

* Authors differ about the course and distinctions of these fibres; and it seems right to observe, that the structure of the heart being more compact than that of other muscles, its fibres are not easily separated.

their uses in the arteries and veins are different, so are they differently disposed. Those of the arteries are intended to give way to the passage of the blood into them from the ventricles, but to oppose its return: and, on the contrary, the valves of the veins are constructed so as to allow the blood only to pass into the heart. In consequence of these different uses, we find the valves of the pulmonary artery and of the aorta attached to the orifices of those vessels, so as to have their concave surfaces turned towards the artery; and their convex surfaces, which mutually meet together, being placed towards the ventricle, only permit the blood to pass one way, which is into the arteries. There are usually three of these valves belonging to the pulmonary artery, and as many to the aorta; and from their figure they are called *valvulæ semilunares.* The communication between the two great veins and the ventricles is by means of the two appendages or auricles into which the blood is discharged; so that the other valves which may be said to belong to the veins, are placed in each ventricle, where the auricle opens into it. The valves in the right ventricle are usually three in number, and are named *valvulæ tricuspides;* but in the left ventricle we commonly observe only two, and these are the *valvulæ mitrales.* The membranes which form these valves in each cavity are attached so as to project somewhat forward; and both the *tricuspides* and the *mitrales* are connected with the tendinous strings, which were described as arising from the fleshy *columnæ.* By the contraction of either ventricle, the blood is driven into the artery which communicates with that ventricle; and these tendinous strings being gradually relaxed as the sides of the cavity are brought nearer to each other, the valves naturally close the opening into the auricle, and the blood necessarily directs its course into the then only open passage, which is into the artery; but after this contraction, the heart becomes relaxed, the tendinous strings are again stretched out, and, drawing the valves of the auricle downwards, the blood is poured by the veins into the ventricle, from whence, by another contraction, it is again thrown into the artery, as will be described hereafter. The right ventricle is not quite so long, though somewhat larger, than the left; but the latter has more substance than the other: and this seems to be, because it is intended to transmit the blood to the most distant parts of the body, whereas the right ventricle distributes it only to the lungs.

The heart receives its nerves from the par vagum and the intercostals. The arteries which serve for its nourishment are two in number, and arise from the aorta. They surround in some measure the basis of the heart, and from this course are called the *coronary arteries.* From these arteries the blood is returned by veins of the same name into the auricles, and even into the ventricles.

The muscular bags called the *auricles* are situated at the basis of the heart, at the sides of each other; and, corresponding with the two ventricles, are like those two cavities distinguished into *right* and *left*. These sacs, which are interiorly unequal, have externally a jagged appendix; which, from its having been compared to the extremity of an ear, has given them their name of *auricles*.

SECT. XI. *Angiology, or a Description of the Blood-vessels.*

THE heart has been described as contracting itself, and throwing the blood from its two ventricles into the pulmonary artery and the aorta, and then as relaxing itself and receiving a fresh supply from two large veins, which are the pulmonary vein and the vena cava. We will now point out the principal distributions of these vessels.

The *pulmonary artery* arises from the right ventricle by a large trunk, which soon divides into two considerable branches, which pass to the right and left lobes of the lungs; each of these branches is afterwards divided and subdivided into an infinite number of branches and ramifications, which extend through the whole substance of the lungs; and from these branches the blood is returned by the veins, which, contrary to the course of the arteries, begin by very minute canals, and gradually become larger, forming at length four large trunks called *pulmonary veins*, which terminate in the *left auricle* by one common opening, from whence the blood passes into the *left ventricle*. From this same ventricle arises the *aorta* or *great artery*, which at its beginning is nearly an inch in diameter; it soon sends off two branches, the *coronaries*, which go to be distributed to the heart and its auricles. After this, at or about the third or fourth vertebra of the back, it makes a considerable curvature; from this curvature * arise three arteries; one of which soon divides into two branches. The first two are the left subclavian and the left carotid, and the third is a common trunk to the right subclavian and right carotid; though sometimes both the carotids arise distinctly from the aorta.

The two *carotids* ascend within the subclavians, along the sides of the trachea; and when they have reached the larynx, divide into two principal branches, the *internal* and *external carotid*. The first of these runs a little way backwards in a bending direction; and having reached the under part of the ear, passes through the canal into the os petrosum, and entering into the cavity of the cranium, is distributed to the brain and the membranes which envelope it, and likewise to the eye. The *external carotid* divides into several branches, which are distributed to the larynx, pharynx, and other parts of the neck; and to the jaws, lips, tongue, eyes, temples, and all the external parts of the head.

* Anatomists usually call the upper part of this curvature *aorta ascendens*; and the other part of the artery to its division at the iliacs, *aorta descendens*: but they differ about the place where this distinction is to be introduced; and it seems sufficiently to answer every purpose, to speak only of the aorta and its curvature.

Each *subclavian* is likewise divided into a great number of branches. It sends off the *vertebral artery*, which passes through the openings we see at the bottom of the transverse processes of the vertebræ of the neck, and in its course sends off many ramifications to the neighbouring parts. Some of its branches are distributed to the spinal marrow, and after a considerable inflection it enters into the cranium, and is distributed to the brain. The *subclavian* likewise sends off branches to the muscles of the neck and scapula; and the mediastinum, thymus, pericardium, diaphragm, the breasts, and the muscles of the thorax, and even of the abdomen, derive branches from the subclavian, which are distinguished by different names, alluding to the parts to which they are distributed; as the *mammary*, the *phrenic*, the *intercostal*, &c. But notwithstanding the great number of branches which have been described as arising from the subclavian, it is still a considerable artery when it reaches the *axilla*, where it drops its former name, which alludes to its passage under the clavicle, and is called the *axillary* artery; from which a variety of branches are distributed to the muscles of the breast, scapula, and arm.—But its main trunk taking the name of *brachialis*, runs along on the inside of the arm near the os humeri, till it reaches the joint of the fore-arm, and then it divides into two branches. This division however is different in different subjects; for in some it takes place higher up and in others lower down. When it happens to divide above the joint, it may be considered as a happy disposition in case of an accident by bleeding; for supposing the artery to be unfortunately punctured by the lancet, and that the hæmorrhage could only be stopped by making a ligature on the vessel, one branch would remain unhurt, through which the blood would pass uninterrupted to the fore-arm and hand. One of the two branches of the brachialis plunges down under the flexor muscles, and runs along the edge of the ulna; while the other is carried along the outer surface of the radius, and is easily felt at the wrist, where it is only covered by the common integuments. Both these branches commonly unite in the palm of the hand, and form an arterial arch from whence branches are detached to the fingers.

The *aorta*, after having given off at its curvature the carotids and subclavians which convey blood to all the upper parts of the body, descends upon the bodies of the vertebræ a little to the left, as far as the os sacrum, where it drops the name of *aorta*, and divides into two considerable branches. In this course, from its curvature to its bifurcation, it sends off several arteries in the following order: 1. One or two little arteries, first demonstrated by Ruysch as going to the bronchi, and called *arteriæ bronchinales Ruyschii*. 2. The arteriæ œsophageæ. These are commonly three or four in number. They arise from the fore-part of the aorta, and are distributed chiefly to the œsophagus. 3. The inferior intercostal arteries, which are distributed between the ribs in the same manner as the arteries of the three or four superior ribs are, which are derived from the subclavian. These arteries send off branches to the medulla spinalis. 4. The diaphragmatic or inferior phrenic arteries, which go to the diaphragm, stomach, omentum, duodenum, pancreas, spleen, liver, and gall-bladder. 5. The cœliac, which sends off the coronary-stomachic, the splenic, and the hepatic artery. 6. The superior mesenteric artery, which is distributed to the mesentery and small intestines, 7. The emulgents, which go to the kidneys. 8. The arteries, which are distributed to the glandulæ renales. 9. The spermatic. 10. The inferior mesenteric artery, which ramifies through the lower portion of the mesentery and the large intestines.—A branch of this artery which goes to the rectum is called the *internal hæmorrhoidal*. 11. The lumbar arteries, and a very small branch called the *sacra*, which are distributed to the muscles of the loins and abdomen, and to the os sacrum and medulla spinalis.

The trunk of the aorta, when it has reached the last vertebra lumborum, or the os sacrum, drops the name of *aorta*, and separates into two forked branches called the *iliacs*. Each of these soon divides into two branches; one of which is called the *internal iliac*, or *hypogastric artery*, and is distributed upon the contents of the pelvis and upon the muscles on its outer side. One branch, called *pudenda communis*, sends small ramifications to the end of the rectum under the name of *hæmorrhoidales externæ*, and is afterwards distributed upon the penis. The other branch, the external iliac, after having given off the circumflex artery of the os ilium and the epigastric, which is distributed to the recti-muscles, passes out of the abdomen under Poupart's ligament, and takes the name of *crural artery.* It descends on the inner part of the thigh close to the os femoris, sending off branches to the muscles, and then sinking deeper in the hind part of the thigh, reaches the ham, where it takes the name of *popliteal:* after this it separates into two considerable branches; one of which is called the *anterior tibial artery;* the other divides into two branches, and these arteries all go to be distributed to the leg and foot.

The blood, which is thus distributed by the aorta to all parts of the body, is brought back by the veins, which are supposed to be continued from the ultimate branches of arteries; and uniting together as they approach the heart, at length form the large trunks, the vena cava ascendens, and vena cava descendens.

All the veins which bring back the blood from the upper extremities, and from the head and breast, pass into the vena cava descendens; and those which return it from the lower parts of the body terminate in the vena cava ascendens; and these two cavas uniting together as they approach the heart, open by one common orifice into the left auricle.

It does not here seem to be necessary to follow the different divisions of the veins as we did those of the arteries; and it will be sufficient to remark, that in general every artery is accompanied by its vein, and that both are distinguished by the same name. But, like many other general rules, this too has its exceptions.* The veins for instance, which accompany the external and internal carotid, are not called the *carotid veins*, but the *external* and *internal jugular*.—In the thorax, there is a vein distinguished by a proper name, and this is the *azygos*, or *vena sine pari*. This vein, which is a pretty considerable one, runs along by the right side of the vertebræ of the back, and is chiefly destined to receive the blood from the intercostals on that side, and from the lower half of those on the left side, and to convey it into the vena cava descendens. In the abdomen we meet with a vein, which is still a more remarkable one, and this is the *vena portæ*, which performs the office both of an artery and a vein. It is formed by a re-union of all the veins which come from the stomach, intestines, omentum, pancreas, and spleen, so as to compose one great trunk, which goes to ramify through the liver; and after having deposited the bile, its ramifications unite and bring back into the vena cava, not only the blood which the vena portæ had carried into the liver, but likewise the blood from the hepatic artery. Every artery has a vein which corresponds with it; but the trunks and branches of the veins are more numerous than those of the arteries. —The reasons for this disposition are perhaps more difficult to be explained; the blood in its course through the veins is much farther removed from the source and cause of its mo-

* In the extremities, some of the deep-seated veins, and all the superficial ones, take a course different from that of the arteries.

tion, which are in the heart, than it was when in the arteries; so that its course is consequently less rapid, and enough of it could not possibly be brought back to the heart in the moment of its dilatation, to equal the quantity which is driven into the arteries from the two ventricles, at the time they contract; and the equilibrium which is so essential to the continuance of life and health would consequently be destroyed, if the capacity of the veins did not exceed that of the arteries, in the same proportion that the rapidity of the blood's motion through the arteries exceeds that of its return through the veins.

A large artery ramifying through the body, and continued to the minute branches of veins, which gradually unite together to form a large trunk, may be compared to two trees united to each other at their tops; or rather as having their ramifications so disposed that the two trunks terminate in one common point; and if we farther suppose, that both these trunks and their branches are hollow, and that a fluid is incessantly circulated through them, by entering into one of the trunks and returning through the other, we shall be enabled to conceive how the blood is circulated through the vessels of the human body.

Every trunk of an artery, before it divides, is nearly cylindrical, or of equal diameter through its whole length, and so are all its branches when examined separately. But every trunk seems to contain less blood than the many branches do into which that trunk separates; and each of these branches probably contains less blood than the ramifications do into which it is subdivided: and it is the same with the veins; the volume of their several ramifications, when considered together, being found to exceed that of the great trunk which they form by their union.

