AN

INTRODUCTION

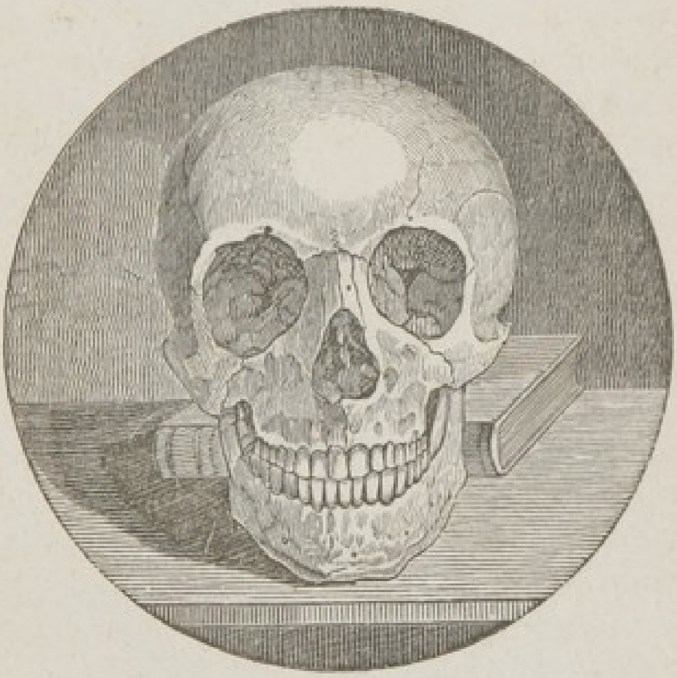
TO THE

STUDY OF HUMAN ANATOMY.

BY JAMES PAXTON,

MEMBER OF THE ROYAL COLLEGE OF SURGEONS, HONORARY MEMBER OF THE ASHMOLEAN SOCIETY, AND AUTHOR OF NOTES AND ILLUSTRATIONS TO PALEY'S NATURAL THEOLOGY.

WITH ILLUSTRATIONS.



FOURTH AMERICAN EDITION, WITH ADDITIONS,

BY WINSLOW LEWIS, JR. M.D.

BOSTON:
WILLIAM D. TICKNOR AND COMPANY,
CORNER OF WASHINGTON AND SCHOOL STREETS.
M DCCC XLIV.
1844

BOSTON:
PRINTED BY THURSTON, TORRY AND CO.
18, Devonshire Street.

PREFACE OF THE AMERICAN EDITOR.

The evident utility of the anatomical work of Paxton, founded on the union of graphic and explanatory designs, must at once be apparent to those, who, without such a guide, have experienced great difficulties in conceiving of the appearances of parts from verbal description alone. The only work on Anatomy re-published in this country, accompanied with plates, is that of Charles and John Bell, which is expensive, without being well done, and the student is obliged to turn from the book of the text, to that of the plates. This inconvenience is here obviated at a moderate cost. The reader has, at a *coup d'œil*, the representation of the part before him, with a simple explanation. This work only claims to be of an elementary character, and one to be studied at the very commencement of professional reading: to serve to introduce the student to those more elaborate and excellent systems, with which our own anatomists have enriched this department. Those of Wistar and of Horner, are works which may honor any country.

The American Editor of Paxton has made, he trusts, some useful additions, which he has preferred rather to embody with the work, than to disfigure it, by placing them in notes. Its mechanical excellence will at least bear proof of the skill of the artists.

W. L., Jun.

PREFACE TO THE ENGLISH EDITION.

The present work contains a concise and clear demonstration of the structure of the human body; and on this it grounds its claim to the notice of the professional and the scientific reader. It is admitted that a much larger store of anatomical knowledge is contained in the works of Fyfe, Bell, Lizars, and others, as well as in the splendid publications of continental authors; but no one has given to the public a treatise in its present form, containing graphic and descriptive anatomy on the same page. The principal object of the present undertaking is to furnish the student with sufficient directions for cultivating this particular department of science, in the shortest and most successful manner; and for this purpose the author has endeavored to give a correct drawing, as well as an exact description of the parts, by which the mind will be assisted in forming its conceptions, and the memory in retaining or recalling past impressions, when the dissections are imperfectly remembered, or cannot be repeated.

Those who are familiar with the admirable work of J. Cloquet, *Anatomie de l'Homme*, will perceive that frequent use has been made of it, both in figures and description.

Much interest has of late been excited by publications which display the mechanism of nature; indeed, the utility and application of *animal mechanics*, in several branches of science beside those of medicine and surgery, have been frequently pointed out. From the structure and functions of living bodies, writers on Natural Theology find ample materials for showing design and goodness in the creation; and certainly no ground of argument could be better chosen, or afford more striking illustrations of the wisdom and power of the Creator, than the anatomy of man; which, throughout, is but the history of means adapted to certain ends. Those only, who study the structure of animated nature, can estimate and admire as they ought, the wonderful contrivances of the human frame. "It is evident, therefore, that the more correctly a divine is informed respecting anatomy and physiology, the more effectually will he be enabled to employ his knowledge as an argument in favor of natural religion."* And, as a branch of general education also, it deserves the attention of all those concerned in the instruction of youth.

It is acknowledged by most persons, that natural history cannot be advantageously studied unless we are acquainted with the structure of the objects of our research, or with comparative anatomy, so called from its comparing the anatomy of other living creatures with that of man. So, also, the science of geology, which in the present age so much engages the attention of philosophic inquiry, receives great elucidation from the anatomical character of animals.

Natural philosophy has derived aid from the investigation of the human structure, particularly from a knowledge of the formation of the eye and the ear; for "the eye is an organ or instrument by which vision is performed: it is by its nature the most perfect optical instrument, and *the foundation of all others*."†

The provisions in the eyes of different animals for regulating the admission of light, the adaptation of their refracting powers to the different media, and the momentary changes in their forms for the vision of near or distant objects, are some of the most interesting points of physiology, and evidently connected with the science of optics.

The organ of hearing may be said to be completely artificial, differing in different animals according to the circumstances in which the function is to be exercised. All these varieties are founded on the general laws for the transmission of sound through various vibrating substances; those laws, therefore, cannot fail to derive elucidation from a knowledge of the mechanism of the ear.

In the fine arts, sculpture and painting receive considerable assistance from a knowledge of anatomy. Without

* Dr. Macartney. † Emerson.

some acquaintance with this science, the artist cannot determine the correctness of his figures; for the bones give the form and the proportion of the joints, and the muscles the intervening outline. The various emotions of the mind naturally call into action certain muscles; and the predominating passion stamps upon the countenance a corresponding indelible impression, though the mind may not be at every instant under its influence. The representation of muscular actions constitutes the anatomy of expression; so that the success of the historical painter must very much depend on his knowing the separate and combined action of the moving powers, in the various attitudes and positions of the human body; for not only the face, but every other part of the person, participates in the mental emotion, and more or less influences the contour and general character of the figure. Many of the ancient statues, as the Laocoon, the Gladiator, and others, display a studied observation and a correct expression of muscular action.

As a branch of general education, anatomy and physiology are subservient to several other objects. For instance— in many judicial inquiries; in the examination of legal evidence; in the regulation and infliction of punishments; and in the consideration of the best modes of coercion, or the restraints which are most effectual in preventing crime; — the powers of the human constitution should be accurately considered.

I have taken a cursory view of some of the collateral advantages which may accrue from the study of anatomy and physiology; but to the student in medicine, these sciences must be considered indispensable. Not only is it his duty, before entering into practice, to obtain the most perfect knowledge of this department of his profession, by studying the structure and functions of animal bodies, but he must carefully, during the whole course of his professional career, keep up his stock of information. On the importance of anatomical science, the late Dr. Baillie has thus expressed himself: "There is not a physician, or surgeon, who can conscientiously discharge his duty to his patient or to himself, who does not occasionally, I ought to say, who does not frequently, inspect the human frame; a knowledge of which is the very foundation of medical science, and a guide to us in the distribution of life and health to our fellow-creatures."

From an acquaintance with the structure and functions of the several parts of the human body when in health, we are able, for the most part, to judge of its state when under deviations occasioned by disease, and thus to act upon just and rational principles in the treatment of the innumerable derangements to which our frame is liable. It is in the pages of death that we read the history of life — it is by taking to pieces the machine that we discover some at least of the wheels which put it in motion: for the same reason we are obliged to examine the body by disssection, before we can explain its constitution and actions. The anatomist, therefore, first studies the apparently simple elements which compose our complex fabric, examining successively all those solid pieces of framework which give to the body its proportions, permit or limit its movements; that by separating the levers of the system, he may be better able to observe their junctures, and the fastenings which retained them in their situation. Next he traces out the moving powers which act on them and direct them, or which enable the animated form to execute the external and internal actions necessary to existence. He then dissects the principal tubes which distribute that vital and regenerating fluid, which repairs the waste of material, by supplying an accession of substance to the complicated machine. Afterwards he investigates those organs which communicate sensation, and transmit, swifter than lightning, the orders of the will, by means of those delicate fibres which establish such intimate relations between us and the bodies with which we are surrounded. Lastly, he analyzes those optical, acoustic, and chemical instruments of nature, which produce sensations; and contemplates, in their defunct state, those organs which, under a living principle, exercised a series of functions, excelling each other in the wonder they excite, and following one another in such intimate succession, as gives them the appearance of being connected together by an invisible but most admirable chain.

CONTENTS.

ARTICLE I.

OSSEOUS SYSTEM.

CHAPTER I.

CHAPTER II.

CHAPTER III.

CHAPTER IV.

CHAPTER V.

CHAPTER VI.

CHAPTER VII.

ARTICLE II.

CARTILAGINOUS SYSTEM.

CHAPTER I.

ARTICLE III.

FIBROUS SYSTEM.

CHAPTER I.

CHAPTER II.

CHAPTER III.

CHAPTER IV.

CHAPTER V.

CHAPTER VI.

CHAPTER VII.

CHAPTER VIII.

CHAPTER IX.

ARTICLE IV.

MUSCULAR SYSTEM.

CHAPTER I.

CHAPTER II.

CHAPTER III.

CHAPTER IV.

CHAPTER V.

CHAPTER VI.

ARTICLE V.

VASCULAR SYSTEM.

CHAPTER I.

CHAPTER II.

CHAPTER III.

ARTICLE VI.

ORGANS OF ABSORPTION.

CHAPTER I.

CHAPTER II.

ARTICLE VII.

NERVOUS SYSTEM.

CHAPTER I.

CHAPTER II.

CHAPTER III.

ARTICLE VIII.

PARTICULAR ORGANS OF SENSATION.

CHAPTER I.

CHAPTER II.

CHAPTER III.

CHAPTER IV.

CHAPTER V.

CHAPTER VI.

CHAPTER VII.

ARTICLE IX.

ORGANS OF DIGESTION.

ARTICLE X.

ORGANS OF RESPIRATION.

ARTICLE XI.

ORGANS OF THE VOICE.

ARTICLE XII.

ORGANS OF SECRETION.

ARTICLE XIII.

ORGANS OF GENERATION IN THE MALE.

ARTICLE XIV.

ORGANS OF GENERATION, ETC., IN THE FEMALE.

ARTICLE XV.

THE FŒTUS.

ARTICLE XVI.

SEROUS SYSTEM, AND CELLULAR TISSUE.

GENERAL OBSERVATIONS.

The science of anatomy investigates whatever enters into the composition of animated beings; and the dissection of their dead bodies is the chief means of prosecuting the study. The anatomist isolates portions, to display them more distinctly; he injects vessels, to exhibit their course; macerates some parts, to unravel their intimate conformation; dries other parts, to preserve them for future reference; and uses various other processes to facilitate his inquiries into the intricate and complicated machinery of the animal frame. Anatomy, therefore, may be said to be the science of animal organization; and it requires such an examination of the instruments of life, as shall disclose their number, size, situation, form, color, connexion, texture, and functions.

This science comprehends the structure of organized beings in general; but it is the anatomy of man only which forms the subject of the present INTRODUCTION.

The anatomy of the human body explains its structure under two different conditions: the first is a healthy state of the organs, termed *special anatomy;* the second is a diseased state producing alterations of structure, termed *morbid* or *pathological anatomy.* I confine myself to a description of the structures and organs of the adult in the former of these conditions.