The return of the blood through the veins to the heart, is promoted by the action of the muscles, and the pulsation of the arteries. And this return is likewise greatly assisted by the *valves* which are to be met with in the veins, and which constitute one of the great distinctions between them and the arteries. These valves, which are supposed to be formed by the inner coat of the veins, permit the blood to flow from the extremities towards the heart, but oppose its return. They are most frequent in the smaller veins. As the column of blood increases, they seem to become less necessary; and therefore in the vena cava ascendens, we meet with only one valve, which is near its origin.

The arteries are composed of several tunics. Some writers enumerate five of these tunics; but perhaps we may more properly reckon only three, viz. the *nervous*, *muscular*, and *cuticular* coats. The veins are by some anatomists described as having the same number of coats as the arteries; but as they do not seem to be irritable, we cannot with propriety suppose them to have a muscular tunic. We are aware of Dr. Verschuir's* experiments to prove that the jugular and some other veins possess a

* De Arteriarum et Venarum vi irritabili, 4to.

certain degree of irritability; but it is certain, that his experiments, repeated by others, have produced a different result; and even he himself allows, that sometimes he was unable to distinguish any such property in the veins. Both these series of vessels are nourished by still more minute arteries and veins, which are seen creeping over their coats, and ramifying through their whole substance, and are called *vasa vasorum:* they have likewise many minute branches of nerves.

The arteries are much stronger than the veins, and they seem to require this force to be enabled to resist the impetus with which the blood circulates through them, and to impel it on towards the veins.

When the heart contracts, it impels the blood into the arteries, and sensibly distends them; and these vessels again contract, as the heart becomes relaxed to receive more blood from the auricles; so that the cause of the contraction and dilatation of the arteries seems to be easy to be understood, being owing in part to their own contractile power, and in part to the action of the heart; but in the *veins*, the effects of this impulse not being so sensibly felt, and the vessels themselves having little or no contractile power, the blood seems to flow in a constant and equal stream: and this, together with its passing gradually from a small channel into a larger one, seems to be the reason why the *veins* have no pulsatory motion, except the large ones near the heart; and in these it seems to be occasioned by the motion of the diaphragm, and by the regurgitation of the blood in the *cavas*.

SECT. XII. *Of the Action of the Heart, Auricles, and Arteries.*

THE heart, at the time it contracts, drives the blood from its ventricles into the arteries; and the arteries being thus filled and distended, are naturally inclined to contract the moment the heart begins to dilate, and ceases to supply them with blood. These alternate motions of contraction and dilatation of the heart and arteries, are distinguished by the names of *systole* and *diastole*. When the heart is in a state of contraction or systole, the arteries are at that instant distended with blood, and in their diastole; and it is in this state we feel their pulsatory motion which we call the *pulse*. When the heart dilates, and the arteries contract, the blood is impelled onwards into the veins through which it is returned back to the heart. While the heart, however, is in its systole, the blood cannot pass from the veins into the ventricles, but is detained in the auricles, which are two reservoirs formed for this use, till the diastole, or dilatation of the heart, takes place; and then the distended auricles contract, and drive the blood into the ventricles; so that the auricles have an alternate systole and diastole as well as the heart.

Although both the ventricles of the heart contract at the same time, yet the blood passes from one to the other. In the same moment, for instance, that the left ventricle drives the blood into the aorta, the right ventricle impels it into the pulmonary artery, which is distributed through all the substance of the lungs. The blood is afterwards brought back into the left ventricle by the pulmonary vein, at the same time that the blood is returned by the cavas, into the right ventricle, from all the other parts of the body.

This seems to be the mode of action of the heart and its vessels ; but the cause of this action has, like all other intricate and interesting subjects, been differently explained. It seems to depend on the stimulus made on the different parts of the heart by the blood itself, which by its quantity and heat, or other properties,* is perhaps capable of first exciting that motion, which is afterwards continued through life, independent of the will, by a regular return of blood to the auricles, in a quantity proportioned to that which is thrown into the arteries.

The heart possesses the *vis insita*, or principle of irritability, in a much greater degree than any other muscle of the body. The pulse is quicker in young than in old subjects, because the former are *cæt. par.* more irritable than the latter. Upon the same principle we may explain, why the pulse is constantly quicker in weak than in robust persons.

* Dr. Harvey long ago suggested, that the blood is possessed of a living principle ; and Mr. J. Hunter has lately endeavoured to revive this doctrine : in support of which he has adduced many ingenious arguments. The subject is a curious one, and deserves to be prosecuted as an inquiry which cannot but be interesting to physiologists.

Sect. XIII. *Of the Circulation.*

After what has been observed of the structure and action of the heart and its auricles, and likewise of the arteries and veins, there seem to be but very few arguments required to demonstrate the *circulation of the blood*, which has long since been established as a medical truth. This circulation may be defined to be a perpetual motion of the blood, in consequence of the action of the heart and arteries, which impel it through all the parts of the body, from whence it is brought back by the veins of the heart.

A very satisfactory proof of this circulation, and a proof easy to be understood, may be deduced from the different effects of pressure on an artery and a vein. If a ligature, for instance, is passed round an artery, the vessel swells considerably between the ligature and the heart; whereas if we tie up a vein, it only becomes filled between the extremity and the ligature, and this is what we every day observe in bleeding. The ligature we pass round the arm on these occasions, compresses the superficial veins; and the return of the blood through them being impeded, they become distended. When the ligature is too loose, the veins are not sufficiently compressed, and the blood continues its progress towards the heart; and, on the contrary, when it is made too tight, the arteries themselves become compressed;

and the flow of the blood through them being impeded, the veins cannot be distended.

Another phænomenon, which effectually proves the circulation, is the loss of blood that every living animal sustains by opening only a single artery of a moderate size; for it continues to flow from the wounded vessel till the equilibrium is destroyed which is essential to life. This truth was not unknown to the ancients; and it seems strange that it did not lead them to a knowledge of the circulation, as it sufficiently proves, that all the other vessels must communicate with that which is opened. Galen, who lived more than 1500 years ago, drew this conclusion from it; and if we farther observe, that he describes (after Erasistratus, who flourished about 450 years before him) the several valves of the heart, and determines their disposition and uses, it will appear wonderful, that a period of near 2000 years should afterwards elapse before the true course of the blood was ascertained. This discovery, for which we are indebted to the immortal Harvey, has thrown new lights on physiology and the doctrine of diseases, and constitutes one of the most important periods of anatomical history.

Sect. XIV. *Of the Nature of the Blood.*

Blood, recently drawn from a vein into a bason, would seem to be an homogeneous fluid of a red colour;* but when suffered to rest, it soon coagulates, and divides into two parts, which are distinguished by the names of *crassamentum* and *serum*. The crassamentum is the red coagulum, and the serum is the water in which it floats. Each of these may be again separated into two others; for the crassamentum, by being repeatedly washed in warm water, gives out all its red globules, and what remains appears to be composed of the coagulable lymph,† which is a gelatinous substance, capable of being hardened by fire till it becomes perfectly horny: and if we expose the serum to a certain degree of heat, part of it will be found to coagulate like the white of an egg, and there will remain a clear and limpid water, resembling urine both in its appearance and smell.

The serum and crassamentum differ in their proportion in different constitutions; in a strong person, the crassamentum is in a greater proportion to the serum than in a weak one;‡ and the same difference is found to take place in diseases.§

* The blood, as it flows through the arteries, is observed to be more florid than it is in the veins; and this redness is acquired in its passage through the lungs. *Vid.* sect. vii.

† It may not be improper to observe, that till of late the *coagulable lymph* has been confounded with the *serum* of the blood, which contains a substance that is likewise coagulable, though only when exposed to heat, or combined with certain chemical substances; whereas the other coagulates spontaneously when exposed to the air or to rest.

‡ Hewson's Experim. Enq. Part I.

§ When the blood separates into *serum* and *crassamentum*, if the latter be covered with a crust of a whitish or buff colour, it has been usually considered as a certain proof of the blood's being in a state of too great viscidity. This appearance commonly taking place in inflammatory diseases, has long served to confirm the

Sect. XV. *Of Nutrition.*

The variety of functions which we have described as being incessantly performed by the living body, and the continual circulation of the blood through it, must necessarily occasion a constant dissipation of the several parts which enter into its composition. In speaking of the insensible perspiration, we observed how much was incessantly passing off from the lungs and the surface of the skin. The discharge by urine is likewise every day considerable; and great part of the bile, saliva, &c. are excluded by stool. But the solid, as well as the fluid parts of the body, require a constant renewal of nutritious particles. They are exposed to the attrition of the fluids which are circulated through them; and the contraction and relaxation they repeat so many thousand times in every day, would necessarily occasion a dissolution of the machine, if the renewal was not proportioned to the waste.

It is easy to conceive how the chyle formed from the aliment is assimilated into the nature

theory which ascribes the cause of inflammation to lentor and obstructions. But from the late Mr. Hewson's experiments it appears, that when the action of the arteries is increased, the blood, instead of being more viscid, is, on the contrary, more fluid than in the ordinary state, previous to inflammation; and that in consequence of this, the coagulable lymph suffers the red globules, which are the heaviest part of the blood, to fall down to the bottom before it coagulates; so that the crassamentum is divided into two parts: one of which is found to consist of the coagulable lymph alone (in this case termed the *buff*); and the other, partly of this and partly of the red globules.

of blood, and repairs the loss of the fluid parts of our body; but how the solids are renewed, has never yet been satisfactorily explained. The nutritious parts of the blood are probably deposited by the arteries by exsudation through their pores into the tela cellulosa; and as the solid parts of the body are in the embryo only a kind of jelly, which gradually acquires the degree of consistence they are found to have when the body arrives at a more advanced age; and these same parts which consist of bones, cartilages, ligaments, muscles, &c. are sometimes reduced again by disease to a gelatinous state; we may, with some degree of probability, consider the coagulable lymph as the source of nutrition.

If the supply of nourishment exceeds the degree of waste, the body increases; and this happens in infancy and in youth: for at those periods, but more particularly the former one, the fluids bear a large proportion to the solids; and the fibres being soft and yielding, are proportionably more capable of extension and increase. But when the supply of nutrition only equals the waste, we neither increase nor decrease; and we find this to be the case when the body has attained its full growth or *acmé*: for the solids having then acquired a certain degree of firmness and rigidity, do not permit a farther increase of the body. But as we approach to old age, rigidity begins to be in excess, and the fluids * bear a much less propor-

* As the fluids become less in proportion to the solids, their acrimony is found to increase; and this may perhaps compensate for the want of fluidity in the blood by diminishing its cohesion.

tion to the solids than before. The dissipation of the body is greater than the supply of nourishment; many of the smaller vessels become gradually impervious;* and the fibres losing their moisture and their elasticity, appear flaccid and wrinkled. The lilies and the roses disappear, because the fluids by which they were produced can no longer reach the extremities of the capillary vessels of the skin. As these changes take place, the nervous power being proportionably weakened, the irritability and sensibility of the body, which were formerly so remarkable, are greatly diminished; and in advanced life, the hearing, the eye-sight, and all the other senses, become gradually impaired.

SECT. XVI. *Of the Glands and Secretions.*

THE glands are commonly understood to be small, roundish, or oval bodies formed by the convolution of a great number of vessels, and destined to separate particular humours from the mass of blood.

They are usually divided into two classes; but it seems more proper to distinguish three kinds of glands, viz. the mucous, conglobate, and conglomerate.

The *mucous glands*, or follicles, as they are most commonly called, are small cylindrical

* In infancy, the arteries are numerous and large in respect to the veins, and the lymphatic glands are larger than at any other time of life; whereas, in old age, the capacity of the venous system exceeds that of the arteries, and the lymphatic system almost disappears.

tubes continued from the ends of arteries. In some parts of the body, as in the tonsils, for example, several of these follicles may be seen folded together in one common covering, and opening into one common sinus. These follicles are the vessels that secrete and pour out mucus in the mouth, œsophagus, stomach, intestines, and other parts of the body.

The *conglobate glands* are peculiar to the lymphatic system. Every lymphatic vein passes through a gland of this kind in its way to the thoracic duct. They are met with in different parts of the body, particularly in the axilla, groin, and mesentery, and are either solitary or in distinct clusters.

The *conglomerate glands* are of much greater bulk than the conglobate, and seem to be an assemblage of many smaller glands. Of this kind are the liver, kidneys, &c. Some of them, as the pancreas, parotids, &c. have a granulated appearance. All these conglomerate glands are plentifully supplied with blood-vessels; but their nerves are in general very minute, and few in number. Each little granulated portion furnishes a small tube, which unites with other similar ducts, to form the common excretory duct of the gland.