The human body is composed of solids and fluids, united in different proportions. The solids give the form and consistence to the different parts of our bodies, and they consist of bones, ligaments, muscles, tendons, vessels, nerves, etc. The fluids form the greatest part of the body, and are the blood, chyle, and all the secreted liquids, as urine, sweat, saliva, tears, bile, &c. These are all contained either in vessels, cells, or reservoirs. When the fluids of the animal frame are separated from the solids, their weight is in the proportion of eight to ten. This has been ascertained by an examination of human bodies found buried in the dry sands of Arabia, with their fluids evaporated and their solids remaining perfect; and the fact is confirmed by experiments on inferior animals.

The anatomy of the solids has been divided into various branches, expressive of the parts referred to; as,

Osteology,	A description of the bones.
Syndesmology,	A description of the ligaments.
Myology,	A description of the muscles.
Splanchnology,	A description of the viscera.
Adenology,	A description of the glands.
Angiology,	A description of the structure and distribution of the vessels.
Neurology,	A description of the nerves.
Dermology,	A description of the skin.

The description and composition of the animal fluids come under the head of Physiology particularly.

The solid parts of the body are named *organs*, or the instruments by which the functions are exercised.

These solid parts of our fabric, when minutely examined, are found to consist ultimately of layers of minute fibres, or filaments, varied in appearance and texture, according to the use and offices of the part which they compose.

As the different organs which constitute the body are of a more simple or complex structure, they are made up of one or more *tissues* or textures, which are the original materials, performing the same function, in whatever part of the body they exist. Most of the organs of the body are composed of a variety of these elementary textures, which are spread out in the form of membranes, collected into cords, or hollowed out into canals; and by their diversity of combination, figure, and color, they produce all the modifications of structure and functions which different organs possess.

Bichat, an eminent French anatomist, pointed out the simple analysis or division of the body into its elementary parts; and the knowledge of these has been of the utmost importance in the investigation and treatment of diseases, as well as of the greatest convenience in anatomical arrangement.

The systems of texture may be placed in the following order; 1st, the bony system; 2d, the cartilaginous; 3d, the fibrous; 4th, the muscular; 5th, the vascular; 6th, tha nervous; 7th, the mucous; 8th, the serous; 9th, the glandular; 10th, the adipose; 11th, the cellular; 12th, the dermoid.

These are further subdivided: as the bony system, into the bony and medullary; the cartilaginous, including the fibro-cartilaginous; the vascular is divided into the arterial, the venous, and the lymphatic, etc. But in this place I wish to take a more general view of animal structures, and these twelve divisions will comprehend the whole.

The elementary tissues are variously combined and proportioned; the cellular, vascular, and nervous tissues, give origin to a variety of compound solids, and these solids are furnished with the properties suited to the place they occupy and the offices they discharge.

It is difficult to ascertain the chemical ingredients which enter into the composition of the body; but, according to our present knowledge of animal chemistry, the *inorganic elements* consist of carbon, azote, oxygen, hydrogen, phosphorus, sulphur, iron, calcium, sodium, potassium, etc. These different chemical elements again form *organic elements:* as *gelatin*, or what is called animal jelly; *fibrin*, or a whitish elastic filamentous substance; *albumen*, a vivid transparent fluid like the white of an egg, coagulating by alcohol and heat; *mucous*, a viscid transparent fluid, incapable of coagulation; *fat*, or animal oil, a well-known substance, insoluble in water, and readily melting by the action of heat. More particular notice, however, of the formation and chemical composition of individual structure will subsequently occur.*

* For the several other chemical products, I refer the reader to Berzelius on Animal Chemistry.

ANATOMY

OF

THE HUMAN BODY.

CHAP. I.

OF THE BONES, OR OSSEOUS SYSTEM IN GENERAL.

THE bones are the hardest parts of animal bodies; they are a firm and common basis, on which the moving powers are fixed; they constitute a framework for protecting the vital organs, as the heart and lungs, or form complete cases, where the more delicate parts of our organization, as the brain and spinal marrow, are securely lodged. They also constitute a series of levers, by means of which, through the agency of the muscles, locomotion and the various and numerous offices of life are performed.

A complete assemblage of conjoined bones forms the skeleton; if it be united by its natural ligaments, it is denominated a natural skeleton; if by wires, it is called, though incorrectly, an artificial skeleton, signifying, however, that it is artificially articulated, which indeed is the most useful mode of connecting bones; for, by this means, the joints can be moved and examined at pleasure; on the contrary, bones united by their ligaments have the joints rigid and concealed.

The appearance of the skeleton is different in different subjects, according to the period of life and the sex: the present subject is to describe its formation and particular organization in the adult, either male or female.

The forms of the bones are sufficiently obvious in many parts of the body to give the points to the outline, determining the size, proportion, and motions of its several members.

The bones afford attachments to the moving powers, *i. e.* to the muscles by their tendons, and also to the ligaments.

OSSIFICATION.

The bones experience many changes before they arrive to the term of their perfection, which is not until about the twentieth year.

In the first periods, their consistence does not exceed that of other parts. In four weeks they harden and appear cartilaginous, their form is perfect, and they are covered by their peculiar membrane, the periosteum. Towards the eighth week their vessels commence to carry red blood, instead of colorless fluid, which before circulated in them. It is at this period that the true ossification begins, departing from certain centres, which are called the *points of ossification*, and these vary according to the forms of the bones. In the flat bones, the ossific matter is deposited in a radiated manner; in the long bones, in parallel lines.

The larger bones are the first formed, with the exception of the minutest in the body, viz. those of the ear. In these, ossification is the soonest completed; and they exceed all the others in density, and in the proportion of the hard matter of bones which they contain.

The use, for which a bone is destined, appears to have some influence on the degree of rapidity, with which it is formed and developed. Thus the jaw bones are early matured, as they are so soon in life required for use. On the other hand, the sternum and coccyx are tardily perfected, because it is necessary that the cavities, which they help to inclose, should be kept in a somewhat cartilaginous state until a later period.

Most of the bones are formed of several pieces, as may be more particularly observed in the long ones, which have their extremities* separated from their body by a thin partition of cartilage, and it is some time before the whole is united.

In the skull, some of the bones, in the first rudiments of ossification, display a radiated, calcareous phosphate, diverging from the centre to the circumference. Unossified substance at first occupies the interstices left between them, but subsequently additional bony fibres proceed until the cranium is perfect.

When ossification is completed, the bones still continue to undergo different changes. The general growth in stature is completed with the process of ossification; but increase of bulk is still for a long time advancing to middle age, when the bone is stronger and less vascular; and the different elevations of the surface become more prominent and marked, particularly in individuals accustomed to strong exercise. Finally, as we advance in years, vitality progressively decreases; and in extreme old age the earthy substance predominates, and the bones become extremely fragile.

* Termed epiphyses and apophyses,

EMINENCES AND DEPRESSIONS OF BONES.

A variety of *eminences* and *depressions* characterize a number of the bones. The eminences are all those projections, prolongations, or productions, observable on their surfaces ; and different names have been assigned to these, derived from their figure, situation, and use.

These *eminences* are termed *heads*, when they are convex, roundish, and smooth on their surface. *Necks*, when smallest at the middle, and gradually increasing toward the extremity. *Condyles*, when the head is rather long and unequally rounded. *Tubercles* or *tuberosities*, when uneven, rough, and irregular. *Spines or spinous processes*, when sharp or pointed. Long elevations with sharp edges are all called *cristæ*. Such processes as terminate in a sharp point, or rather edge, receive the general name of *coronoid*, though most of them receive particular names from their resemblance to other things, as *mastoid*, *styloid*, *coracoid*.

Processes are also named from their *situation*, as oblique, transverse, &c.

Some from their *uses*. Thus two tubercles on the os femoris are designated as *trochanters*, because they serve to turn that bone.

The *depressions* are either *deep* or *superficial*. Of the *deep* depressions or cavities, some are termed *cotylæ* or *cotyloid*, from their being like a cup, such as the greater cavity which receives the head of the femur. Others are named *alveoli* or *sockets*, as those in which the teeth are lodged.

The more *shallow* or *superficial* cavities are called *glenæ* or *glenoid*, as that part of the scapula which receives the head of the humerus. The cavities of the interior of bones will be described when considering their structure.

These eminences and depressions are most strongly marked in those persons, who take very robust exercise, and in the male more than the female, in the adult more than the infant.

The eminences of articulation are generally the expanded extremities of bones, forming surfaces of union with other bones, in which there are corresponding depressions. The mode of union varies with the form and use of the bones thus united ; some being immovably united, others having a limited or a free motion.

Muscular depressions are in proportion to the strength or action of the muscles to which they give origin ; and the degree of projection of the eminences for insertion is always a sure sign of the strength of the muscles attached to them, and the energy of their motion. Asperities on the surface of bones in general show where tendons or muscles are implanted. An extended line usually indicates the attachment of a broad tendon ; projecting points have tendons or ligaments corresponding.

It may be easily conceived, that the moving powers must act with greater advantage by being removed farther from the centre of the bone, by means of such projecting points. The eminences for the insertion of ligaments also afford a similar advantage, by removing, in some degree, the ligament from the articulation, thus facilitating the motion of the latter, as we may observe in the elbow and the knee.

Eminences and depressions, from apparent impression, are such as the irregularities of the inner surface of the skull, or such as muscular impressions on other bones, present. They are supposed to be occasioned by the pressure of different organs on the surface in their growth or actions. If these impressions are not actually the result of the compression of the organs on the bone, they show that the bones are provided with forms admirably accommodated to the adjacent parts.

FORMS OF BONES.

Viewed in respect to form, bones have been arranged under four classes—the *long*, the *broad*, the *short*, and the *mixed* bones.

The first or *long* bones, in general, belong to the parts of locomotion, where they become levers moved in various directions by the muscles. These have all a medullary canal, and their extremities are considerably larger than their bodies, and are porous and reticulated, which gives them a greater degree of lightness, increases the articulating surfaces, and consequently diminishes their liability to luxation. The body of these bones is usually round. The greater distance these are from the trunk of the body, the less is their volume, but the greater their number.

The second, or *broad* bones, are little connected with locomoti on, serving chiefly for the insertion of muscles, which proceed to the long bones, and form ordinarily by their union the walls or parietes of certain cavities, as the cranium and pelvis. They are nearly equal in length and breadth, but vary in thickness. They have two lamina; and in the cranium the internal is thinner and harder, and has therefore the name of *tabula vitrea*.

The third, the *short* bones, are situated in those parts in which solidity and motion must be united, as in the spine, the wrist, and the instep, where their number insures these two properties, namely: solidity, because the force of external mechanical shocks is expended on the wide surface, by which they are connected; and mobility, because from their individual partial motions, there results collectively a very extensive general one.

Besides these three classes of bones, there is a fourth, termed by Meckel *mixed* bones, for they seem to be formed by the union of the bones of the other classes, chiefly of the second and third, being composed of flat and short portions, viz. the sphenoid, temporal, and ethmoid bones.

COLOR OF BONES.

The color of the bones depends upon their age, or the manner in which they have been prepared. In the adult, the color is of an opaque white when fresh, more or less tinged with red ; in younger subjects, however, the bones are more vascular and colored than in those of more advanced years.

TEXTURE OF BONES.

The texture of the bones, like every other animal structure, has a fibrous appearance. The nature of bony fibre is everywhere the same, but being differently arranged admits of two essential modifications ; in one bone, or in part of the bone, the fibres, more or less distant from each other, display a profusion of cells ; in other parts, closely compressed together, they form a kind of compact substance, in which they cannot easily be discerned. By sawing a cylindrical bone in a longitudinal direction, the arrangement of the fibres is evident.

Fig. 1.

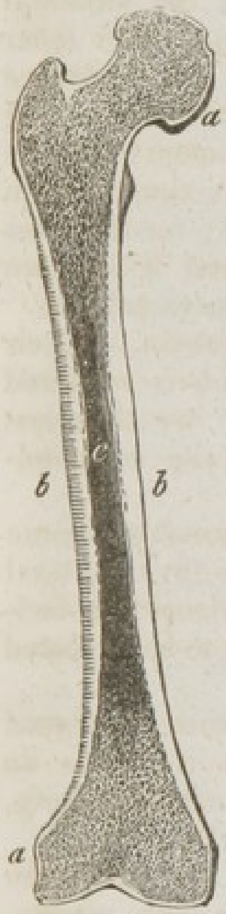


Fig. 1 is a section of the thigh bone ; *a*, *a*, the extremities, having to some extent a shell of compact texture, crowded with small cells, diminishing in size, but increasing in number as they approach the articulation. They are named *cancelli*, or spongy structure. *c*, the cavity for containing the marrow. The hollowness increases the diameter, consequently the comparative strength of the cylinder. *b*, *b*, the *walls* or sides of the shaft, very solid. Observe, the compact texture is thicker near the middle of the bone, where the greatest forces are most frequently applied.