The principal glands, and the humours they secrete, have been already described in different parts of this work; and there only remains for us to examine the general structure of the glands, and to explain the mechanism of secretion. On the first of these subjects two different systems have been formed; each of which has had, and still continues to have, its adherents. One of these systems was advanced by Malpighi, who supposed that an artery entering into a gland ramifies very minutely through its whole substance; and that its branches ultimately terminate in a vesicular cavity or follicle, from whence the secreted fluid passes out through the excretory duct. This doctrine at first met with few opponents; but the celebrated Ruysch, who first attempted minute injections with wax, afterwards disputed the existence of these follicles, and asserted, that every gland appears to be a continued series of vessels, which after being repeatedly convoluted in their course through its substance, at length terminate in the excretory duct. Anatomists are still divided between these two systems: that of Malpighi, however, seems to be the best founded.

The mode of secretion has been explained in a variety of ways, and they are all perfectly hypothetical. In such an inquiry it is natural to ask, how one gland constantly separates a particular humour, while another gland secretes one of a very different nature from the blood? The bile, for instance, is separated by the liver, and the urine by the kidneys. Are these secretions to be imputed to any particular dispositions in the fluids, or is their cause to be looked for in the solids?

It has been supposed, that every gland contains within itself a fermenting principle, by which it is enabled to change the nature of the blood it receives, and to endue it with a particular property. So that, according to this system, the blood, as it circulates through the kidneys, becomes mixed with the fermenting principle of those glands, and a part of it is converted into urine; and again, in the liver, in the salival and other glands, the bile, the saliva, and other juices, are generated from a similar cause. But it seems to be impossible for any liquor to be confined in a place exposed to the circulation, without being carried away by the torrent of blood, every part of which would be equally affected; and this system of fermentation has long been rejected as vague and chimerical. But as the cause of secretion continued to be looked for in the fluids, the former system was succeeded by another, in which recourse was had to the analogy of the humours. It was observed, that if paper is moistened with water, and oil and water are afterwards poured upon it, that the water only will be permitted to pass through it; but that, on the other hand, if the paper has been previously soaked in oil instead of water, the oil only, and not the water will be filtered through it. These observations led to a supposition, that every secretory organ is originally furnished with a humour analogous to that which it is afterwards destined to separate from the blood; and that in consequence of this disposition, the secretory vessels of the liver, for instance, will only admit the bilious particles of the blood, while all the other humours will be excluded. This system is an ingenious one, but the difficulties with which it abounds are unanswerable; for oil and water are immiscible; whereas the blood, as it is circulated through the body, appears to be an homogeneous fluid.

Every oil will pass through a paper moistened only with one kind of oil; and wine, or spirits mixed with water, will easily be filtered through a paper previously soaked in water. Upon the same principle, all our humours, though differing in their other properties, yet agreeing in that of being perfectly miscible with each other, will all easily pass through the same filtre.—But these are not all the objections to this system. The humours which are supposed to be placed in the secretory vessels for the determination of similar particles of the blood, must be originally separated without any analogous fluid; and that which happens once, may as easily happen always. Again, it sometimes happens from a vicious disposition, that humours are filtered through glands which are naturally not intended to afford them a passage, and when this once has happened, it ought, according to this system, to be expected always to do so: whereas this is not the case; and we are, after all, naturally led to seek for the cause of secretions in the solids. It does not seem right to ascribe it to any particular figure of the secretory vessels; because the soft texture of those parts does not permit them to preserve any constant shape, and our fluids seem to be capable of accommodating themselves to every kind of figure. Some have imputed it to the difference of diameter in the orifices of the different secretory vessels. To this doctrine objections have likewise been raised; and it has been argued, that the vessels of the liver, for instance, would, upon this principle, afford a passage not only to the bile, but to all the other humours of less consistence with it. In reply to this objection, it has been supposed, that secondary vessels exist, which originate from the first, and permit all the humours thinner than the bile to pass through them.

Each of these hypotheses is probably very remote from the truth.

EXPLANATION OF PLATE XXVIII.

THIS plate represents the Heart in situ, all the large Arteries and Veins, with some of the Muscles, &c.

MUSCLES, &c.—SUPERIOR EXTREMITY.—a, Masseter. b, Complexus. c, Digastricus. d, Os hyoides. e, Thyroid gland. f, Levator scapulæ. g, Cucullaris. h h, The clavicles cut. i, The deltoid muscle. k, Biceps flexor cubiti cut. l, Caraco-brachialis. m, Triceps extensor cubiti. n, The heads of the pronator teres, flexor carpi radialis, and flexor digitorum sublimis, cut. o, The flexor carpi ulnaris, cut at its extremity. p, Flexor digitorum profundus. q, Supinator radii longus, cut at its extremity. r, Ligamentum carpi transversale. s, Extensores carpi radiales. t, Latissimus dorsi. u, Anterior edge of the serratus anticus major. v v, The inferior part of the diaphragm. w w, Its anterior edge cut. x x, The kidneys. y, Transversus abdominis. z, Os ilium.

ANATOMY

Scot Philad.

Inferior Extremity.—*a*, Psoas magnus, *b*, Iliacus internus. *c*, The fleshy origin of the tensor vaginæ femoris. *d d*, The ossa pubis cut from each other. *e*, Musculus pectineus cut from its origin. *f*, Short head of the triceps abductor femoris cut. *g*, The great head of the triceps. *h*, The long head cut. *i*, Vastus internus. *k*, Vastus externus. *l*, Crureus. *m*, Gemellus. *n*, Soleus. *o*, Tibia. *p*, Peronæus longus. *q*, Peronæus brevis. *r*, Fibula.

Heart and Blood-vessels.—A, The heart, with the coronary arteries and veins. B, The right auricle of the heart. C, The aorta ascendens. D, The left subclavian artery. E, The left carotid artery. F, The common trunk which sends off the right subclavian and right carotid arteries. G, The carotis externa. H, Arteria facialis, which sends off the coronary arteries of the lips. I, Arteria temporalis profunda. K, Aorta descendens. L L, The iliac arteries,—which send off M M, The femoral or crural arteries. *N. B.* The other arteries in this figure have the same distribution as the veins of the same name:—And generally, in the anatomical plates, the description to be found on the one side, points out the same parts in the other. 1, The frontal vein. 2, The facial vein. 3, Vena temporalis profunda. 4, Vena occipitalis. 5, Vena jugularis externa. 6, Vena jugularis interna, covering the arteria carotis communis. 7. The vascular arch on the palm of the hand, which is formed by, 8, The radial artery and vein, and, 9, The ulnar artery and vein. 10 10, Cephalic vein. 11, Basilic vein, that on the right side cut. 12, Median vein. 13, The humeral vein, which, with the median, covers the humeral artery. 14 14, The external thoracic or mammary arteries and veins. 15, The axillary vein, covering the artery. 16 16, The subclavian veins, which, with (6 6) the jugulars, form, 17, The vena cava superior. 18, The cutaneous arch of veins on the fore part of the foot. 19, The vena tibialis antica, covering the artery. 20, The vena profunda femoris, covering the artery. 21, The upper part of the vena saphena major. 22, The femoral vein. 23 23, The iliac veins. 24 24, Vena cava inferior. 25 25, The renal veins covering the arteries. 26 26, The diaphragmatic veins.

PART V. OF THE BRAIN AND NERVES.

SECT. I. *Of the Brain and its Integuments.*

THE bones of the cranium were described in the osteological part of this work, as inclosing the brain, and defending it from external injury: but they are not its only protection; for when we make an horizontal section through these bones, we find this mass every where surrounded by two membranes,* the dura and pia mater.—The first of these lines the interior surface of the cranium, to which it every where adheres strongly,† but more particularly at the sutures, and at the many foramina through which vessels pass between it and the pericranium. The *dura mater* ‡ is perfectly smooth and inelastic, and its inner surface is constantly bedewed with a fine pellucid fluid, which every where separates it from the pia mater. The dura mater sends off several considerable processes, which divide the brain into separate portions, and prevent them from compressing each other. Of these processes there is one superior and longitudinal, called the *falx* or *falciform process*, from its resemblance to a scythe. It arises from the spine of the os frontis, near the crista galli, and extending along in the direction of the sagittal suture, to beyond the lambdoidal suture, divides the brain into two hemispheres. A little below the lambdoidal

* The Greeks called these membranes *meninges ;* but the Arabians, supposing them to be the source of all the other membranes of the body, afterwards gave them the names of *dura* and *pia mater ;* by which they are now usually distinguished.

† In young subjects this adhesion is greater than in adults; but even then, in the healthy subject, it is no where easily separable, without breaking through some of the minute vessels by means of which it is attached to the bone.

‡ This membrane is commonly described as consisting of two laminæ; of which the external one is supposed to perform the office of periosteum internum to the cranium, while the internal one forms the folds and processes of the dura mater. In the natural state, however, no such separation is apparent ; like other membranes, we may indeed divide it, not into two only, but many laminæ ; but this division is artificial, and depends on the dexterity of the anatomist.

suture, it divides into two broad wings or expansions called the *transverse* or *lateral processes*, which prevents the lobes of the cerebrum from pressing on the cerebellum. Besides these there is a fourth, which is situated under the transverse processes, and being continued to the spine of the occiput, divides the cerebellum into two lobes.

The blood, after being distributed through the cavity of the cranium by means of the arteries, is returned, as in the other parts of the body, by veins which all pass on to certain channels, situated behind these several processes.

These canals or sinuses communicate with each other, and empty themselves into the internal jugular veins, which convey the blood into the vena cava. They are in fact triangular veins, running through the substance of the dura mater, and, like the processes, are distinguished into *longitudinal* and *lateral;* and where these three meet, and where the fourth process passes off, we observe a fourth sinus, which is called *torcular;* Herophilus, who first described it, having supposed that the blood at the union of these two veins, is, as it were, in a press.

Besides these four canals, which were known to the ancients, modern anatomists enumerate many others, by giving the appellation of *sinuses* to other veins of the dura mater, which for the most part empty themselves into some of those we have just now described. There are the inferior longitudinal sinus, the superior and inferior petrous sinuses, the cavernous sinuses, the circular sinus, and the anterior and posterior occipital sinuses.

These sinuses or veins, by being conveyed through a thick dense membrane, firmly suspended, as the dura mater is, within the cranium, are less liable to rupture; at the same time they are well supported, and by running every where along the inner surface of the bones, they are prevented from pressing on the substance of the brain. To prevent too great a dilatation of them, we find filaments (called *chordæ Willisii*, from their having been first noticed by Willis) stretched across their cavities; and the oblique manner in which the veins from the brain run through the substance of the brain into these channels, serves the purpose of a valve, which prevents the blood from turning back into the smaller and weaker vessels of the brain.

The *pia mater* is a much softer and finer membrane than the dura mater; being exceedingly delicate, transparent, and vascular. It invests every part of the brain, and sends off an infinite number of elongations, which insinuate themselves between the convolutions, and even into the substance of the brain. This membrane is composed of two laminæ; of which the exterior one is named *tunica arachnoidea*, from its thinness, which is equal to that of a spider's web. These two laminæ are intimately adherent to each other at the upper part of the brain, but are easily separable at the basis of the brain, and through the whole length of the medulla spinalis. The external layer, or tunica arachnoidea, appears to be spread uniformly over the surface of the brain, but without entering into its furrows as the inner layer does; the latter being found to insinuate itself between the convolutions, and even into the interior cavities of the brain. The blood-vessels of the brain are distributed through it in their way to that organ, and are therefore divided into very minute ramifications, before they penetrate the substance of the brain.

There are several parts included under the general denomination of *brain*. One of these, which is of the softest consistence, and fills the greatest part of the cavity of the cranium, is the *cerebrum*, or *brain* properly so called. Another portion, which is seated in the inferior and posterior part of the head, is the *cerebellum;* and a third, which derives its origin from both these, is the *medulla oblongata*.

The *cerebrum* is a medullary mass of a moderate consistence, filling up exactly all the upper part of the cavity of the cranium, and divided into two hemispheres by the falx of the dura mater. Each of these hemispheres is usually distinguished into *an interior*, *a middle*, and *a posterior lobe*. The first of these is lodged on the orbital processes of the os frontis: the middle lobes lie on the middle fossæ of the basis of the cranium, and the posterior lobes are placed on the transverse septum of the os occipitis, immediately over the cerebellum, from which they are separated by the lateral processes of the dura mater. These two portions afford no distinguishing mark of separation; and on this account Haller, and many other modern anatomists, omit the distinction of middle lobe, and speak only of the anterior and posterior lobes of the brain.