The short bones are almost entirely of a cellular structure, covered only by a thin layer of compact texture ; in this respect their organization is similar to the heads of long bones.

The broad bones are usually composed of two compact plates of a moderate thickness, having a cellular structure interposed ; but in general wherever broad bones are thin, and there is a deficiency of cancelli, very powerful muscles meet, and by their thick layers compensate for the want of solidity in the bone, as in the occiput, ilium, scapula, etc.

PERIOSTEUM.*

This is a fibrous membrane, so called from its surrounding all the bones, and providing them with a covering everywhere extended over them, except in such parts as are tipped with cartilage, and the teeth which are protected by enamel.

The ancients had figured to themselves the periosteum as extending from one bone to another over the articulations, and thus forming a continued bag for the whole skeleton. This idea is nearly correct; for although the periosteum ceases at the joint, it is interwoven with the ligaments that surround the joints; in this manner continuity may be conceived.

The periosteum in infancy is slightly united to the bone, and is removed from it with the utmost facility. In the adult the adhesion is more firm; it is excessively so in an aged person. The inner surface of this membrane is firmly fixed to the bone by numerous vessels and fibrous threads, particularly in the extremities of the long bones and on the short bones, which we can easily conceive by the great number of apertures we see in them. The connexion between the periosteum and the adjacent organs is much varied; for the most part the muscles are attached to, or glide upon it, and it is more or less united to them and to the integuments by cellular membrane.

The periosteum borrows its vessels from those adjacent. Their innumerable branches form an intricate net-work, which is rendered very striking by injections, especially in infants; they are then lost in the compact texture of the bone, or are returned to the surrounding parts.

This membrane is no doubt supplied with nerves, though so minute as not to be easily demonstrated. Like bone in its healthy or natural state, it possesses little or no sensibility; yet when inflamed its feeling is exceedingly painful, so that we cannot but allow it to be endowed with nerves.

That absorbent vessels also penetrate the periosteum, is argued from its restoration from diseases. In some cases it attains an unnatural thickness, and in process of time regains its natural tenuity, which can only be the result of the action of the absorbents.

The periosteum is subservient to several uses. 1st. It is the nutrient membrane of the bone; it endows its exterior with vitality, and if it be separated from it, the surface of the bone perishes. 2d. It gives convenient insertion to nearly the whole of the fibrous system; viz. the tendons, ligaments, aponeuroses and also muscles, are attached to this membrane. 3d. By means of the smooth surface of the periosteum, the action of the muscular fibres and the tendons is easy, and the effects of friction are averted.

* In the English edition, the description of the periosteum is deferred until the author is on the subject of Fibrous Membranes; but being so immediately connected with tho Osseous System, it was considered proper to place it where it now is.

COMPOSITION OF BONES.

The composition of bones, whatever may be their forms, is the same ; it consists of a mixture of earthy and animal matter.

The existence of the first is proved by burning bones in fire ; combustion, destroying the animal matter, leaves a brittle substance, which is the earthy part, of the same form with that of the bone.

The animal part of bone is not less evident, for by immersion in a weak acid, the earthy matter is dissolved, and there remains a cartilaginous body, flexible and elastic, bearing the same form as the bone.

These two substances are the essential component parts of bones. The earthy is intended to provide them with the strength and solidity, that characterize them ; the animal parts endow the bones with the principles of vitality, growth, and nutrition.

The skeleton consists of about two hundred and fifty-two* bones, which are divided into those of the *head*, the *trunk*, and the *extremities ;* some of them are single, and others are in pairs. There are

fifty-five bones of the head.	Frontal	*Os frontis*	1
	Parietal	*Ossa parietalia*	2
	Occipital	*Os occipitis*	1
	Temporal	*Ossa temporum*	2
	Sphenoidal	*Os sphenoides*	1
	Ethmoid	*Os ethmoides*	1
	Nasal	*Ossa nasi*	2
	Malar	*Ossa malarum*	2
	Lachrymal	*Ossa lachrymalia*	2
	Upper jaw bones	*Ossa maxillaria superiora*	2
	Palate bones	*Ossa palatina*	2
	Inferior turbinated bones	*Ossa turbinata*	2
	Vomer		1
	Lower jaw	*Os maxillare inferius*	1
	Teeth	*Dentes*	32
	Tongue bone	*Os hyoides*	1

To these may be added the proper bones of the ear, contained in the temporal bones :

8 bones of the ear.	*Mallei*	2
	Incudes	2
	Stapedes	2
	Orbicularia	2

The back bone or spine consists of

57 bones of the trunk.	*Vertebræ*		24
	Ribs	*Costæ*	24
	Breast bone	*Sternum*	2
	Hip bones	*Ossa innominata*	2
	Rump bone	*Os sacrum*	1
	Coccygeal bones	*Ossa coccygis*	4

* The exact number of bones in the human frame is variable ; the sesamoid bones and ossa Wormiana are not constant ; and in reckoning the bones of the skeleton, the small bones of the ear are usually omitted.

one hundred and thirty-two bones of the extremities.

Collar bones	*Claviculæ*	2
Blade bones	*Scapulæ*	2
Arm bones	*Ossa humeri*	2
Fore arm bones	*Radii et ulnæ*	4
Wrist bones	*Ossa carpi*	16
Hand bones	*Ossa metacarpi*	8
Finger bones	*Phalanges digitorum manus*	24
Thumb bones	*Ossa pollicis*	6
Sesamoid	*Ossa sesamoidea*	4
Thigh bones	*Ossa femoris*	2
Knee pans	*Patellæ*	2
Shin bones	*Tibiæ*	2
Small bones of the legs	*Fibulæ*	2
Tarsal	*Ossa tarsi*	14
Metatarsal	*Ossa metatarsi*	10
Toe bones	*Phalanges digitorum pedis*	28
Sesamoid	*Ossa sesamoidea*	4
		252

In describing the relative position, or the relation which one part bears to another in the subsequent chapters, the anatomist supposes the body erect. By *superior* and *inferior*, is signified higher and lower with respect to the erect position. By *anterior* and *posterior* is denoted the situation of the parts as nearer to the fore or hinder surface of the body; and by *laterally* is to be understood, that the parts so described approach the one side or the other. *Inner* and *outer*, and *external* and *internal*, express the relation of any given part or portion of the body to the middle line of the body, or to an imaginary plane bisecting the body into lateral halves, passing through the head and trunk, and continued between the lower extremities.

TAB. I.

TABLE I.

Represents a front view of the male skeleton.

HEAD AND NECK.

a, The frontal bone.
b, The parietal bone.
c, The temporal bone.
d, A portion of the sphenoid bone.
e, The nasal bone.
f, The malar, or cheek bones.
g, The superior maxillary, or upper jaw bone.
h, The lower jaw.
i, The bones of the neck.

TRUNK.

a, The twelve bones of the back.
b, The five bones of the loins.
c, *d*, The breast bone, composed of two pieces.
e, *f*, The seven true ribs.
g,*g*, The five false ribs.
h, The rump bone, or sacrum.
i, The hip bones.

UPPER EXTREMITY.

a, The collar bone.
b, The shoulder blade.
c, The upper arm bone.
d, The radius.
e, The ulna.
f, The carpus, or wrist.
g, The bones of the hand.
h, The first row of finger bones.
i, The second row of finger bones.
k, The third row of finger bones.
l, The bones of the thumb.

LOWER EXTREMITY.

a, The thigh bone.
b, The knee pan.
c, The tibia, or large bone of the leg.
d, The fibula, or small bone of the leg.
e, The heel bone.
f, The bones of the instep.
g, The bones of the foot.
h, The first row of toe bones.
i, The second row of toe bones.
k, The third row of toe bones.

TABLE II.

Represents a back view of the male skeleton.

THE HEAD.

a, The parietal bone.
b, The occipital bone.
c, The temporal bone.
d, The cheek bone.
e, The lower jaw bone.

NECK AND TRUNK.

a, The bones of the neck.
b, The bones of the back.
c, The bones of the loins.
d, The hip bone.
e, The sacrum.

UPPER EXTREMITY.

a, The collar bone.
b, The blade bone.
c, The upper bone of the arm.
d, The radius.
e, The ulna.
f, The bones of the wrist.
g, The bones of the hand.
h, The first row of finger bones.
i, The second row of finger bones.
k, The third row of finger bones.
l, The bones of the thumb.

LOWER EXTREMITY.

a, The thigh bone.
b, The large bone of the leg.
c, The small bone of the leg.
d, The heel bone.
e, The bones of the instep.
f, The bones of the toes.

TAB. II.

CHAP. II.

BONES OF THE HEAD.

These comprehend the bones of the *cranium* and *face*, which are twenty-two in number. Some of them are in pairs, but others are only single bones.

In the cranium or skull there are two pairs and four single bones, viz.

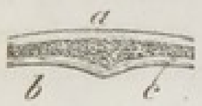
2 Parietal.	1 Occipital.
2 Temporal.	1 Ethmoid.
1 Frontal.	1 Sphenoid.

To the face there are six pairs and two single bones, viz.

2 Nasal.	2 Palatine.
2 Lachrymal.	2 Turbinated.
2 Malar.	1 Vomer.
2 Superior maxillary.	1 Inferior maxillary.

The cranium is the vaulted cavity for lodging the brain, its membranes and vessels.

Fig. 2.



The inner and outer surfaces of the bones are composed of compact layers, Fig. 2, *a*, called the *external*, and *b*, the *internal tables* of the skull. They are not parallel to each other, but in some places very compressed. There is an intermediate cellular texture, *c*, between them, termed *diploe*, which is similar to the cancelli of other bones, and it serves a like purpose, viz. to convey vessels and nerves from one region to another. The character of the two tables differs; the external is *fibrous*, the inner exceedingly compact and brittle, so as to obtain the name of *vitreous*.

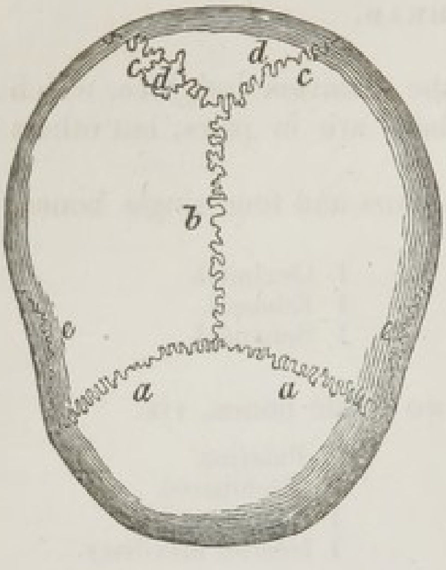
THE SUTURES.

Upon the face of the skull we observe various lines, dividing it into different portions, as in Fig. 3, the upper part of the skull. These lines are the joining of the several bones to each other, and form a resemblance, on a superficial view, to the stitches of a seam; they are denominated *sutures*. Their origin is this: the radiated fibres of the bones in their growth approach each other, the fibres of one bone entering the interval of the fibres of another bone, and forming the serrated line of union called suture.

a, *a*, The *coronal suture*, has its name from being situated at that part of the head, upon which the ancients were used to place the laurel or olive crown, given to the victors in their games. It passes transversely over the skull, and joins the frontal with the parietal bones.

b, The *sagittal suture*, named from its straight course. It extends from the middle of the superior margin of the frontal, to the angle of the occipital bone. It is the union of the two parietal bones. This suture is occasionally continued down the frontal bone to the nose: this part of it is then named the *frontal suture.*

Fig 3.



c, The *lambdoidal suture*, receiving this name from its resemblance to the Greek Δ. It commences at the termination of the sagittal suture, and extends on each side to the base of the cranium. It joins the occipital to the parietals above, and to the temporal bones below. There is great irregularity in this suture: it is frequently diverted from its regular course by the interposition of little bones (separate ossifications), *d*, *d*, which, from being of a triangular shape, have been called *ossa triquetra*, or ossa Wormiana, in compliment to Olaus Wormius, an anatomist, who first particularly described them.

The superior portions of the temporal bone are joined to the parietal by thin, indented, yet scaly overlapping of the former, *e*, *e*, hence named the *squamous* suture. Near the occipital angle it loses its squamous character, and is simply united by a serrated line, under the name of *additamentum suturæ squamosæ.*

Two other sutures are sometimes reckoned, viz. the ethmoidal and the sphenoidal; but they unite the ethmoid and sphenoid bones, to those adjacent, by irregular lines, by no means having the character of a suture.