The cerebrum appears to be composed of two distinct substances. Of these, the exterior one, which is of a greyish or ash-colour, is called the *cortex*, and is somewhat softer than the other, which is very white, and is called *medulla* or *substantia alba*.

After having removed the falx, and separated the two hemispheres from each other, we perceive a white convex body, the corpus callosum, which is a portion of the medullary substance, uniting the two hemispheres to each other, and not invested by the cortex. By making an horizontal incision in the brain, on a level with this corpus callosum, we discover two oblong cavities, named the *anterior* or *lateral ventricles*, one in each hemisphere. These two ventricles, which communicate with each other by a hole immediately under the plexus choroides, are separated laterally by a very fine medullary partition, called *septum lucidum*, from its thinness and transparency. The lower edge of this septum is fixed to the fornix, which is a kind of medullary arch (as its name implies) situated under the corpus callosum, and nearly of a triangular shape. Anteriorly the fornix sends off two medullary chords, called its *anterior crura;* which seem to be united to each other by a portion of medullary substance, named *commissura anterior cerebri*. These crura diverging from one another, are lost at the outer side of the lower and fore-part of the third ventricle. Posteriorly the fornix is formed into two other crura, which unite with two medullary protuberances called *pedes hippocampi*, and sometimes *cornua ammonis*, that extend along the back part of the lateral ventricles. The concave edge of the pedes hippocampi is covered by a medullary lamina, called *corpus fimbriatum*.

Neither the edges of the fornix, nor its posterior crura, can be well distinguished, till we have removed the plexus choroides. This is a production of the pia mater, which is spread over the lateral ventricles. Its loose edges are collected, so as to appear like a vascular band on each side.

When we have removed this plexus, we discover several other protuberances included in the lateral ventricles. These are the corpora striata, the thalami nervorum opticorum, the tubercula quadrumgemina, and the pineal gland.

The *corpora striata* are two curved oblong eminences, that extend along the anterior part of the lateral ventricles. They derive their name from their striated appearance, which is owing to an intermixture of the cortical and medullary substances of the brain. The *thalami nervorum opticorum*, are so called, because the optic nerves arise chiefly from them, and they are likewise composed both of the cortex and medulla. They are separated from the corpora striata only by a kind of medullary chord, the geminum centrum semi-circulare. The thalami are nearly of an oval shape, and are situated at the bottom of the upper cavity of the lateral ventricles. They are closely united, and at their convex part seem to become one body.

Anteriorly, in the space between the thalami, we observe an orifice by which the lateral ventricles communicate, and another leads down from this, under the different appellations of *foramen commune anterius*, *vulva iter ad infundibulum*, but more properly *iter ad tertium ventriculum;* and the separation of the thalami from each other posteriorly, forms another opening or interstice called *anus*. This has been supposed to communicate with the third ventricle; but it does not, the bottom of it being shut up by the pia mater. The back part of the anus is formed by a kind of medullary band, which connects the thalami to each other, and is called *commissura posterior cerebri*.

Behind the thalami and commissura posterior, we observe a small, soft, greyish, and oval body, about the size of a pea. This is the glandula pinealis; it is described by Galen under the name of *cònarion*, and has been rendered famous by Descartes, who supposed it to be the seat of the soul. Galen seems formerly to have entertained the same opinion. Some modern writers have, with as little reason, imagined that the soul is placed in the corpus callosum.

The pineal gland rests upon four remarkable eminences, disposed in pairs, and seated immediately below it. These tubercles, which by the ancients were called *testes* and *nates*, have, since the time of Winslow, been more commonly named *tubercula quadrugemina*.

Under the thalami we observe another cavity, the third ventricle, which terminates anteriorly in a small medullary canal, the infundibulum, that leads to the glandula pituitaria.

It has been doubted, whether the infundibulum is really hollow; but some late experiments on this part of the brain * by Professor Murray of Upsal, clearly prove it to be a medullary canal, surrounded by both laminæ of the pia mater. After freezing the brain, this channel was found filled with ice; and de Haen tells † us, he found it dilated, and filled with a calcareous matter.‡

The soft spongy body in which the infundibulum terminates, was by the ancients supposed to be of a glandular structure, and destined to filter the serosity of the brain. Spigelius pretended to have discovered its excretory duct, but it seems certain that no such duct exists. It is of an oblong shape, composed, as it were, of two lobes. In ruminant animals it is much larger than in man.

From the posterior part of the third ventricle, we see a small groove or channel, descending obliquely backwards. This channel, which is called the *aqueduct of Sylvius*, though it was known to the ancients, opens into another cavity of the brain, placed between the cerebellum and medulla oblongata, and called the *fourth ventricle*.

* Disp. de Infundibulo Cerebri.

† Ratio Med. tom. vi. p. 271.

‡ The under part of it, however, appears to be impervious; at least no injection that can be depended on has been made to pass from it into the glandula pituitaria without laceration of parts.

The *cerebellum*, which is divided into two lobes, is commonly supposed to be of a firmer texture than the cerebrum; but the truth is, that in the greater number of subjects, there appears to be no sensible difference in the consistence of these two parts. It has more of the cortical than of the medullary substance in its composition.

The furrow that divides the two lobes of the cerebellum leads anteriorly to a process, composed of medullary and cortical substances, covered by the pia mater; and which, from its being divided into numerous furrows, resembling the rings of the earth-worm, is named *processus vermiformis*. This process forms a kind of ring in its course between the lobes.

The surface of the cerebellum does not afford those circumvolutions which appear in the cerebrum; but instead of these, we observe a great number of minute furrows, running parallel to each other, and nearly in a transverse direction. The pia mater insinuates itself into these furrows.

When we cut into the substance of the cerebellum, from above downwards, we find the medullary part running in a kind of ramifying course, and exhibiting an appearance that has gotten the name of *arbor vitæ*. These ramifications unite to form a medullary trunk; the middle, anterior, and most considerable part of which forms two processes, the crura cerebelli, which unite with the crura cerebri, to form the medulla oblongata. The last furnishes two other processes, which lose themselves under the nates, and thus unite the lobes of the cerebellum to the posterior part of the cerebrum. Under the nates we observe a transverse medullary line, or linea alba, running from one of these processes to the other; and between them we find a very thin medullary lamina, covered with the pia mater, which the generality of anatomists have (though seemingly without reason) considered as a valve formed for closing the communication between the fourth ventricle and the aquæductus Sylvii. Vieussens named it *valvula major cerebri.*

The *medulla oblongata* is situated in the middle, lower, and posterior part of the cranium, and may be considered as a production or continuation of the whole medullary substance of the cerebrum and cerebellum, being formed by the union of two considerable medullary processes of the cerebrum, called *crura cerebri*, with two other smaller ones from the cerebellum, which were just now spoken of under the name of *crura cerebelli.*

The crura cerebri arise from the middle and lower part of each hemisphere. They are separated from each other at their origin, but are united below, where they terminate in a middle protuberance, the *pons Varolii*, so called, because Varolius compared it to a bridge. This name, however, can convey no idea of its real appearance. It is, in fact, nothing more than a medullary protuberance, nearly of a semi-spherical shape, which unites the crura cerebri to those of the cerebellum.

Between the crura cerebri, and near the anterior edge of the pons Varolii, are two tubercles, composed externally of medullary, and internally of cineritious, substance, to which Eustachius first gave the name of *eminentiæ mamillares*.

Along the middle of the posterior surface of the medulla oblongata, where it forms the anterior part of the fourth ventricle, we observe a kind of furrow which runs downwards and terminates in a point. About an inch above the lower extremity of this fissure, several medullary filaments are to be seen running towards it on each side in an oblique direction, so as to give it the appearance of a writing-pen; hence it is called *calamus scriptorius*.

From the posterior part of the pons Varolii, the medulla oblongata descends obliquely backwards; at its fore-part, immediately behind the pons Varolii, we observe two pair of eminences, which were described by Eustachius, but received no particular appellation till the time of Vieussens, who gave them the names of *corpora olivaria* and *corpora pyramidalia*. The former are the outermost, being placed one on each side. They are nearly of an oval shape, and are composed of medulla, with streaks of cortical substance. Between these are the corpora pyramidalia, each of which terminates in a point. In the human subject these four eminences are sometimes not easily distinguished.

The *medulla spinalis* or *spinal marrow*, which is the name given to the medullary chord that is extended down the vertebral canal, from the great foramen of the occipital bone to the bottom of the last lumbar vertebra, is a continuation of the medulla oblongata. Like the other parts of the brain, it is invested by the dura and pia mater. The first of these, in its passage out of the cranium, adheres to the foramen of the os occipitis. Its connection with the ligamentary substance that lines the cavity of the spine, is only by means of cellular membrane; but between the several vertebræ, where the nerves pass out of the spine, it sends off prolongations, which adhere strongly to the vertebral ligaments. Here, as in the cranium, the dura mater has its sinuses or large veins. These are two in number, and are seen running on each side of the medullary column, from the foramen magnum of the os occipitis to the lower part of the os sacrum. They communicate together by ramifying branches at each vertebra, and terminate in the vertebral, intercostal, and sacral veins.

The pia mater is connected with the dura mater by means of a thin transparent substance which from its indentations between the spinal nerves has obtained the name of *ligamentum denticulatum.* It is somewhat firmer than the tunica arachnoidea, but in other respects resembles that membrane. Its use is to support the spinal marrow, that it may not affect the medulla oblongata by its weight.

The spinal marrow itself is externally of a white colour; but upon cutting into it we find its middle-part composed of a darker coloured mass, resembling the cortex of the brain. When the marrow has reached the first lumbar vertebra, it becomes extremely narrow, and at length terminates in an oblong protuberance; from the extremity of which the pia mater sends off a prolongation or ligament, resembling a nerve, that perforates the dura mater, and is fixed to the os coccygis.

The medulla spinalis gives rise to 30 or 31 pair of nerves, but they are not all of the same size, nor do they all run in the same direction. The upper ones are thinner than the rest, and are placed almost transversely: as we descend we find them running more and more obliquely downwards, till at length their course is almost perpendicular, so that the lowermost nerves exhibit an appearance that is called *cauda equina*, from its resemblance to a horse's tail.

The arteries that ramify through the different parts of the brain, are derived from the internal carotid and from the vertebral arteries. The medulla spinalis is supplied by the anterior and posterior spinal arteries, and likewise receives branches, from the cervical, the inferior and superior intercostal, the lumbar, and the sacral arteries.

Sect. II. *Of the Nerves.*

The nerves are medullary chords, differing from each other in size, colour, and consistence, and deriving their origin from the medulla oblongata and medulla spinalis. There are 39, and sometimes 40, pair of these nerves;

nine* of which originate from the medulla oblongata, and 30 or 31 from the medulla spinalis. They appear to be perfectly inelastic, and likewise to possess no irritability. If we irritate muscular fibres, they immediately contract; but nothing of this sort happens if we irritate a nerve. They carry with them a covering from the pia mater; but derive no tunic from the dura mater, as hath been generally, though erroneously, supposed, ever since the time of Galen,† the outer covering of the nerves being in fact nothing more than the cellular membrane. This covering is very thick where the nerve is exposed to the action of muscles; but where it runs through a bony canal, or is secure from pressure, the cellular tunic is extremely thin, or altogether wanting. We have instances of this in the portio mollis of the auditory nerve, and in the nerves of the heart.

By elevating, carefully and gently, the brain from the basis of the cranium, we find the first nine pair arising in the following order: 1. The nervi olfactorii, distributed through the pituitary membrane, which constitutes the organ of smell. 2. The optici, which go to the

* It has been usual to describe the ten pair of nerves as arising from the medulla oblongata; but as the tenth pair arise in the fame manner as the other spinal nerves, Santorini, Heister, Haller, and others, seem very properly to have classed them among the nerves of the spine.