FRONTAL BONE. *Os frontis.*

Fig. 4.

This bone forms the forehead, part of the temples, and the roof of the orbits; its shape has been compared to that of a clam shell. Fig. 4 is a front, Fig. 5 a back view. Two eminences, *a*, *a*, mark the situation of the *frontal sinuses.* These are formed by an apparent separation of the two tables of the skull, leaving very considerable cavities, which communicate with the nose.*

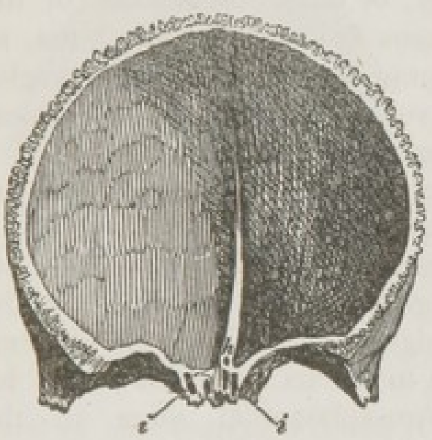
On each side of the forehead we observe *b*, Fig. 4, the *temporal arch*,

* These cavities increase the intensity of the sound of the voice, and render it more melodious.

at first strongly marked, but less so as it passes upwards. The hollow forms part of the temporal fossa. In the middle and at the lower edge of this bone is *c*, the *nasal process*, and *ethmoidal notch*. On the ridge over which the eye-brow is placed we observe *d*, a hole; sometimes it is only a notch in the bone, as on the other side of this specimen, though it is there completed by a ligament, so as to form a hole called the *upper orbitary hole*.* The ridges just mentioned terminate at *e*, *e*, the *external angular processes*. The angles opposite are the *internal angular processes*. Between these are *f*, *f*, the *orbitar plates*, slightly concave, and have near the outer angle a *depression* † for the reception of the lachrymal gland.

On the *internal surface*, Fig. 5, are slight depressions, answering to the convolutions of the brain. *h*, the frontal *spine*, is a sharp ridge commencing at the ethmoidal notch and extending upwards about an inch, where it divides into two ridges with a shallow groove between them, called the *frontal furrow*. At the root of the spine at *h*, is a small hole, which not perforating the bone or leading to any cavity, is called the *blind hole*.‡ *i*, *i*, the *openings* of the frontal sinuses. The os frontis is joined above and behind with the ossa parietalia, which junction terminates at a line running horizontally backwards from the point of the angular process; between those two points and behind as far as the ethmoidal notch, it joins with the sphenoid bone on each side; within the ethmoidal notch it receives the ethmoid bone, which joins to the orbitar plates, at the interior part of which it unites with the os lachrymale; in front it joins its nasal process and spine with the ossa nasi and superior maxillary bones, and by its outer angular processes with the malar bones.

Fig. 5.



The muscles attached to the os frontis are three pairs, viz. the *temporal* muscle, the *corrugator supercilii*, and *orbicularis palpebrarum*, on each side. It is also covered by the *occipito-frontalis*.

THE PARIETAL BONES, *Ossa parietalia*,

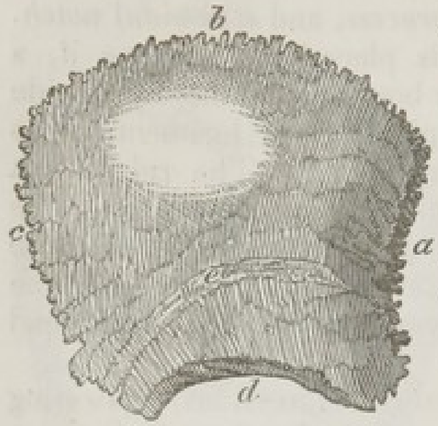
Are a pair, forming the sides and vertex, or top of the head. *Externally*, Fig 6, each bone is convex; and as it has four angles,

* Foramen supra-orbitarium. For the passage of the first branch of the fifth pair of nerves.

† Fossa lachrymalis.

‡ Foramen cæcum.

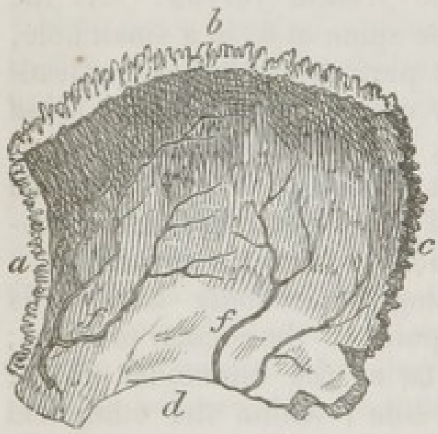
Fig. 6.



they are denominated according to their relative situation in the skull, the *frontal* and *temporal angles*, and the *superior* or *inferior occipital angles.* The marginal edges also are named from their connexions, as *a*, in this and the subsequent figure, the anterior edge, is called the *frontal margin* ; *b*, the *parietal margin* ; *c*, the *occipital margin* ; *d*, the *temporal margin*. On the convex surface is a *transverse arched impression*, *e*, which marks the attachment of the temporal muscle.

On the *internal* and concave surface, Fig. 7, *f*, *f*, are *impressions*, or furrows, which are for the ramifications of the artery of the dura mater, or outer membrane of the brain. Sometimes part of the artery runs in a canal in the bone, as in this specimen at the temporal angle. Near the superior margin there is commonly a small hole, through which a vein passes from the integuments of the head to the longitudinal sinus.

Fig. 7.

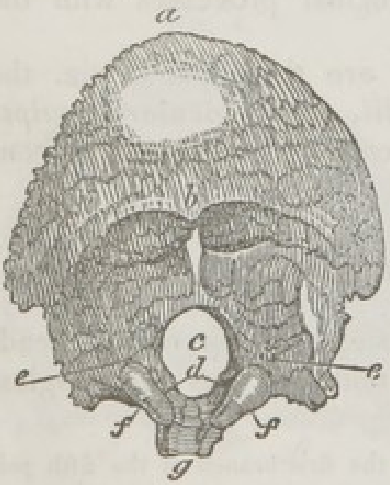


The parietal bone is joined by its frontal edge to the os frontis ; by the parietal edge to its fellow ; by its occihital edge to the os occipitis ; and by its temporo-sphenoidal edge to the temporal and sphenoid bones.

The only muscle attached to the parietal bone is the *temporal.*

THE OCCIPITAL BONE, *Os occipitis*,

Fig. 8.



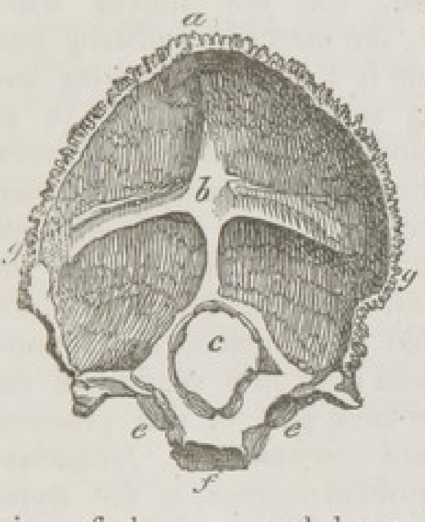
Is situated at the back part of the head, and forms part of the base of the skull. It is convex externally, Fig. 8 ; concave internally, Fig. 9.

The most remarkable parts to be noticed on the exterior, Fig. 8, are *a*, the *occipital angle* ; *b*, a prominence called the *tubercle*, from each side of which there is a *transverse arched ridge*,* and below is another *ridge*, following nearly the same direction. These are to be borne in mind as indicating the attachment of some of the muscles of the head. There are also several depressions, showing the insertion of muscles.

* Linea semicircularis, or arcus transversus.

At the under and fore part of the bone is *c*, the *great opening*,* through which passes the medulla oblongata, or upper part of the spinal marrow, its membranes, the vertebral arteries, and the spinal accessory nerves ; *d*, the *anterior condyloid* holes, through which the lingual nerves pass ; *e*, *e*, the *posterior condyloid holes*, for the passage of the veins of the neck : frequently one or both of the latter holes are wanting, in which case the veins proceed through the foramen magnum ; *f*, *f*, the *condyles* or smooth eminences for articulating with the first bone of the neck ; *g*, the *basilary* or *cuneiform process*.

Fig. 9.



The *inner surface*, Fig. 9, is concave, and divided by a crucial ridge, *b*. To the crucial ridge are attached processes of the dura mater, viz. from *a* to *b*, a portion separating the posterior lobes of the cerebrum ; from *b* to *c*, a portion dividing the cerebellum ; and from *b* to *g* each side, another, which separates the cerebrum from the cerebellum. In this curved ridge from *b* to *g*, are seen *transverse grooves*, showing the situation of the lateral sinuses ; *c*, the *great foramen ; e*, *e*, the *condyles* ; *f*, the *basilary process*. The occipital bone is united by its parietal margin to the parietal bones ; by its temporal to the margin of the mastoid portion of the temporal bone ; by its basilary margin to the petrous portion of the same bone ; and by its basilary process to the sphenoid bone.

The muscles attached to the os occipitis are ten pairs, viz. the *trapezii*, *complexi*, *splenii*, *recti postici majores*, *et minores capitis*, *obliqui superiores capitis*, *recti laterales*, *recti interni*, *majores*, *et minores capitis*, and the single muscle *occipito-frontalis*.

THE TEMPORAL BONES, *Ossa temporum*,

Are a pair. They are so named because they occupy the region of the head where the hair usually commences to whiten, thus indicating the period of life. They are irregular in their form, and unequal in their thickness. Fig. 10 is an outer view. Each bone is distinguished by two distinct portions : the upper part is thin and of a scaly character, hence named the *squamous portion ;* the other half of the bone is of a triangular form passing inwards and downwards, and being of a close texture and rocky hardness, is called the *petrous portion*. If a horizontal line were drawn from *b*, the squamous portion would be all that part above the line. It forms the chief part of the temple. The squamous portion is bounded at

* Foramen magnum occipitis.

its base by *b*, the *zygomatic process*, which is a thin and narrow projection of bone; at its root it has *c*, a *tubercle* or eminence, and terminates in *b*, an indented process, which, from its union with the malar or cheek bone, is called the *malar process*. Immediately behind the eminence *c*, is a *cavity* for the articulation of the lower jaw. At the back part of this cavity is an apparent division in the bone, the *glenoid fissure*, through which passes a nerve called the *cordà tympani*. On the lower surface of the eminence just mentioned, the jaw moves when brought forwards. At *d*, is a deep hole, the *external auditory passage*.* From the lower part of the bone is a remarkably long and pointed process, *e*, which, from having some resemblance to an ancient style, or iron writing pen, is named *styloid process*. Several muscles are attached to this slender portion of bone, and derive their names from it. At the root of the process, *f*, is a ridge of bone termed the *vaginal process*, imagination having formed it into the likeness of a sheath to the styloid process. Further behind is *g*, the *mastoid process;* it is a very considerable prominence, the texture of which is cellular, but the cells are seen only in a section of the part. There is one or more holes at the back part of this process, seen at *c*, Fig. 11, called the *mastoid foramen* or *foramina*. Between the root of the styloid and mastoid processes, is the *stylo-mastoid foramen:* it is the passage for the portio dura of the seventh pair of nerves.

Fig. 10.

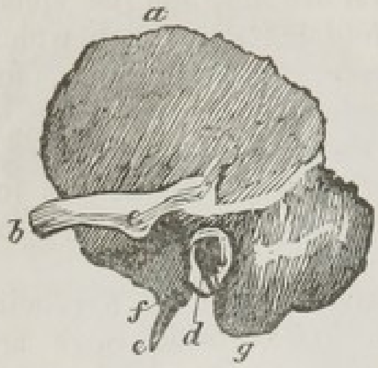
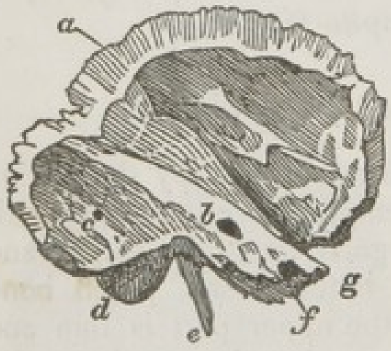


Fig. 11 is the inside view. On the squamous portion we observe marks of the convolutions of the brain, and *a*, the edge bevelled off where it overlaps in joining the parietal bone. On the petrous portion is *b*, the *internal auditory passage*,† by which the nerves of hearing have access from the brain to the ear. Posterior to this is a foramen, called the *aqueduct of the cochlea:* it serves for the entrance and exit of the blood-vessels of the ear. On the opposite side, in the interior part of the petrous portion, is a small hole called the *Vidian foramen*.