† Baron Haller and Professor Zinn seem to have been the first who demonstrated, that the dura mater is reflected upon and adheres to the periosteum at the edges of the foramina that afford a passage to the nerves out of the cranium, and vertebral canal, or is soon lost in the cellular substance.

eyes, where they receive the impressions of visible objects. 3. The oculorum motores, so called because they are distributed to the muscles of the eye. 4. The pathetici, distributed to the superior oblique muscles of the eye, the motion of which is expressive of certain passions of the soul. 5. The nerves of this pair soon divide into three principal branches, and each of these has a different name. Its upper division is the ophthalmicus, which is distributed to various parts of the eyes, eye-lids, forehead, nose, and integuments of the face. The second is called the *maxillaris superior*, and the third *maxillaris inferior ;* both which names allude to their distribution. 6. The abductores ; each of these nerves is distributed to the abductor muscle of the eye, so called, because it helps to draw the globe of the eye from the nose. 7. The auditorii,* which are distributed through the organs of hearing. 8. The par vagum, which derives its name from the great number of parts to which it gives branches both in the thorax and abdomen. 9. The linguales, or hypo-glossi, which are distributed to the tongue, and appear to contribute both to the organ of taste and to the motions of the tongue.†

* This pair, soon after its entrance into the meatus auditorius internus, separates into two branches. One of these is of a very soft and pulpy consistence, it is called the *portio mollis* of the seventh pair, and is spread over the inner part of the ear. The other passes out through the aqueduct of Fallopius in a firm chord, which is distinguished as the portio dura, and is distributed to the external ear and other parts of the neck and face.

† Heister has summed up the uſes of these nine pair of nerves in the two following Latin verses :

It has already been observed, that the spinal marrow sends off 30 or 31 pair of nerves; these are chiefly distributed to the exterior parts of the trunk and to the extremities. They are commonly distinguished into the *cervical*, *dorsal*, *lumbar*, and *sacral nerves*. The cervical, which pass out from between the several vertebræ of the neck are eight* in number; the dorsal, twelve; the lumbar, five; and the sacral, five or six; the number of the latter depending on the number of holes in the os sacrum. Each spinal nerve at its origin is composed of two fasciculi of medullary fibres. One of these fasciculi arises from the anterior, and the other from the posterior, surface of the medulla. These fasciculi are separated by the ligamentum denticulatum; after which we find them contiguous to one another. They then perforate the dura mater, and unite to form a considerable knot or ganglion. Each of these

" *Olfaciens, cernens, oculosque movens, patiensque,*
" *Gastans, abducens, audiensque, vagansque, loquensque.*"

* Besides these, there is another pair called *accessorii*, which arises from the medulla spinalis at its beginning; and ascending through the great foramen of the os occipitis into the cranium, passes out again close to the eighth pair, with which, however, it does not unite; and it is afterwards distributed chiefly to the muscles of the neck, back, and scapula. In this course it sends off filaments to different parts, and likewise communicates with several other nerves. Physiologists are at a loss how to account for the singular origin and course of these nervi accessorii. The ancients considered them as branches of the eighth pair, distributed to muscles of the scapula: Willis likewise considered them as appendages to that pair, and on that account named them *accessorii*. They are sometimes called the *spinal* pair; but as this latter name is applicable to all the nerves of the spine indiscriminately, it seems better to adopt that given by Willis.

ganglions sends off two branches; one anterior, and the other posterior. The anterior branches communicate with each other at their coming out of the spine, and likewise send off one, and sometimes more branches, to assist in the formation of the intercostal nerve.

The knots or ganglions of the nerves just now spoken of, are not only to be met with at their exit from the spine, but likewise in various parts of the body. They occur in the nerves of the medulla oblongata, as well as in those of the spine. They are not the effects of disease, but are to be met with in the same parts of the same nerves, both in the fœtus and adult. They are commonly of an oblong shape, and of a greyish colour, somewhat inclined to red, which is perhaps owing to their being extremely vascular. Internally we are able to distinguish something like an intermixture of the nervous filaments.

Some writers have considered them as so many little brains; Lancisi fancied he had discovered muscular fibres in them, but they are certainly not of an irritable nature. A late writer, Dr. Johnstone,* imagines they are intended to deprive us of the power of the will over certain parts, as the heart, for instance: but if this hypothesis were well founded, we should meet with them only in the nerves leading to involuntary muscles; whereas it is certain, that the voluntary muscles receive their nerves through ganglions. Doctor Monro, from observing the accurate intermixture of the

* Essay on the Use of the Ganglions of the Nerves.

minute nerves which compose them, considers them as new sources of nervous energy.†

The nerves, like the blood-vessels, in their course through the body, communicate with each other; and each of these communications constitutes what is called a *plexus*, from whence branches are again detached to different parts of the body. Some of these are constant and considerable enough to be distinguished by particular names, as the *semilunar plexus;* the *pulmonary plexus;* the *hepatic*, the *cardiac*, &c.

It would be foreign to the purpose of this work, to follow the nerves through all their distributions; but it may be remembered, that in describing the different viscera, mention was made of the nerves distributed to them. There is one pair, however, called the *intercostal*, or *great sympathetic nerve*, which seems to require particular notice, because it has an almost universal connection and correspondence with all the other nerves of the body. Authors are not perfectly agreed about the origin of the intercostal; but it may perhaps not improperly be described, as beginning from filaments of the fifth and sixth pair; it then passes out of the cranium, through the bony canal of the carotid, from whence it descends laterally close to the bodies of the vertebræ, and receives branches from almost all the vertebral nerves; forming almost as many ganglions in its course through the thorax and abdomen. It sends off an infinite number of branches to the viscera in

† Observations on the Nervous System.

those cavities, and forms several plexuses with the branches of the eighth pair or par vagum.

That the nerves are destined to convey the principles of motion and sensibility to the brain from all parts of the system, there can be no doubt ; but how these effects are produced, no one has ever yet been able to determine. The inquiry has been a constant source of hypothesis in all ages, and has produced some ingenious ideas, and many erroneous positions, but without having hitherto afforded much satisfactory information.

Some physiologists have considered a trunk of nerves as a solid chord, capable of being divided into an infinite number of filaments, by means of which the impressions of feeling are conveyed to the sensorium commune. Others have supposed it to be a canal, which afterwards separates into more minute channels; or, perhaps, as being an assemblage of many very small and distinct tubes, connected to each other, and thus forming a cylindrical chord. They who contend for their being solid bodies, are of opinion, that feeling is occasioned by vibration: so that, for instance according to this system, by pricking the finger, a vibration would be occasioned in the nerve, distributed through its substance; and the effects of this vibration, when extended to the sensorium, would be an excital of pain. But the inelasticity, the softness, the connection, and the situation of the nerves, are so many proofs that vibration has no share in the cause of feeling.

Others have supposed, that in the brain and spinal marrow, a very subtile fluid is secreted, and from thence conveyed through the imperceptible tubes, which they consider as existing in the nerves. They have farther supposed, that this very subtile fluid, to which they have given the name of *animal spirits*, is secreted in the cortical substance of the brain and spinal marrow, from whence it passes through the medullary substance. This, like the other system, is founded altogether on hypothesis; but it seems to be an hypothesis derived from much more probable principles, and there are many ingenious arguments to be brought in its support.

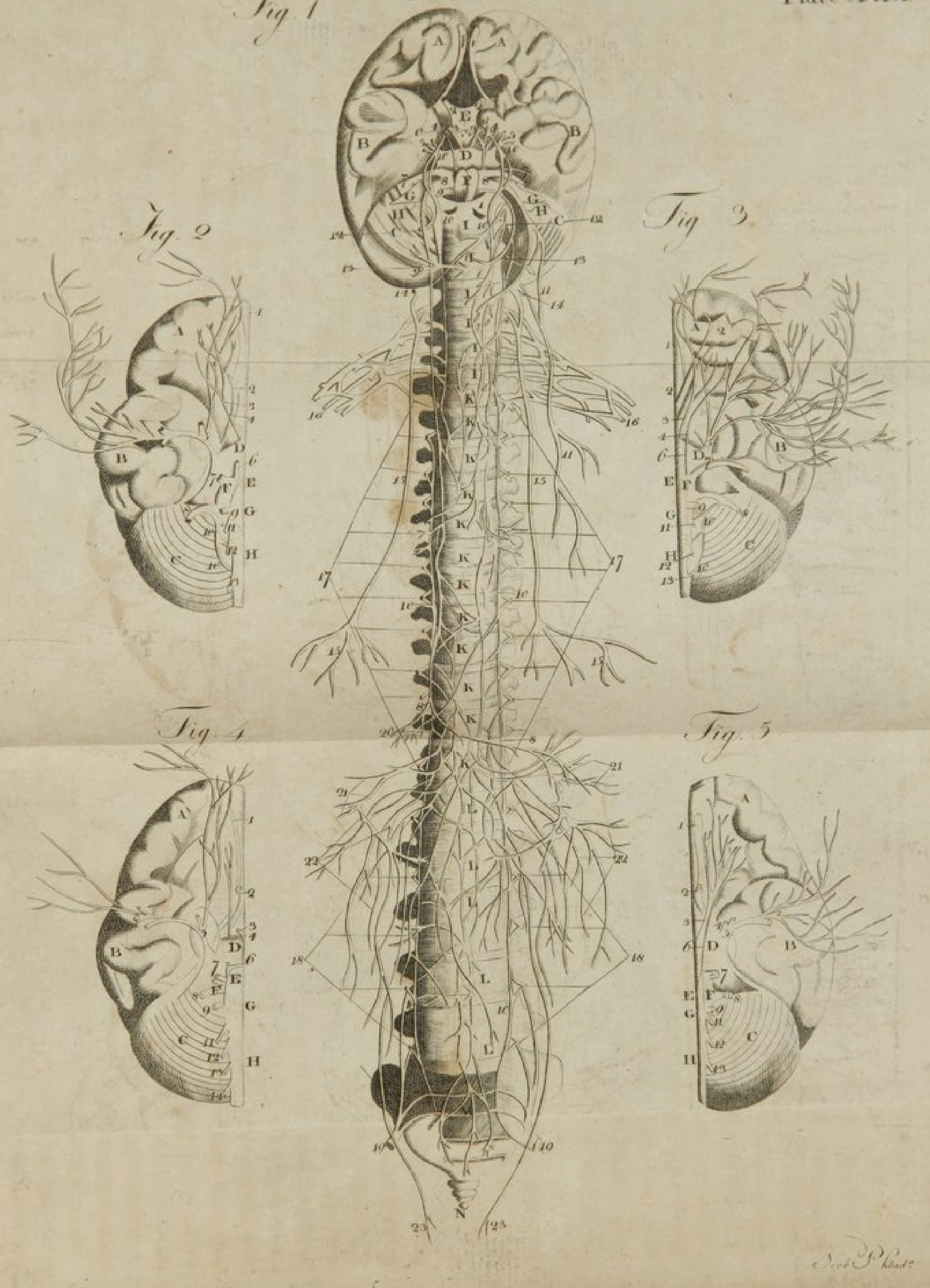
EXPLANATION OF PLATE XXIX.

FIG. 1. Represents the Inferior part of the Brain;—the Anterior part of the whole Spine, including the Medulla Spinalis;—with the origin and large portions of all the NERVES.

AA, The anterior lobes of the cerebrum. BB, The lateral lobes of the cerebrum. CC, The two lobes of the cerebellum. D, Tuber annulare. E, The passage from the third ventricle to the infundibulum. F, The medulla oblongata, which sends off the medulla spinalis through the spine. G G, That part of the os occipitis which is placed above (H H) the transverse processes of the first cervical vertebra. I I, &c. The seven cervical verte-

ANATOMY

Plate XXIX



bræ, with their intermediate cartilages. K K, &c. The twelve dorsal vertebræ, with their intermediate cartilages. L L, &c. The five lumbar vertebræ, with their intermediate cartilages. M, The os sacrum. N, The os coccygis.