Fig. 11.



* Meatus auditorius externus.

† Meatus auditorius internus. It should be observed, that this opening soon divides into two; the first, called the *aqueduct of* Fallopius, for that division of the seventh pair of nerves, the portio dura, which is distributed to the face; the second foramen admits the other division of this nerve, the portio mollis, by several small apertures, into the intricate passages of the ear, to become the proper organ of hearing.

Near the point, called the inferior angle, is *f*, the entrance of the *carotid canal*, for the passage of the chief artery of the brain ; *g*, the bony part of the *Eustachian tube*.* At the base of the bone is the *jugular fossa*, or thimble-like depression, made by the first turn or commencement of the jugular vein. The temporal bone is united, by its malar process, to the zygomatic process of the os malæ ; by the inferior edge of the squamous portion to the spinous process of the os sphenoides ; by the superior edge of the same part to the temporo-sphenoidal edge of the os parietale ; by the superior edge of the mastoid portion to the temporal angle of that bone ; by the inferior part of the mastoid portion and the petrous portion, to the temporal and basilar edges of the os occipitis, and the basilar portion of the os sphenoides.

There are sixteen muscles attached to the temporal bone, viz. the *temporalis*, *masseter*, *retrahens auris, occipito-frontalis*, *sterno-cleido-mastoideus*, *complexus minor*, *splenius*, *digastricus*, *stylo-hyoideus*, *stylo-glossus*, *stylo-pharyngeus*, and the *constrictor pharyngis superior ;* and the muscles moving the small bones of the ear, the *tensor tympani*, *laxator tympani*, *externus mallei*, and *stapedius*.

Besides the parts which have been described, the temporal bone contains the organ of hearing, which includes the *ossicula auditus*, etc. As, however, these parts cannot be understood till several sections of the temporal bone have been made, I shall refer the reader, for a further description, to the article on the senses.

THE SPHENOID BONE,

Figs. 12 and 13,

So called from its situation in the base of the skull, where it wedges in and locks together most of the other bones, for it is united to fourteen distinct bones. Its general resemblance to a bat with extended wings, has given names to different parts of the bone. Fig. 12, *a*, the *pituitary fossa* or *sella turcica*, a slight concavity in the centre of the bone for the lodgment of the pituitary body ; *b*, *b*, points having the name of the *anterior*, and *c*, *c*, the *posterior clinoid processes*, so called from their supposed resemblance to the knobs of a bedstead. An eminence in front, *d*, is called the *olive-shaped process*, upon which the optic nerves meet and unite ; *e*, *e*, the *optic foramina*, through which these nerves and an artery pass to the eye. The points *f*, *f*, continued from the anterior clinoid processes, are the *transverse processes*, or the smaller wings. In front of the body is *g*, the *ethmoidal spine ;* *h*, the *basilar process*, which joins

Fig. 12.

* Iter a palato ad aurem. It is named the Eustachian tube from EUSTACHIUS, an eminent anatomist, who discovered it.

3

the occipital bone ; on each side of that process is a deep notch, forming part of the carotid foramen. Between the transverse spinous process and the temporal portion of the bone, is *i*, *i*, the *sphenoidal fissure* or *foramen lacerum*, which transmits the third, fourth, and sixth pair of nerves, and the first branch of the fifth pair ; behind and below, are *k*, *k*, the *round foramina*, which transmit the second branch of the fifth pair of nerves ; *l*, *l*, the *oval foramina*, through which pass the third branch of the fifth pair of nerves ; *m*, *m*, the *spinal foramina*, by which the middle artery of the dura mater passes ; *n*, *n*, the entrance of the *pterygo-palatine canals*, by which the palatine nerves pass to the mouth ; *o*, *o*, the *temporal portions*, or *plates*, or the larger wings ; *q*, *q*, the *spinous processes*.

In the posterior view, Fig. 13, *f*, *f*, is a profile of the *transverse processes* ; *i*, *i*, the *sphenoidal fissure* ; *o*, *o*, the *temporal plates*, or alæ ; *p*, *p*, the smooth surfaces which constitute part of the orbit of the eye, the *orbitar plates* ; *q*, *q*, the *spinous processes* ; *r*, *r*, the *external pterygoid processes* ; *s*, *s*, the *internal pterygoid processes*, each of which terminates in a little curved process, called the *hook-like process*,* over this a tendon of the extensor muscle of the palate plays ; *t*, the *azygos process* ; *u*, the body containing the *sphenoidal cells* ; the lines point to their openings.

Fig. 13.

There is a foramen at the base of each pterygoid process, called the *Vidian foramen*, from Vidius, who discovered it. This transmits a nerve that does not go from the cavity of the cranium, but returns into it. The second branch of the fifth pair, after passing out of the cranium, sends back, through this foramen, a branch called the *Vidian*, which, upon its arrival in the cranium, enters the temporal bone.

The sphenoid bone is united by its ethmoidal spine to the nasal plate of the os ethmoides ; by its transverse process and the orbitar plates to the os frontis ; and at the back part of its temporal to the sphenoidal angles of the ossa parietalia ; by the posterior edges of the same plates, and its spinous process, it joins the squamous portions of the temporal bones. From its spinous processes to the roots of the pterygoid processes, it touches the inferior angles of the petrous portions of the temporal bones ; and by its basilar process it is connected with the sphenoidal process of the os occipitis : by the anterior edges of its orbitar plates it is united to the ossa malarum ; by the anterior surfaces of its pterygoid plates to the ossa palati ; and by the azygos process to the vomer.

There are thirteen pairs of muscles attached to the os sphenoides ; viz. the *levator palpebræ superioris*, the *recti* muscles of the eyes, the *superior oblique* muscles of the eyes ; the *temporal* and *pterygoid muscles*, *buccinator*, *externus mallei*, *constrictor pharyngis superior*, and *tensor palati*.

* Hamular process.

THE ETHMOID BONE. *Os ethmoides.*

Fig. 14.


Fig. 15.


Fig. 16.


Fig. 14, a side view; Fig. 15, a posterior; Fig. 16, an anterior view. The letters refer to the same parts in each figure.

The ethmoid bone derives its name from the resemblance of its upper surface to a sieve, being full of small holes; it is of a cubical form and consists principally of numerous cells.

a, the *cribriform plate*, perforated by *numerous little holes** to transmit the olfactory nerves, or nerves of smelling, into the nostril. In the middle at *b*, is a sharp process, the *ethmoid crest*.† From the lower part descends *c*, the *nasal plate*, making part of the central partition of the nose; *d*, the *flat or orbitar plates*,‡ which form the principal portions of the inside of the orbits. We see on each side of the nasal septum, *e*, *e*, the *turbinated plates*, thin, pendulous, and convex; and on the back part, this bone has numerous *cells*, *f*, *f*, consisting of many convoluted plates of bone, called labyrinths, very deserving of an attentive examination, being perhaps the most curious bone of the human body. The nerves of smelling, after passing through the foramina of the cribriform plate, are expanded on the perpendicular septum, and throughout the whole extent of the cells. A very considerable surface is thus provided for the distribution of the nerves, occupying little space.

The ethmoid bone is joined by the edge of its cribriform plate to the ethmoidal notch of the os frontis and to the os sphenoides; and by the posterior part of its nasal plate to the latter bone, and to the vomer: by the fore part of the same plate to the back part of the nasal crista of the os frontis; by its anterior edge to the os lachrymale, and by the lower edge of the same plate to the superior maxillary bone.

There are no muscles attached to, or covering this bone.

THE WORMIAN, OR TRIANGULAR BONES.

Ossa Wormiana, Ossa triquetra.

These are little irregular bones found in the course of the suture formed by the parietal and occipital bones, see Fig. 3, *d*, *d*: their existence is not constant.

THE BONES OF THE FACE

Are in pairs, excepting two, one of which forms part of the partition of the nose, and the other is the lower jaw.

* Foramina cribrosa, from cribrum, a sieve.
† Crista galli.
‡ Ossa plana.

The lines of union of the bones of the face have been called sutures, and named according to their connexion with each other; but the union is rather by simple, irregular lines, than by sutures.

THE NASAL BONES. *Ossa nasi.*

Fig. 17. Fig. 18.

Fig. 17, the external surface; Fig. 18, the internal surface. These bones form the bridge of the nose; they are convex externally, thereby giving greater resistance to violence from without; and they are concave internally for enlarging the cavity of the nose;* at their middle part each presents a small foramen which passes through the bone, and transmits a vein to the pituitary membrane. Their superior margin is joined to the nasal process, and spine of the os frontis, and nasal plate of the os ethmoides; their external edges are received into the nasal process of the superior maxillary bone; their inner edges are united to each other, and their lower edges are joined only by the alar cartilages of the nose.

There are two muscles attached to them, viz. the *occipito-frontalis*, and *compressor naris*.

THE LACHRYMAL BONES. *Ossa lachrymalia.*

Fig. 19.

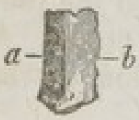


Fig. 19. This bone is nearly the size, shape, and indeed thickness of the finger nail, therefore has the name also of *os unguis*. It is called lachrymal because *a*, the *anterior concave portion*, supports the lachrymal duct, which conveys the tears from the inner corner of the eye into the nose; *b* the *orbitar plate*, which assists in forming the orbit of the eye.

THE CHEEK BONES. *Ossa malarum.*

Fig. 20. The bone of the left side. Its several angles are named as follows: *a*, the *superior orbitar process*; *b*, the *inferior orbitar process*; *c*, the *maxillary process*; *d*, the *zygomatic process*. The concave surface, *e*, forms a portion of the orbit, called the *internal orbitar process*.

Fig. 20.

There is but one foramen, *f*, *malar foramen*, through which the malar nerve passes.

The cheek bone is joined by its zygomatic process to the malar process of the temporal bone; by its superior orbitar process to the external angle of the os frontis; by the posterior edge of its orbitar plate to the os sphenoides; and by the inner edge of the same plate to the os maxillare superius.

There are four muscles attached to it; viz. *obliquus inferior oculi*, *zygomaticus major and minor*, *masseter*; and the *orbicularis palpebrarum* is extended over it.

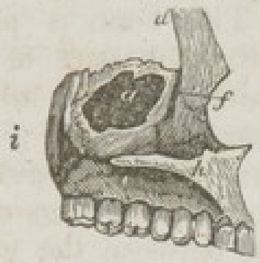
* It has been stated that the inhabitants of Java, the Hottentots, and South-Sea islanders, compress the nose immediately after birth, conceiving a broad nose conducive to beauty.

THE UPPER JAW BONES. *Ossa maxillaria superiora.**

The superior maxillary bones constitute the principal part of the bones of the face. Fig. 21, the outer; Fig. 22, the inner view.

Fig. 21.

Fig. 22.



The body of the bone is of an irregular form, having a large cavity, *a*, opening into the nostrils, commonly called the *antrum of Highmore.*† On the outer surface is *b*, the *infra orbitar foramen*, for the passage of the second branch of the fifth pair of nerves to the face; *c*, the *malar process*; *d*, the *nasal process*; *e*, a depression contributing to form the small cavity for lodging the lachrymal sack; this cavity descends, and becomes at *f*, part of the *nasal duct*. Between the malar and nasal processes, extending backwards, is *g*, the *orbitar plate*. The posterior surface of the bone at *i* is rounded, therefore termed *tuberosity*, the inner edge of which is rough, to join with the pterygoid process of the os palati, forming with it the palato-maxillary canal. From the inner and lower part of the body extends horizontally *h*, the *palatine process*, forming the greater portion of the floor of the nose, and hollowed below, to form an equal part of the roof of the mouth. On the upper surface is a crest or ridge, which is grooved to receive the septum of the nose. Immediately behind the front teeth is the *foramen incisivum*; the *ductus incisivus* is a continuation of this foramen between the palatine processes into the nose. There are usually eight *alveolar cavities* in each bone to receive the teeth.

The superior maxillary bone is united by its malar process to the inferior orbitar process of the os malæ; by its anterior inner edge to the os nasi, and on the inside to the os turbinatum; by the upper part to the os frontis, and the os lachrymale; by the inner edge of its orbitar plate to the flat plate of the os ethmoides; by the posterior point of the same plate to the os palati. It is connected by its tuberosity, body, and palatine process with the same bone; by the inner edge of the palatine process with that of its fellow; and by the nasal crest with the vomer.

There are ten muscles attached to this bone; viz., the *constrictor pharyngis superior*, *pterygoideus externus*, *buccinator*, *masseter*, *levator anguli oris*, *levator* and *depressor labii superioris alæque nasi*, *orbicularis palpebrarum*, *obliquus oculi inferior*, and *compressor naris*.

* Superior maxillary bones. † Sinus maxillaris, antrum Highmorianum.

THE PALATINE BONES. *Ossa palatina.*

Fig. 23, the anterior; Fig. 24, the posterior view of the palate bone. The letters refer to the same part in each figure.

Fig. 23.

Fig. 24.

This bone is placed at the lower and back part of the last described bone, below the middle region of the base of the skull; *a*, the *palatine process*, wide at its outer edge to join its fellow; from the outer edge of the palatine rises up *b*, the *nasal process*, which forms a thin partition between the cell of the superior maxillary bone and the nose; it is marked internally by a strong ridge, to which the turbinated bone is attached: behind the nasal process, backwards and outwards, at *c*, is a projecting point of bone, the *pterygoid process;* it has two grooves, one of which terminates in *f*, the *palato-maxillary foramen*, through which the palatine nerve and vessels proceed to the palate. There is another small foramen near the last, marked *g*, the *palatine foramen*, to transmit branches of the same vessels and nerves to the soft palate. The upper part of this bone is divided by a notch into two portions, *d*, the *sphenoidal process*, which is united to the body of the sphenoidal bone, *e*, a small triangular portion, which, entering into the formation of the socket of the eye, is termed the *orbitar process*.

The os palati is joined to its fellow by the palatine process; and by the nasal crest to the vomer; by the anterior part of the palatine process to the superior maxillary bone; by the ridge on the inside to the os turbinatum; by the nasal and pterygoid processes to the body and tuberosity of the os maxillare superius; by its pterygoid, sphenoidal, and orbitar processes to the pterygoid process and body of the os sphenoides; and by its orbitar process to the same process of the os maxillare superius, and the flat plate of the ethmoidal bone.

Five muscles are attached to, and connected with the os palati; viz., *buccinator*, *pterygoideus externus* and *internus*, *constrictor pharyngis*, *superior* and *azygos uvulæ*.

TURBINATAD BONES. *Ossa turbinata.**

Fig. 25.

Sometimes called the inferior spongy bones, to distinguish them from the upper spongy bones, which belong to, and are part of, the ethmoidal bone. They are pendent in the nostrils, curved, and exceedingly porous in their texture. This bone is joined on the upper and on the outer side to the body of the superior maxillary bone; anteriorly to the nasal process of the same bone, and to the os lachrymale; and posteriorly to the nasal process of the os palati.

Fig. 25.

* Ossa Spongiosa inferiora.

THE VOMER.

Fig. 26, is thus named from its shape resembling a ploughshare. It is divided into four edges, *a*, the *sphenoidal*, the broadest, and hollowed to receive the azygos process of the sphenoidal bone; *b*, the anterior or *nasal* process, grooved to receive the nasal plate of the ethmoid bone, and the cartilaginous septum of the nose; *c*, the inferior or *crista*, uniting with the crest of the superior maxillary bone; *d*, the posterior or *pharyngeal* margin, concave and facing the *pharynx*.

Fig. 26.

THE LOWER JAW. *Os maxillare inferius.*

This is by far the largest bone in the face, but it is here divided, to show to greater advantage the outer and inner surfaces. Figs 27, 28. The letters refer to each. *a*, *a*, the *basis*, is the boundary of the face; *b*, *b*, the *angle*; *c*, *c*, the *ramus*; *d*, the *condyle*; *e*, *e* the *coronoid process*. Fig. 28, *f*, the *inferior maxillary foramen*; into which nerves and vessels enter to supply in their course through the canal the teeth, and afterwards to pass out at *g*, the *mental foramen*. There are the same number and kind of teeth in the lower as in the upper jaw, and consequently similar cavities or alveoli to receive them. The number of the teeth may be reckoned as follows, viz. (on each side of the jaw) *h*, *two incisors*, or cutting teeth; *i*, *one canine*, or dog tooth; *k*, *two small molar*; *l*, *three large molar*, or grinding teeth.*

Fig. 27.

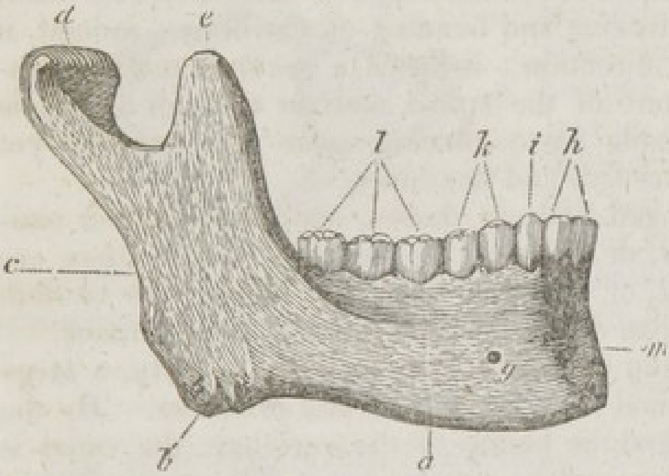
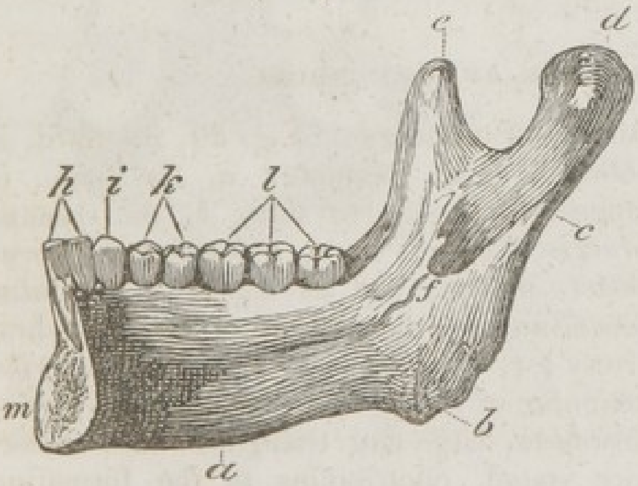


Fig. 28.



The lower jaw is connected by capsular and lateral ligaments with the glenoid cavities of the ossa temporum, having an inter-articular cartilage between them.

* The teeth will be particularly described at the end of the osseous system.

There are twelve pairs of muscles attached to this bone; viz., externally, the *masseteres*, *depressores anguli oris*, *depressores et levatores labii inferioris*; internally, the *temporales*, *pterygoid esxterni et interni*, *buccinatores*, *mylo-hyoidei*, *genio-hyoidei*, *digastrii*, *et genio-hyo-glossi:* the *platysma myoides* passes over it.

CHAP. III.

THE BONES OF THE TRUNK.

The trunk is composed of the spine or back bone, the thorax or chest, and the pelvis or hips.

The spine, though spoken of as a single bone, consists of twenty-four bones, which turn or play upon each other, and hence have been called *vertebræ*. The vertebral column supports the trunk, the head, and arms, and admits of turning and bending of the body; indeed, it has a movement in every direction: it forms a secure canal for conducting the delicate structure of the spinal marrow through its whole length; and it is remarkable for combining those two opposite yet very essential qualities, strength and flexibility.

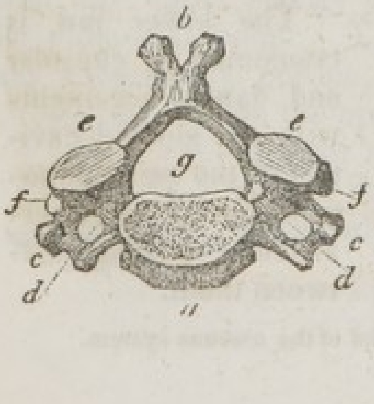
The vertebræ are arranged in three classes, according to their situation. 1st. The *cervical*, or those of the neck, of which there are seven. 2nd. The *dorsal*, or those of the back, which are twelve. 3rd. The *lumbar*, or those of the loins, consisting of five bones.

As a general description of a vertebra, each has a *body*, a *large foramen* to contain the spinal marrow, and several *processes*. By the junction of the processes and the bodies of the vertebræ, the canal is formed for the spinal marrow and its membranes. The roots of those processes, called the articular processes, are hollowed out above and below into notches; these, when the vertebræ are fitted together, form apertures, called the holes of conjunction, (*foramina intervertebralia*,) on each side of the spine, through which the nerves pass out from the spinal canal.

THE VERTEBRÆ OF THE NECK.

These are smaller than the other vertebræ. Fig. 29, the third, is selected as an example; *a*, the body, is longest from side to side; *b*, the *spinous process*, forked; *c*, *c*, the *transverse processes*, double, and having *d*, *d*, *circular foramina*, for the passage of the vertebral artery; *e*, *e*, the *superior*, *f*, *f*, the *inferior articular* or *oblique processes*; *g*, the *spinal foramina*, large and triangular, and, as before stated, contributing to the formation of the canal for the spinal marrow.

Fig. 29.



THE PECULIARITIES OF THE VERTEBRÆ OF THE NECK.

FIRST VERTEBRA, OR ATLAS.

The first vertebra, which, from its use in supporting the head, has the name of *atlas*, consists of a ring of bone, as we observe in Fig. 30, the upper, and Fig. 31, the lower surface. As it receives the commencement of the spinal marrow, the opening *a*, is large, and in place of the body at the front it is further hollowed out at *b*, for the reception of the dentiform process of the next vertebra ; *c*, *c*, the *superior articular processes*, irregularly oval, and concave ; these articulate with corresponding processes of the skull, by which the head has the power of bending backward and forward. In Fig. 31, we observe *e*, *e*, the *inferior articular surfaces*, are flat, and thus adapted to the superior articular surfaces of the adjoining vertebra, allowing a horizontal motion of the head ; *d*, *d*, the *transverse processes*, broad, a little forked, and perforated.

Fig. 30.

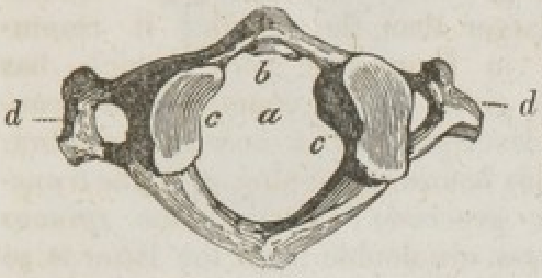
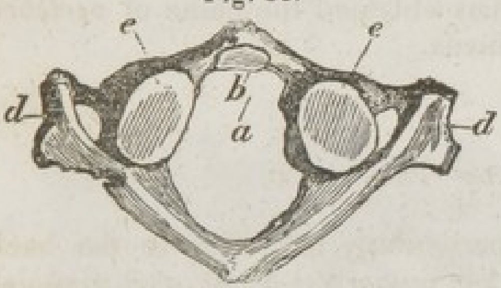


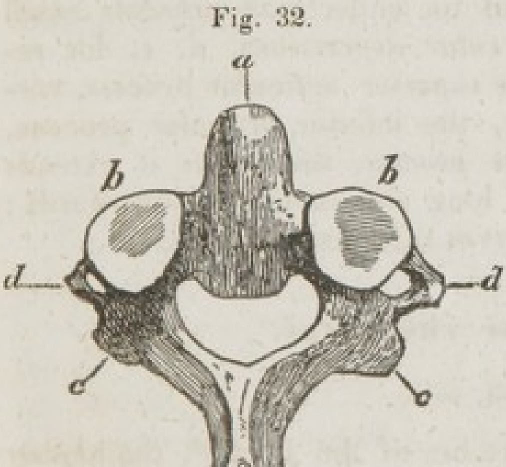
Fig. 31.



THE SECOND VERTEBRA, OR DENTATA.*

The most remarkable characteristic of this vertebra is *a*, a projecting point called the *tooth-like* process,† which rises from the upper part of the body, and has an articulating surface on its front, which is received into the hollow of the atlas. Fig. 32, *b*, *b*, the *superior articular processes* of the dentata, are flat, for on these planes the atlas rotates ; *c*, *c*, the *inferior articular processes* ; *d*, *d*, the *transverse processes*, small and single : the foramina in them are not perpendicular, but pass upwards and outwards, and the spinal foramen is large.