Nerves.—1 1, The first pair of nerves, named *olfactory*, which go to the nose. 2 2, The second pair, named *optic*, which goes to form the tunica retina of the eye. 3 3, The third pair, named *motor oculi;* it supplies most of the muscles of the eye-ball. 4 4, The fourth pair, named *pathetic*,—which is wholly spent upon the musculus trochlearis of the eye. 5 5, The fifth pair divides into three branches.—The first, named *ophthalmic*, goes to the orbit, supplies the lachrymal gland, and sends branches out to the forehead and nose.—The second, named *superior maxillary*, supplies the teeth of the upper jaw, and some of the muscles of the lips.—The third named *inferior maxillary*, is spent upon the muscles and teeth of the lower jaw, tongue, and muscles of the lips. 6 6, The sixth pair, which, after sending off the beginning of the intercostal or great sympathetic, is spent upon the abductor oculi. 7 7, The seventh pair, named *auditory*, divides into two branches.—The largest, named *portio mollis*, is spent upon the internal ear. The smallest, *portio dura*, joins to the fifth pair within the internal ear by a reflected branch from the second of the fifth; and within the tympanum, by a branch from the third of the fifth named *chorda tympani.*—

Vid. fig. 3. near B. 8 8, &c. The eighth pair, named *par vagum*,—which accompanies the intercostal, and is spent upon the tongue, larynx, pharynx, lungs, and abdominal viscera. 9 9, The ninth pair, which are spent upon the tongue. 10 10, &c. The intercostal, or great sympathetic, which is seen from the sixth pair to the bottom of the pelvis on each side of the spine, and joining with all the nerves of the spine;—in its progress supplying the heart, and, with the par vagum, the contents of the abdomen and pelvis. 11 11, The accessorius, which is spent upon the sternocleido-mastoidæus and trapezius muscles. 12 12, The first cervical nerves;—13 13, The second cervical nerves;—both spent upon the muscles that lie on the neck, and teguments of the neck and head. 14 14, The third cervical nerves, which, after sending off (15 15, &c.) the phrenic nerves to the diaphragm, supply the muscles and teguments that lie on the side of the neck and top of the shoulder. 16 16, The brachial plexus, formed by the fourth, fifth, sixth, seventh cervicals, and first dorsal nerves; which supply the muscles and teguments of the superior extremity. 17 17, The twelve dorsal, or proper intercostal nerves, which are spent upon the intercostal muscles and some of the large muscles which lie upon the thorax. 18 18, The five lumbar pairs of nerves, which supply the lumbar and abdominal muscles, and some of the teguments and muscles of the inferior extremity. 19 19, The sacro-sciatic, or posterior crural nerve, formed by the two inferior lumbar, and three superior of the os sacrum. This large nerve supplies the greatest part of the muscles and teguments of the inferior extremity. 20, The stomachic plexus, formed by the eighth pair. 21 21, Branches of the solar or cæliac plexus, formed by the eighth pair and intercostals, which supply the stomach and chylopoietic viscera. 22 22, Branches of the superior and inferior mesenteric plexuses, formed by the eighth pair and intercostals, which supply the chylopoietic viscera, with part of the organs of urine and generation. 23 23, Nerves which accompany the spermatic cord. 24 24, The hypogastric plexus, which supplies the organs of urine and generation within the pelvis.

FIG. 2, 3, 4, 5. Shows different Views of the Inferior part of the Brain, cut perpendicularly through the Middle,—with the Origin and large Portions of all the Nerves which pass out through the Bones of the Cranium,—and the three first Cervicals.

A, The anterior lobe. B, The lateral lobe of the cerebrum. C, One of the lobes of the cerebellum. D, Tuber annulare. E, Corpus pyramidale, in the middle of the medulla oblongata. F, The corpus olivare, in the side of the medulla oblongata. G, The medulla oblongata. H, The medulla spinalis.

NERVES.—1 2 3 4 5 6 7 8 and 9, Pairs of nerves. 10 10, Nervus accessorius, which comes from—11, 12, and 13, The three first cervical nerves.

PART VI. OF THE SENSES AND THEIR ORGANS.

IN treating of the senses, we mean to confine ourselves to the external ones of *touch*, *taste*, *smelling*, *hearing*, and *vision*. The word *sense*, when applied to these five, seems to imply not only the sensation excited in the mind by certain impressions made on the body, but likewise the organ destined to receive and transmit these impressions to the sensorium. Each of these organs being of a peculiar structure, is susceptible only of particular impressions, which will be pointed out as we proceed to describe each of them separately.

SECT. I. *Of Touch.*

THE sense of touch may be defined to be the faculty of distinguishing certain properties of bodies by the feel. In a general acceptation, this definition might perhaps not improperly be extended to every part of the body possessed of sensibility,* but it is commonly con-

* In the course of this article, mention has often been made of the sensibility or insensibility of different parts of the body: it will therefore, perhaps, not be amiss to observe in this place, that many parts which were formerly supposed to possess the most exquisite sense, are now known to have but little or no feeling, at least in a sound state; for in an inflamed state, even the bones, the most insensible parts of any, become susceptible

fined to the nervous papillæ of the cutis, or true skin, which, with its appendages, and their several uses, have been already described.

The exterior properties of bodies, such as their solidity, moisture, inequality, smoothness, dryness, or fluidity, and likewise their degree of heat, seem all to be capable of making different impressions on the papillæ, and consequently of exciting different ideas in the sensorium commune. But the organ of touch, like all the other senses, is not equally delicate in every part of the body, or in every subject; being in some much more exquisite than it is in others.

SECT. II. *Of the Taste.*

THE sense of taste is seated chiefly in the tongue; the situation and figure of which are sufficiently known.

On the upper surface of this organ we may observe a great number of papillæ, which, on account of their difference in size and shape,

of the most painful sensations. This curious discovery is due to the late Baron Haller. His experiments prove, that the bones, cartilages, ligaments, tendons, epidermis, and membranes (as the pleura, pericardium, dura and pia mater, periosteum, &c.) may in a healthy state be considered as insensible. As sensibility depends on the brain and nerves, of course different parts will possess a greater or less degree of feeling, in proportion as they are supplied with a greater or smaller number of nerves. Upon this principle it is, that the skin, muscles, stomach, intestines, urinary bladder, ureters, uterus, vagina penis, tongue, and retina, are extremely sensible, while the lungs and glands have only an obscure degree of feeling.

are commonly divided into three classes. The largest are situated towards the basis of the tongue. Their number commonly varies from seven to nine, and they seem to be mucous follicles. Those of the second class are somewhat smaller, and of a cylindrical shape. They are most numerous about the middle of the tongue. Those of the third class are very minute, and of a conical shape. They are very numerous on the apex and edges of the tongue, and have been supposed to be formed by the extremities of its nerves.

We observe a line, the *linea linguæ mediana*, running along the middle of the tongue, and dividing it as it were into two portions. Towards the basis of the tongue, we meet with a little cavity, named by Morgagni *foramen cæcum*, which seems to be nothing more than a common termination of some of the excretory ducts of mucous glands situated within the substance of the tongue.

We have already observed, that this organ is every where covered by the cuticle, which, by forming a reduplication, called the *frænum*, at its under part, serves to prevent the too great motion of the tongue, and to fix it in its situation. But, besides this attachment, the tongue is connected by means of its muscles and membranous ligaments, to the lower jaw, the os hyoides, and the styloid processes.

The principal arteries of the tongue are the linguales, which arise from the external carotid. Its veins empty themselves into the external jugulars. Its nerves arise from the fifth, eighth, and ninth pair.

The variety of tastes seems to be occasioned by the different impressions made on the papillæ by the food. The different state of the papillæ with respect to their moisture, their figure, or their covering, seems to produce a considerable difference in the taste, not only in different people, but in the same subject, in sickness and in health. The great use of the taste seems to be to enable us to distinguish wholesome and salutary food from that which is unhealthy; and we observe that many quadrupeds, by having their papillæ* very large and long, have the faculty of distinguishing flavours with infinite accuracy.

Sect. III. *Of Smelling.*

The sense of smelling, like the sense of taste, seems intended to direct us to a proper choice of aliment, and is chiefly seated in the nose, which is distinguished into its external and internal parts. The situation and figure of the former of these do not seem to require a definition. It is composed of bones and cartilages, covered by muscular fibres and by the common integuments. The bones make up the upper portion, and the cartilages the lower one. The septum narium, like the nose, is likewise in part bony, and in part cartilaginous. These bones and their connections were described in the osteology.

* Malpighi's description of the papillæ, which has been copied by many anatomical writers, seems to have been taken chiefly from the tongues of sheep.

The internal part of the nose, besides the ossa spongiosa, has six cavities or sinuses, the maxillary, the frontal, and the sphenoid, which were all described with the bones of the head. They all open into the nostrils; and the nose likewise communicates with the mouth, larynx, and pharynx, posteriorly behind the velum palati.

All these several parts, which are included in the internal division of the nose, viz. the inner surface of the nostrils, the lamellæ of the ossa spongiosa, and the sinuses, are lined by a thick and very vascular membrane, which, though not unknown to the ancients, was first well described by Schneider,* and is therefore now commonly named *membrana pituitaria Schneideri.* This membrane is truly the organ of smelling; but its real structure does not yet seem to be perfectly understood. It appears to be a continuation of the cuticle, which lines the inner surface of the mouth. In some parts of the nose it is smooth and firm, and in others it is loose and spongy. It is constantly moistened by a mucous secretion; the finer parts of which are carried off by the air we breathe, and the remainder, by being retained in the sinuses, acquires considerable consistence. The manner in which this mucus is secreted has not yet been satisfactorily ascertained; but it seems to be by means of mucous follicles.

Its arteries are branches of the internal maxillary and internal carotid. Its veins empty themselves into the internal jugulars. The first pair of nerves, the olfactory, are spread

* De Catarrho, lib. iii.

over every part of it, and it likewise receives branches from the fifth pair.

After what has been said of the pituitary membrane, it will not be difficult to conceive how the air we draw in at the nostrils, being impregnated with the effluvia of bodies, excites in us that kind of sensation we call *smelling*. As these effluvia, from their being exceedingly light and volatile, cannot be capable in a small quantity of making any great impression on the extremities of the olfactory nerves, it was necessary to give considerable extent to the pituitary membrane, that by this means a greater number of odoriferous particles might be admitted at the same time. When we wish to take in much of the effluvia of any thing, we naturally close the mouth, that all the air we inspire may pass through the nostrils; and at the same time, by means of the muscles of the nose, the nostrils are dilated, and a greater quantity of air is drawn into them.

In many quadrupeds, the sense of smelling is much more extensive and delicate than it is in the human subject; and in the human subject it seems to be more perfect the less it is vitiated by a variety of smells. It is not always in the same state of perfection, being naturally affected by every change of the pituitary membrane, and of the lymph with which that membrane is moistened.

SECT. IV. *Of Hearing.*

BEFORE we undertake to explain the manner in which we are enabled to receive the impressions of sound, it will be necessary to describe the *ear*, which is the *organ of hearing.* It is commonly distinguished into external and internal. The former of these divisions includes all that we are able to discover without dissection, and the meatus auditorius, as far as the tympanum; and the latter, all the other parts of the ear.

The *external ear* is a cartilaginous funnel, covered by the common integuments, and attached, by means of its ligaments and muscles, to the temporal bone. Although capable only of a very obscure motion, it is found to have several muscles. Different parts of it are distinguished by several names; all its cartilaginous part is called *ala* or *wing*, to distinguish it from the soft and pendent part below, called the *lobe.* Its outer circle or border is called *helix*, and the semicircle within this, *antihelix.* The moveable cartilage placed immediately before the meatus auditorius, which it may be made to close exactly, is named *tragus;* and an eminence opposite to this at the extremity of the antihelix, is called *antitragus.* The concha is a considerable cavity formed by the extremities of the helix and antihelix. The meatus auditorius, which at its opening is cartilaginous, is lined with a very thin membrane, which is a continuation of the cuticle from the surface of the ear.

In this canal we find a yellow wax, which is secreted by a number of minute glands or follicles, each of which has an excretory duct. This secretion, which is at first of an oily consistence, defends the membrane of the tympanum from the injuries of the air; and by its bitterness, prevents minute insects from entering into the ear. But when from neglect or disease it accumulates in too great a quantity, it sometimes occasions deafness. The inner extremity of the meatus is closed by a very thin transparent membrane, the membrana tympani, which is set in a bony circle like the head of a drum. In the last century Rivinus, professor at Liepsic, fancied he had discovered a hole in this membrane, surrounded by a sphincter, and affording a passage to the air, between the external and internal ear. Cowper, Heister, and some other anatomists, have admitted this supposed foramen, which certainly does not exist. Whenever there is any opening in the membrana tympani, it may be considered as accidental. Under the membrana tympani runs a branch of the fifth pair of nerves, called *chorda tympani;* and beyond this membrane is the cavity of the tympanum, which is about seven or eight lines wide, and half so many in depth; it is semispherical, and every where lined by a very fine membrane. There are four openings to be observed in this cavity. It communicates with the mouth by means of the Eustachian tube. This canal, which is in part bony and in part cartilaginous, begins by a very narrow opening at the anterior and almost superior part of the tympanum, increasing in size as it advances towards the palate of the mouth, where it terminates by an oval opening. This tube is every where lined by the same membrane that covers the inside of the mouth. The real use of this canal does not seem to have been hitherto satisfactorily ascertained; but sound would seem to be conveyed through it to the membrana tympani, deaf persons being often observed to listen attentively with their mouths open. Opposite to this is a minute passage, which leads to the sinuosities of the mastoid process; and the two other openings, which are in the internal process of the os petrosum, are the fenestra ovalis, and fenestra rotunda, both of which are covered by a very fine membrane.