Fig. 32.



Thus two distinct motions are perfectly accomplished without interfering with each other. When we nod the head, we use the joint be-

* Named dentata from its projecting tooth-like process, *a*.

† Processus dentatus.

tween the head and the first bone of the neck; when we turn the head round, we use the pivot joint formed by the dentata and atlas.

THE SEVENTH VERTEBRA OF THE NECK.

Fig. 33.

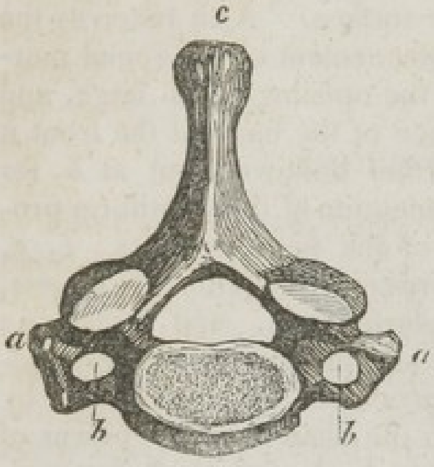


Fig. 33. The seventh vertebra is larger than the others; it resembles in form the third, which has been given as an example and general description of a cervical vertebra. In this before us, neither *a*, *a*, the *transverse processes*; nor *c*, the *spinous process*, are double; but the latter is so much longer than the others, that this bone has obtained the name of *vertebra prominens*.

THE VERTEBRÆ OF THE BACK.

Fig. 34. The twelve vertebræ particularly belonging to the back are termed *dorsal*. They are named in numerical order, and diminish in size from the first to the fourth, from which they increase to the twelfth, which is the largest: *a*, the *body*, is longer from front to back, than transversely; *b*, the *superior*, and *c*, the *inferior articular surfaces*. The body somewhat flattened on either side presents small *semicircular depressions*, *d*, *e*, for receiving the heads of the ribs: *f*, the *superior articular process*, vertical, and directed backwards; *g*, the inferior articular process, directed forwards; *h*, the *transverse process*, thicker as it extends backwards; *i*, the *spinous process*, long and inclining downwards; *j*, the notch under which pass the nerves of the spinal cord.

Fig. 34.

THE VERTEBRÆ OF THE LOINS.

Figs. 35, 36.

We have here two views of a vertebra of the loins;* the lumbar vertebræ are the lowest five of the spine: *a*, *a*, their *bodies*, though of a circular form in front, are somewhat oblong from side to side, and larger, and of a more spongy texture, than any of the other classes; *b*, *b*, *b*, the *superior*; *c*, *c*, *c*, the *inferior articular processes*,

* Vertebra lumborum.

Fig. 35.

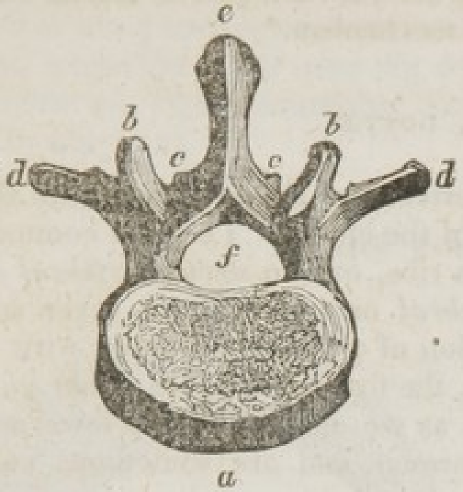
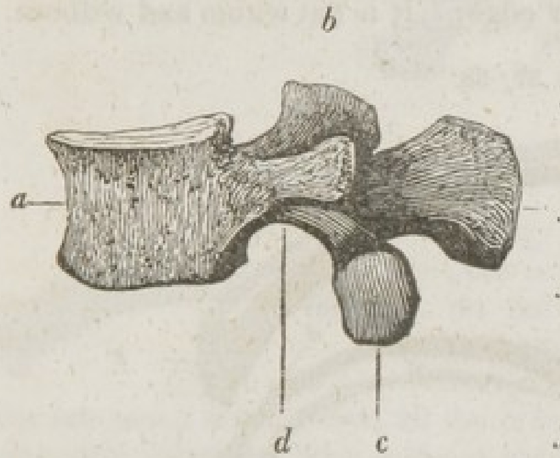


Fig. 36.



strong and deep : the superior concave ; the inferior convex ; *d, d, d,* the *transverse processes,* are small and long ; these, like bony processes in general, serve as levers for the moving powers ; *e, e,* the *spinous processes,* strong, horizontal, and flattened at the sides ; *f,* the *spinal foramen.* Numerous muscles are attached to the back part of the spine, viz.: the *trapezii, latissimi dorsi, rhomboidei majores et minores, levatores scapulæ, serrati postici superiores et inferiores, splenii, complexi, sacro-lumbales, cervicales descendentes, trachelo-mastoidei, longissimi dorsi, transversales colli, spinales et semi-spinales colli, recti capitis postici majores et minores, obliqui capitis superiores et inferiores, multifidi spinæ, interspinales, intertransversales, et levatores costarum ;* on the fore part, *longi colli, recti capitis interni majores et minores, recti capitis laterales, scaleni antici, medii et postici, diaphragma, quadrati lumborum, psoæ magni et parvi, obliqui interni, et transversales abdominis.*

GENERAL OBSERVATIONS ON THE SPINE.

The twenty-four vertebræ,* united by an elastic substance, form the spine, or vertebral column ; their volume is very considerable in the lumbar region, but decreasing in size as they ascend to the head, though with some irregularity : it is a pyramid, reposing its base on the sacrum, as a sort of pedestal, and having on its summit the head. The spine in front appears perpendicular ; a lateral view presents a waved line, having a very near approach to HOGARTH's line of beauty. Altogether, the structure of the vertebral column is admirable, so

* If we find a separate vertebra, we may know to which class it belongs by the following rule, viz., the peculiar characteristic of a cervical vertebra is the perforations in the transverse processes. The dorsal are distinguished by having articular surfaces for the heads of the ribs. The lumbar by their size, and the length of the transverse processes.

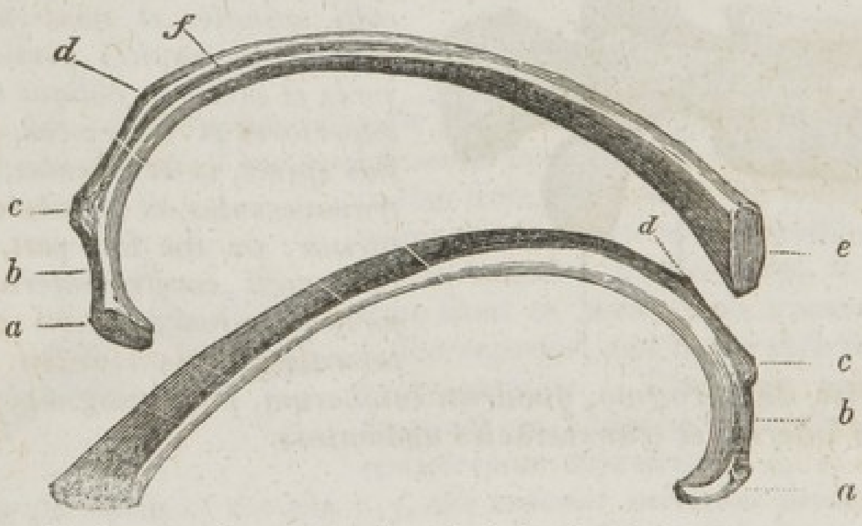
that, after an attentive examination, we are not surprised that all writers on natural theology should have selected this part of animal bodies as a specimen of the most exquisite mechanism.*

THE RIBS, COSTÆ,

Are placed on each side of the vertebræ of the back, and with them form the posterior and lateral parts of the chest. They are commonly divided into seven true and five false ribs, or into *sterno-vertebral* and *vertebral:* of these, the *sterno-vertebral* or true ribs, the seven superior, are united by means of a portion of cartilage† directly with the sternum; the *vertebral* or false ribs, the five inferior, are either joined by their cartilages to each other, or, as we see in the two lowermost, are totally unconnected with the sternum, and are sometimes called loose or floating ribs.

The *fourth rib* is here taken for general description. Fig 37, is the lower, and Fig. 38, the upper edge. It is flat within and without.

Figs. 37, 38.



The vertebral extremity, *a*, *a*, is called the *head*, which has an articular surface divided by a middle ridge to articulate with the bodies of the two contiguous dorsal vertebræ. The bone at *b*, *b*, is contracted, forming the *neck;* at the back of the rib is *c*, *c*, the *tubercle*, having a plain articular surface for the transverse process of the vertebra; further outward the bone suddenly bends forward, producing *d*, *d*, the *angle*, from which proceeds the body, which in its natural situation passes forwards and downwards to *e*, *e*, the *sternal extremity*, where it has a slight oval concavity to which the cartilage adheres, and which cartilage joins the rib to the sternnm or breast bone. At the under edge of each rib we find, Fig. 37, *f*, a groove for the intercostal vessels and nerves.

From the first to the seventh pair, the ribs increase in length; this

* See Paxton's Paley's Nat. Theol. ch. viii.; Durham's Phys. Theol. ch. viii.
† Gristle.

gives the chest its conical shape : from the seventh they begin to decrease in length to the twelfth, which is as short as the first : and with regard to the direction of their inclination, that of the first is nearly horizontal, whilst the lower ones dip down more and more at their points. But there are other remarkable distinctions in the first, eleventh, and twelfth ribs — as

THE FIRST RIB.

Fig. 39.

Fig. 39. The *first rib* is very short, and much curved. It is flat above and below ; *a*, the *head* ; *b*. the *tubercle*, large and placed at the angle of the bone ; *c*, the *sternal extremity*, which is united to the breast bone by a short portion of cartilage at a right angle.

THE ELEVENTH AND TWELFTH RIBS.

Fig. 40.

Fig. 40, is the *twelfth rib* ; the eleventh is like it, only a little longer. They do not articulate with the transverse processes of the vertebræ, and are unconnected with the breast bone. These ribs are much shorter than all the others, except the first ; their heads have only single articular surfaces to join with the whole articular cavities of the two lowest dorsal vertebræ.

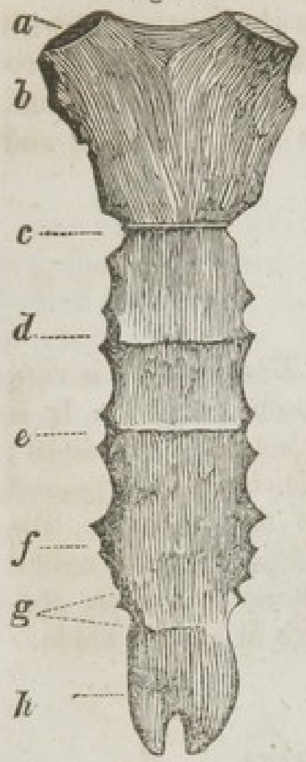
The muscles attached to the ribs are ; the *pectorales majores et minores, subclavii, sterno-thyroidei, scaleni antici, medii, et postici, latissimi dorsi, serrati majores antici, superiores et inferiores postici, sacro-lumbales, accessorei ad sacro-lumbales, longissimi dorsi, levatores et depressores costarum, intercostales, sterno-costalis, diaphragma, obliqui externi et interni, transversales, et recti abdominis, et quadrati lumborum.*

THE BREAST BONE, STERNUM.

The situation of the *sternum*, or breast bone, is well known. It is connected with the cartilages of the ribs, and with the collar bones, and is usually divided into two or three parts. In the position before us, Fig. 41, it consists of two bones. The first is broad and thick above, and a little contracting as it descends.* It is irregularly convex before, and concave behind. At the upper angle, *a*, the collar bone, is articulated ; *b*, the articular surface for the cartilage of the

* This portion of the sternum is called the *manubrium* or the *handle*.

Fig. 41.



first rib ; *c.* the depression, which, with the depression of the second bone, form an articular surface for the cartilage of the second rib ; *d*, *e*, *f*, *g*, mark the concave articular surfaces of the third, fourth, fifth, sixth, and seventh ribs ; *g*, points to the two last depressions of articulation, which are contiguous.

There are transverse lines on the lower bone, which indicate its further division in early life.

h, The *ensiform or xiphoid cartilage*, terminates the lower extremity of the sternum. In the adult it is frequently ossified.