There are three distinct bones in the cavity of the tympanum; and these are the malleus, incus, and stapes. Besides these there is a fourth, which is the *os orbiculare*, considered by some anatomists as a process of the stapes, which is necessarily broken off by the violence we are obliged to use in getting at these bones; but when accurately considered, it seems to be a distinct bone.

The *malleus* is supposed to resemble a hammer, being larger at one extremity, which is its head, than it is at the other, which is its handle. The latter is attached to the membrana tympani, and the head of the bone is articulated with the incus.

The *incus*, as it is called from its shape, though it seems to have less resemblance to an anvil than to one of the dentes molares with its roots widely separated from each other, is distinguished into its body and its legs. One of its legs is placed at the entry of the canal which leads to the mastoid process; and the other, which is somewhat longer, is articulated with the stapes, or rather with the os orbiculare, which is placed between them.

The third bone is very properly named *stapes*, being perfectly shaped like a stirrup. Its basis is fixed into the fenestra ovalis, and its upper part is articulated with the os orbiculare. What is called the *fenestra rotunda*, though perhaps improperly, as it is more oval than round, is observed a little above the other, in an eminence formed by the os petrosum, and is closed by a continuation of the membrane that lines the inner surface of the tympanum. The stapes and malleus are each of them furnished with a little muscle, the stapedeus and tensor tympani. The first of these, which is the smallest in the body, arises from a little cavern in the posterior and upper part of the cavity of the tympanum; and its tendon, after passing through a hole in the same cavern, is inserted at the back part of the head of the stapes. This muscle, by drawing the stapes obliquely upwards, assists in stretching the membrana tympani.

The tensor tympani,* or internus mallei, as it is called by some writers, arises from the cartilaginous extremity of the Eustachian tube, and is inserted into the back part of the handle

* Some anatomists describe three muscles of the malleus; but only this one seems to deserve the name of muscle; what are called the *externus* and *obliquus mallei*, seeming to be ligaments rather than muscles.

of the malleus, which it serves to pull inwards, and of course helps to stretch the membrana tympani.

The labyrinth is the only part of the ear which remains to be described. It is situated in the os petrosum, and is separated from the tympanum by a partition which is every where bony, except at the two fenestræ. It is composed of three parts; and these are the vestibulum, the semicircular canals, and the cochlea.

The *vestibulum* is an irregular cavity, much smaller than the tympanum, situated nearly in the centre of the os petrosum, between the tympanum, the cochlea, and the semicircular canals. It is open on the side of the tympanum by means of the fenestra ovalis, and communicates with the upper portion of the cochlea by an oblong foramen, which is under the fenestra ovalis, from which it is separated only by a very thin partition.

Each of the three *semicircular canals* forms about half a circle of nearly a line in diameter, and running each in a different direction, they are distinguished into *vertical*, *oblique*, and *horizontal*. These three canals open by both their extremities into the vestibulum; but the vertical and the oblique being united together at one of their extremities, there are only five orifices to be seen in the vestibulum.

The *cochlea* is a canal which takes a spiral course, not unlike the shell of a snail. From its basis to its apex it makes two turns and a half; and is divided into two canals by a very thin lamina or septum, which is in part bony and in part membranous, in such a manner that these two canals only communicate with each other at the point. One of them opens into the vestibulum, and the other is covered by the membrane that closes the fenestra rotunda. The bony lamella which separates the two canals is exceedingly thin, and fills about two-thirds of the diameter of the canal. The rest of the septum is composed of a most delicate membrane, which lines the whole inner surface of the cochlea, and seems to form this division in the same manner as the two membranous bags of the pleura, by being applied to each other, form the mediastinum.

Every part of the labyrinth is furnished with a very delicate periosteum, and filled with a watery fluid, secreted as in other cavities. This fluid transmits to the nerves the vibrations it receives from the membrane closing the fenestra rotunda, and from the basis of the stapes, where it rests on the fenestrum ovale. When this fluid is collected in too great a quantity, or is compressed by the stapes, it is supposed to escape through two minute canals or aqueducts, lately described by Dr. Cotunni,* an ingenious physician at Naples. One of these aqueducts opens into the bottom of the vestibulum, and the other into the cochlea, near the fenestra rotunda. They both pass through the os petrosum, and communicate with the cavity of the cranium where the fluid that passes through them is absorbed; and they are lined

* De aquæductibus Auris Humanæ Internæ, 8vo, 1760.

by a membrane which is supposed to be a production of the dura mater.

The arteries of the external ear come from the temporal and other branches of the external carotid, and its veins pass into the jugular. The internal ear receives branches of arteries from the basilary and carotids, and its veins empty themselves into the sinuses of the dura mater, and into the internal jugular.

The portio mollis of the seventh pair is distributed through the cochlea, the vestibulum, and the semi-circular canals; and the portio dura sends off a branch to the tympanum, and other branches to the external ear and parts near it.

The *sense of hearing*, in producing which all the parts we have described assist, is occasioned by a certain modulation of the air collected by the funnel-like shape of the external ear, and conveyed through the meatus auditorius to the membrana tympani. That sound is propagated by means of the air, is very easily proved by ringing a bell under the receiver of an air-pump; the sound it affords being found to diminish gradually as the air becomes exhausted, till at length it ceases to be heard at all. Sound moves through the air with infinite velocity; but the degree of its motion seems to depend on the state of the air, as it constantly moves faster in a dense and dry, than it does in a moist and rarefied air.

That the air vibrating on the membrana tympani communicates its vibration to the different parts of the labyrinth, and by means of the fluid contained in this cavity affects the auditory nerve so as to produce sound, seems to be very probable; but the situation, the minuteness, and the variety of the parts which compose the ear, do not permit much to be advanced with certainty concerning their mode of action.

Some of these parts seem to constitute the immediate organ of hearing, and these are all the parts of the vestibulum: but there are others which seem intended for the perfection of this sense, without being absolutely essential to it. It has happened, for instance, that the membrana tympani, and the little bones of the ear, have been destroyed by disease, without depriving the patient of the sense of hearing.*

Sound is more or less loud in proportion to the strength of the vibration; and the variety of sounds seems to depend on the difference of this vibration; for the more quick and frequent it is, the more acute will be the sound, and *vice versa.*

Before we conclude this article, it will be right to explain certain phenomena, which will be found to have a relation to the organ of hearing.

Every body has, in consequence of particular sounds, occasionally felt that disagreeable sensation which is usually called *setting the teeth on edge:* and the cause of this sensation

* This observation has led to a supposition, that a perforation of this membrane may in some cases of deafness be useful; and Mr. Cheselden relates, that, some years ago, a malefactor was pardoned on condition that he should submit to this operation; but the public clamour raised against it was so great, that it was thought right not to perform it.

may be traced to the communication which the portio dura of the auditory nerve has with the branches of the fifth pair that are distributed to the teeth, being probably occasioned by the violent tremor produced in the membrana tympani by these very acute sounds. Upon the same principle we may explain the strong idea of sound which a person has who holds a vibrating string between his teeth.

The humming which is sometimes perceived in the ear, without any exterior cause, may be occasioned either by an increased action of the arteries in the ears, or by convulsive contractions of the muscles of the malleus and stapes, affecting the auditory nerve in such a manner as to produce the idea of sound. An ingenious philosophical writer* has lately discovered that there are sounds liable to be excited in the ear by irritation, and without any assistance from the vibrations of the air.

Sect. V. *Of Vision.*

The eyes, which constitute the organ of vision, are situated in two bony cavities named *orbits*, where they are surrounded by several parts, which are either intended to protect them from external injury, or to assist in their motion.

The globe of the eye is immediately covered by two eye-lids or palpebræ, which are com-

* Elliot's Philosophical Observations on the Senses of Vision and Hearing, 8vo.

posed of muscular fibres covered by the common integuments, and lined by a very fine and smooth membrane, which is from thence extended over part of the globe of the eye, and is called *tunica conjunctiva*. Each eye-lid is cartilaginous at its edge ; and this border which is called *tarsus*, is furnished with a row of hairs named *cilia* or *eye-lashes*.

The cilia serve to protect the eye from insects and minute bodies floating in the air, and likewise to moderate the action of the rays of light in their passage to the retina. At the roots of these hairs there are sebaceous follicles, first noticed by Meibomius, which discharge a glutinous liniment. Sometimes the fluid they secrete has too much viscidity, and the eye-lids become glued to each other.

The upper border of the orbit is covered by the eye-brows or supercilia, which by means of their two muscles are capable of being brought towards each other, or of being carried upwards. They have been considered as serving to protect the eyes, but they are probably intended more for ornament than utility.*

The orbits in which the eyes are placed, are furnished with a good deal of fat, which affords a soft bed on which the eye performs its several motions. The inner angle of each orbit, or that part of it which is near the nose, is called *canthus major*, or the *great angle ;* and the outer angle, which is on the opposite side of the eye, is the *canthus minor*, or *little angle*.

* It is observable, that the eye-brows are peculiar to the human species.

The little reddish body which we observe in the great angle of the eye-lids, and which is called *caruncula lachrymalis*, is supposed to be of a glandular structure, and, like the follicles of the eye-lids, to secrete an oily humour. But its structure and use do not seem to have been hitherto accurately determined. The surface of the eye is constantly moistened by a very fine limpid fluid called the *tears*, which is chiefly, and perhaps wholly, derived from a large gland of the conglomerate kind, situated in a small depression of the os frontis near the outer angle of the eye. Its excretory ducts pierce the tunica conjunctiva just above the cartilaginous borders of the upper eye-lids. When the tears were supposed to be secreted by the caruncule, this gland was called *glandula innominata;* but now that its structure and uses are ascertained, it very properly has the name of *glandula lachrymalis*. The tears poured out by the ducts of this gland are, in a natural and healthy state, incessantly spread over the surface of the eye, to keep it clear and transparent, by means of the eye-lids, and as constantly pass out at the opposite corner of the eye or inner angle, through two minute orifices, the puncta lachrymalia;* being determined into these little openings by a reduplication of the tunica conjunctiva, shaped like a crescent the two points of which answer to the puncta.

* It sometimes happens, that this very pellucid fluid, which moistens the eye, being poured out through the excretory ducts of the lachrymal gland faster than it can be carried off through the puncta, trickles down the cheek, and is then strictly and properly called *tears*.

This reduplication is named *membrana*, or *valvula semilunaris*. Each of these puncta is the beginning of a small excretory tube, through which the tears pass into a little pouch or reservoir, the sacculus lachrymalis, which lies in an excavation formed partly by the nasal process of the os maxillare superius, and partly by the os unguis. The lower part of this sac forms a duct called the *ductus ad nares*, which is continued through a bony channel, and opens into the nose, through which the tears are occasionally discharged.*

The motions of the eye are performed by six muscles; four of which are straight and two oblique. The straight muscles are distinguished by the names of *elevator*, *depressor*, *adductor*, and *abductor*, from their several uses in elevating and depressing the eye, drawing it towards the nose, or carrying it from the nose towards the temple. All these four muscles arise from the bottom of the orbit, and are inserted by flat tendons into the globe of the eye. The oblique muscles are intended for the more compound motions of the eye. The first of these muscles, the obliquus superior, does not, like the other four muscles we have described, arise from the bottom of the orbit, but from the edge of the foramen that transmits the optic nerve, which separates the origin of this muscle from that of

* When the ductus ad nares becomes obstructed in consequence of disease, the tears are no longer able to pass into the nostrils; the sacculus lachrymalis becomes distended; and inflammation, and sometimes ulceration taking place, constitute the disease called *fistula lachrymalis*.

the others. From this beginning it passes in a straight line towards a very small cartilaginous ring, the situation of which is marked in the skeleton by a little hollow in the internal orbitar process of the os frontis. The tendon of the muscle after passing through this ring, is inserted into the upper part of the globe of the eye, which it serves to draw forwards, at the same time turning the pupil downwards.

The obliquus inferior arises from the edge of the orbit, under the opening of the ductus lachrymalis; and is inserted somewhat posteriorly into the outer side of the globe, serving to draw the eye forwards and turn the pupil upwards. When either of these two muscles acts separately, the eye is moved on its axis; but when they act together, it is compressed both above and below. The eye itself, which is now to be described, with its tunics, humours, and component parts, is nearly of a spherical figure. Of its tunics, the conjunctiva has been already described as a partial covering, reflected from the inner surface of the eye-lids over the anterior portion of the eye. What has been named *albuginea* cannot properly be considered as a coat of the eye, being in fact nothing more than the tendons of the straight muscles spread over some parts of the sclerotica.

The immediate tunics of the eye, which are to be demonstrated when its partial coverings, and all the other parts with which it is surrounded, are removed, are the sclerotica, cornea, choroides, and retina.

The *sclerotica*, which is the exterior coat, is every where white and opaque, and is joined at its anterior edge to another, which has more convexity than any other part of the globe, and being exceedingly transparent is called *cornea*.* These two parts are perfectly different in their structure; so that some anatomists suppose them to be as distinct from each other as the glass of a watch is from the case into which it is fixed. The sclerotica is of a compact fibrous structure; the cornea, on the other hand, is composed of a great number of laminæ united by cellular membrane. By macerating them in boiling water, they do not separate from each other, as some writers have asserted; but the cornea soon softens, and becomes of a glutinous consistence.

The ancients supposed the sclerotica to be a continuation of the dura mater. Morgagni, and some other modern writers, are of the same opinion; but this point is disputed by Winslow, Haller, Zin, and others. The truth seems to be, that the sclerotica, though not a production of the dura mater, adheres intimately to that membrane.

The *choroides* is so called because it is furnished with a great number of vessels. It has likewise been named *uvea*, on account of its resemblance to a grape. Many modern anatomical writers have considered it as a production of the pia mater. This was likewise the opinion

* Some writers, who have given the name of *cornea* to all this outer coat, have named what is here and most commonly called *sclerotica*, *cornea opaca*; and its anterior and transparent portion, *cornea lucida*.

of the ancients; but the strength and thickness of the choroides, when compared with the delicate structure of the pia mater, are sufficient proofs of their being two distinct membranes.

The choroides has of late generally been described as consisting of two laminæ; the innermost of which has been named after Ruysch, who first described it. It is certain, however, that Ruysch's distinction is ill founded, at least with respect to the human eye, in which we are unable to demonstrate any such structure, although the tunica choroides of sheep and some other quadrupeds may easily be separated into two layers.

The choroides adheres intimately to the sclerotica round the edge of the cornea; and at the place of this union, we may observe a little whitish areola, named *ligamentum ciliare*, though it is not of a ligamentous nature.

They who suppose the choroides to be composed of two laminæ, describe the external one as terminating in the ligamentum ciliare, and the internal one as extending farther to form the iris, which is the circle we are able to distinguish through the cornea; but this part is of a very different structure from the choroides; so that some late writers have perhaps not improperly considered the iris as a distinct membrane. It derives its name from the variety of its colours, and is perforated in the middle.— This perforation, which is called the *pupil* or *sight* of the eye, is closed in the fœtus by a very thin vascular membrane. This membrana pupillaris commonly disappears about the seventh month.

On the under side of the iris we observe many minute fibres, called *ciliary processes*, which pass in radii or parallel lines from the circumference to the centre. The contraction and dilatation of the pupil are supposed to depend on the action of these processes. Some have considered them as muscular, but they are not of an irritable nature: others have supposed them to be filaments of nerves; but their real structure has never yet been clearly ascertained.

Besides these ciliary processes, anatomists usually speak of the circular fibres of the iris, but no such seem to exist.

The posterior surface of the iris, the ciliary processes, and part of the tunica choroides, are covered by a black mucus for the purposes of accurate and distinct vision; but the manner in which it is secreted has not been determined.

Immediately under the tunica choroides we find the third and inner coat, called the *retina*, which seems to be merely an expansion of the pulpy substance of the optic nerve, extending to the border of the crystalline humour.

The greatest part of the globe of the eye, within these several tunics, is filled by a very transparent and gelatinous humour of considerable consistence, which, from its supposed resemblance to fused glass, is called the *vitreous humour*. It is invested by a very fine and delicate membrane, called *tunica vitrea*, and sometimes *arachnoides*.—It is supposed to be composed of two laminæ; one of which dips into its substance, and by dividing the humour into cells adds to its firmness. The fore-part of the vitreous humour is a little hollowed, to receive a very white and transparent substance of a firm texture, and of a lenticular and somewhat convex shape, named the *crystalline humour*. It is included in a capsula, which seems to be formed by a separation of the two laminæ of the tunica vitrea.

The fore-part of the eye is filled by a very thin and transparent fluid, named the *aqueous humour*, which occupies all the space between the crystalline and the prominent cornea—The part of the choroides which is called the *iris*, and which comes forward to form the pupil, appears to be suspended as it were in this humour, and has occasioned this portion of the eye to be distinguished into two parts. One of these, which is the little space between the anterior surface of the crystalline and the iris, is called the *posterior chamber;* and the other, which is the space between the iris and the cornea, is called the *anterior chamber* of the eye.* Both these spaces are completely filled with the aqueous humour.†

* We are aware that some anatomists, particularly Lieutaud, are of opinion, that the iris is every where in close contact with the crystalline, and that it is of course right to speak only of one chamber of the eye; but as this does not appear to be the case, the situation of the iris and the two chambers of the eye are here described in the usual way.

† When the crystalline becomes opaque, so as to prevent the passage of the rays of light to the retina, it constitutes what is called a *cataract;* and the operation of couching consists in removing the diseased crystalline from its bed in the vitreous humour. In this operation the cornea is perforated, and the aqueous humour escapes out of the eye, but it is constantly renewed again in a very short time. The manner, however, in which it is secreted, has not yet been determined.

The eye receives its arteries from the internal carotid through the foramina optica; and its veins pass through the foramina lacera, and empty themselves into the lateral sinuses. Some of the ramifications of these vessels appear on the inner surface of the iris, where they are seen to make very minute convolutions, which are sufficiently remarkable to be distinguished by the name of *circulus arteriosus*, though perhaps improperly, as they are chiefly branches of veins.

The optic nerve passes in at the posterior part of the eye, in a considerable trunk, to be expanded for the purposes of vision, of which it is now universally supposed to be the immediate seat. But Messrs. Mariotte and Mery contended, that the choroides is the seat of this sense; and the ancients supposed the crystalline to be so. Besides the optic, the eye receives branches from the third, fourth, fifth, and sixth pair of nerves.

The humours of the eye, together with the cornea, are calculated to refract and converge the rays of light in such a manner as to form at the bottom of the eye a distinct image of the object we look at; and the point where these rays meet is called the *focus* of the eye. On the retina, as in the *camera obscura*, the object is painted in an inverted position; and it is only by habit that we are enabled to judge of its true situation, and likewise of its distance and magnitude. To a young gentleman who was born blind, and who was couched by Mr. Cheselden, every object (as he expressed himself) seemed to touch his eyes as what he felt did his skin; and he thought no objects so agreeable as those which were smooth and regular, although for some time he could form no judgment of their shape, or guess what it was in any of them that was pleasing to him.

In order to paint objects distinctly on the retina, the cornea is required to have such a degree of convexity, that the rays of light may be collected at a certain point, so as to terminate exactly on the retina.—If the cornea is too prominent, the rays, by diverging too soon, will be united before they reach the retina, as is the case with near-sighted people or *myopes;* and on the contrary, if it is not sufficiently convex, the rays will not be perfectly united when they reach the back part of the eye; and this happens to long-sighted people or *presbi*, being found constantly to take place as we approach to old age, when the eye gradually flattens.* These defects are to be supplied by means of glasses. He who has too prominent an eye, will find his vision improved by means of a concave glass; and upon the same principles, a convex glass will be found useful to a person whose eye is naturally too flat.

* Upon this principle, they who in their youth are near-sighted may expect to see better as they advance in life, as their eyes gradually become more flat.

ANATOMY

Plate XXX

Scot Philad.

EXPLANATION OF PLATE XXX.

FIGURE 1. Shows the Lachrymal Canals, after the Common Teguments and Bones have been cut away.

a, The lachrymal gland. b, The two puncta lachrymalia, from which the two lachrymal canals proceed to c, The lachrymal sac. d, The large lachrymal duct. e, Its opening into the nose. f, The caruncula lachrymalis. g, The eye-ball.

FIG. 2. An interior View of the Coats and Humours of the Eye.

a a a a, The tunica sclerotica cut in four angles, and turned back. b b b b, The tunica choroides adhering to the inside of the sclerotica, and the ciliary vessels are seen passing over—c c, The retina which covers the vitreous humour. d d, The ciliary processes, which were continued from the choroid coat. e e, The iris. f, The pupil.

FIG. 3. Shows the Optic Nerves, and Muscles of the Eye.

a a, The two optic nerves before they meet. b, The two optic nerves conjoined. c, The right optic nerve. d, Musculus attollens palpebræ superioris. e, Attollens oculi. f, Abductor. g g, Obliquus superior, or trochlearis. h, Adductor. i, The eye-ball.

FIG. 4. Shows the Eye-ball with its Muscles.

a, The optic nerve. b, Musculus trochlearis. c, Part of the os frontis, to which the trochlea or pully is fixed, through which,—d, The tendons of the trochlearis passes. e, Attollens oculi. f, Adductor oculi. g, Abductor oculi. h, Obliquus inferior. i, Part of the superior maxillary bone to which it is fixed. k, The eye-ball.

FIG. 5. Represents the Nerves and Muscles of the Right Eye, after part of the Bones of the orbit have been cut away.

A, The eye-ball. B, The lachrymal gland. C, Musculus abductor oculi. D, Attollens. E, Levator palpebræ superioris. F, Depressor oculi. G, Adductor. H, Obliquus superior, with its pully. I, Its insertion into the sclerotic coat. K, Part of the obliquus inferior. L, The anterior part of the os frontis cut. M, The crista galli of the ethmoid bone. N, The posterior part of the sphenoid bone. O, Transverse spinous process of the sphenoid bone. P, The carotid artery, denuded where it passes through the bones. Q, The carotid artery within the cranium. R, The ocular artery.

NERVES.—a a, The optic nerve. b, The third pair.—c, Its joining with a branch of the first branch of the fifth pair, to form l,—The lenticular ganglion, which sends off the ciliary nerves, d. e e, The fourth pair. f, The trunk of the fifth pair. g, The first branch of the fifth pair, named ophthalmic.—h, The frontal branch of it. i, Its ciliary branches, along with which the nasal twig is sent to the nose. k, Its branch to the lachrymal gland. l, The lenticular ganglion. m, The second branch of the fifth pair, named superior maxillary. n, The third branch of the fifth pair, named inferior maxillary. o, The sixth pair of nerves,—which sends off p, The beginning of the great sympathetic. q, The remainder of the sixth pair, spent on c, The abductor oculi.

FIG. 6. Represents the head of a youth, where the upper part of the cranium is sawed off,—to show the upper part of the brain, covered by the pia mater, the vessels of which are minutely filled with wax.

A A, The cut edges of the upper part of the cranium. B, The two tables and intermediate diploë. B B, The two hemispheres of the cerebrum. C C, The incisure made by the falx. D, Part of the tentorium cerebello super expansum. E, Part of the falx, which is fixed to the crista galli.

FIG. 7. Represents the parts of the External Ear, with the Parotid Gland and its Duct.

a a, The helix. b, The antihelix. c, The antitragus. d, The tragus. e, The lobe of the ear. f, The cavitas innominata. g, The scapha. h, The concha. i i, The parotid gland. k, A lymphatic gland, which is often found before the tragus. l, The duct of the parotid gland. m, Its opening into the mouth.

FIG. 8. A view of the posterior part of the external ear, meatus auditorius, tympanum, with the small bones, and Eustachian tube of the right side.

a, The back part of the meatus, with the small ceruminous glands. b, The incus. c, Malleus. d, The chorda tympani. e, Membrana tympani. f, The Eustachian tube. g, Its mouth from the fauces.

FIG. 9. Represents the anterior part of the right external ear, the cavity of the tympanum—its small bones, cochlea, and semicircular canals.

a, The malleus. b, Incus with its long leg, resting upon the stapes. c, Membrana tympani. d, e, The Eustachian tube, covered by part of—f f, The musculus circumflexus palati. 1, 2, 3, The three semicircular canals. 4, The vestible. 5, The cochlea. 6, The portio mollis of the seventh pair of nerves.

FIG. 10. Shows the muscles which compose the fleshy substance of the Tongue.

a a, The tip of the tongue, with some of the papillæ minimæ. b, The root of the tongue. c, Part of the membrane of the tongue, which covered the epiglottis. d d, Part of the musculus hyo-glossus. e, The lingualis. f, Genio-glossus. g g, Part of the stylo-glossus.

THE END.