The sternum, ribs, and dorsal vertebræ, form the chest or thorax, the offices and uses of which are multiplied ; for it is the centre of motion for directing the animated machine, protects the heart, lungs, and other important parts ; but its agency in respiration must be considered its most important function. The muscles attached to the sternum are the *pectorales majores, sterno-cleido-mastoidei, sterno-hyodei, sterno-thyroidei, et intercostales interni.*

THE BONES OF THE PELVIS.

The large bony cavity situated at the lowest part of the trunk, by which its weight is transferred to the lower extremities, is called the *basin* or *pelvis ;* for it in part contains and supports the bowels and other viscera. It consists of a pair, and two or more single bones.

UNNAMED BONES. *Ossa innominata.*

The two large, broad, and irregularly shaped bones, called *ossa innominata* or hip bones, constitute the fore part and sides of the basin, and the lower part of the sides of the abdomen — the upper edge is frequently called the hip.

Each bone is usually described as three bones, from its having been composed of three distinct pieces in the first period of life : these portions retain the same name though united in one solid broad bone. To obtain therefore a knowledge of the terms employed in this description, we must advert to its original construction. Fig. 42 shows the three portions united by cartilage ; *a*, the *ilium ; b*, the *ischium ; c*, the *os pubis ;* the subsequent description will have a reference to these terms.

Fig. 42.

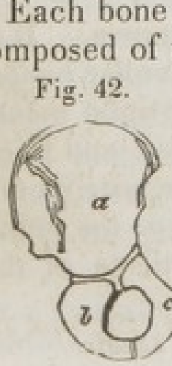


Fig. 43.

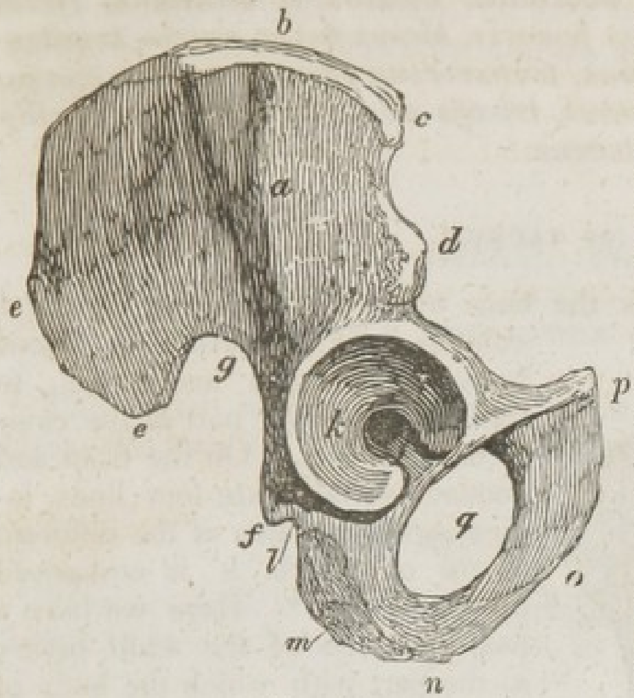


Fig. 44.

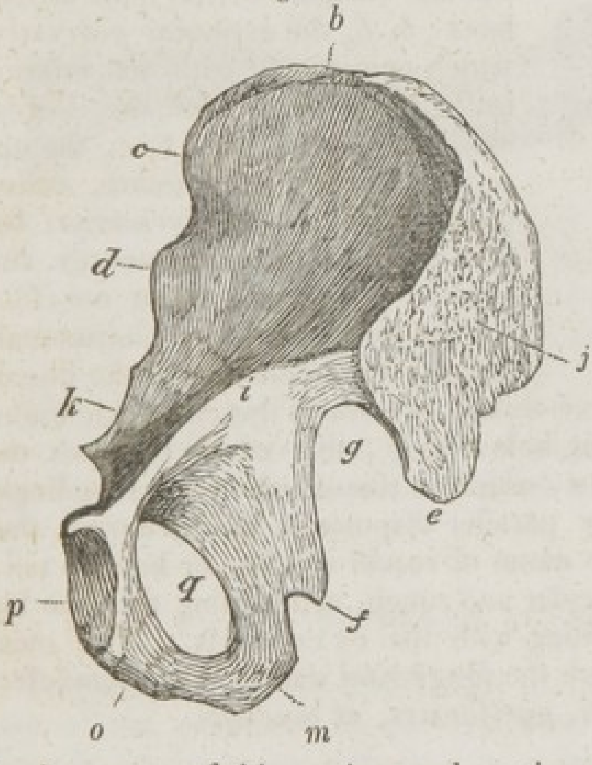


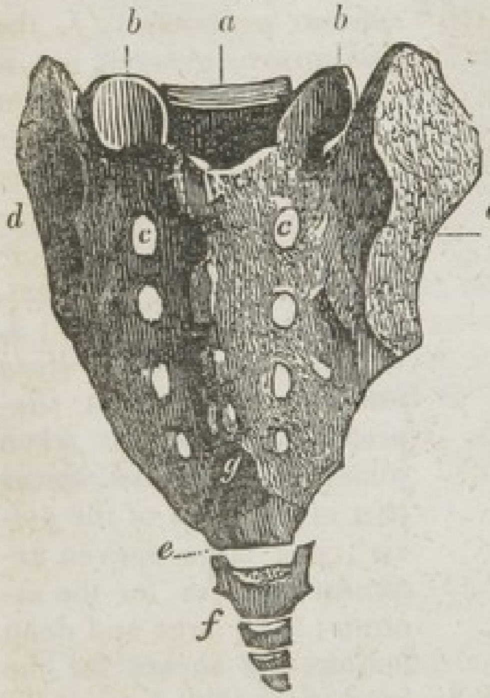
Fig. 43, the outer surface of the *hip bone*, or *os innominatum* ; Fig. 44, the inner surface. The letters refer to both views ; *a*, the *dorsum* or *back* of the ilium; *b*, the *crest* ; *c*, the *anterior superior spinous process* ; *d*, the *anterior inferior spinous process* ; *e*, *e*, the *posterior superior* and *inferior spinous processes* ; *f*, the *fifth spinous process*, but is distinguished by the term *ischium* ; *g*, the *greater ischiatic notch*. The inner surface, *h*, of the os innominatum, or rather that portion of it called the ilium, is concave and smooth ; *i*, an elevated line, the *linea innominata* or *linea ilio-pectinata*, which, when joined to its fellow, forms part of the brim of the pelvis ; *j*, a large uneven *articular surface* for the sacrum ; *k*, a large and deep hollow, the socket for the head of the thigh bone, called the *acetabulum*, from its resemblance to a measuring cup used by the ancients. The margin is not perfectly circular, but appears deficient at the under part, forming a *notch*, which in the recent subject is filled up with ligament to complete the edge of the cup. In the centre of this cavity, and continued to the notch is a *depression*, to which the round ligament of the thigh bone is fixed ; *l*, the lesser *ischiatic notch* ; *m*, *n*, the *tuberosity* of the ischium ; *o*, the *ramus* of the ischium ; *p*, the *pubis* ; *q*, the *obturator* or *thyroid foramen*. The muscles attached to and covering the os innominatum, are the *psoas magnus et parvus, iliacus, levator ani, obturator internus, pyriformis, coccygeus, obliquus externus et internus, transversalis, rectus, et pyramidalis abdominis, quadratus lumborum, longissimus dorsi, sacro-lumbalis, et latissimus dorsi, tensor vaginæ fe-*

moris, sartorius, gluteus maximus, medius et minimus, rectus femoris, gemini, quadratus femoris, biceps flexor cruris, semitendinosus et semimembranosus, transversus perinæi et transversus perinæi alter, ischiocavernosus, triceps adductor femoris, gracilis, pectineus, et obturator externus.

OS SACRUM.

Fig. 45. The *sacrum* is the basis which supports the vertebral column. The sacrum is placed between the ossa innominata, to form the posterior part of the cavity of the pelvis. On the front and concave surfaces are four lines, indicating the junction of the different pieces of which it is composed during infancy.* Here we have a posterior view of the adult bone; *a*, the part with which the body of the last vertebra of the loins articulates; *b*, *b*, the *articular processes*, which correspond with the inferior articular processes of the lowest vertebra of the loins; *c*, *c*, the uppermost of eight foramina, called the *posterior sacral foramina*, for the passage of small nerves and vessels. Between these are four eminences, short and horizontal, forming a continuation of the line of the spinous processes of the vertebræ. Above is the commencement of the *sacral canal*, terminating below at *g*; this canal receives the extremity of the spinal marrow, which in this situation is exceedingly fibrous, and, from the nearly parallel disposition of the nerves that issue from it, has obtained the name of *cauda equina*, or horse's tail; *d*, *d*, the lateral surfaces, irregular and rough, articulating with the hip bones; *e*, an oval surface uniting with the os coccygis. The muscles attached to the sacrum are the *longissimi dorsi*, *sacro-lumbales*, *multifidi spinæ*, *glutei maximi*, *pyriformes*, *et coccygei*.

Fig. 45.



THE COCCYX. *Os coccygis.*†

The *os coccygis*, *f*, Fig. 45, is divided into several bones which are appended to the sacrum; and although in advanced age it is one solid bone, yet in the prime of life, as is represented in the present instance, it consists of four distinct bones. The upper one is united

* These have been called the false vertebræ.

† So called from its figure being somewhat like a cuckoo's beak.

to the sacrum by a flat surface, on each side of which are projections called the cornua. The only muscles attached to this bone are the *coccygei.*

CHAP. IV.

BONES OF THE UPPER EXTREMITY.

The upper extremity consists of the collar bone, the shoulder blade, the arm, the fore arm, and the hand.

THE COLLAR BONE, *Clavicula*,

Termed *clavicle* from its resemblance to an ancient key, has a body and two extremities. Fig. 46, *a*, the *sternal extremity*, presenting a triangular surface for its articulation, by means of an intervening cartilage, to the sternum; *b*, the *rhomboid process;* c, the *tubercle; d*, the *scapular extremity*, which is the flattest part of the bone, and has a narrow articular surface for the acromion of the scapula.

Fig. 46.

The muscles attached to the calvicle are six; to its under part, the *pectoralis major*, *deltoides*, and *subclavius;* and to its upper part, the *trapezius*, *sterno-cleido-mastoideus*, *and sterno-hyoideus.*

The clavicle tends to prevent the arm from falling forward on the breast; and increases the sphere of action of the arm, by enabling it to describe a circle, the centre of which is the connexion of the clavicle with the shoulder.

THE SHOULDER BLADE. *Scapula.*

The scapula, or shoulder blade, is situated on the back and upper part of the ribs, and forms the posterior part of the shoulder. Its form is an irregular triangle; it is flat, and so very thin as to be transparent in its greatest extent. This bone is retained in its situation merely by muscles that unite it to the head, the os hyoides, the ribs, the vertebræ, and the upper arm bone; by means of these muscles it consequently has the power of moving upwards, downwards, backwards, and forwards; and by a quick succession of these motions the arm is rotated. Thus the scapula serves not only as a support, but a fulcrum for every action of the superior extremity.

Fig. 47, the front; Fig. 48, the back view.

Fig. 47.

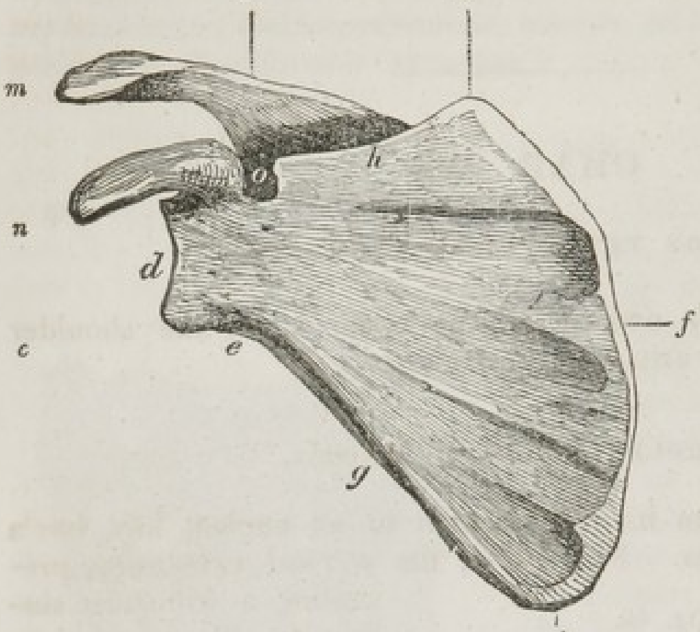
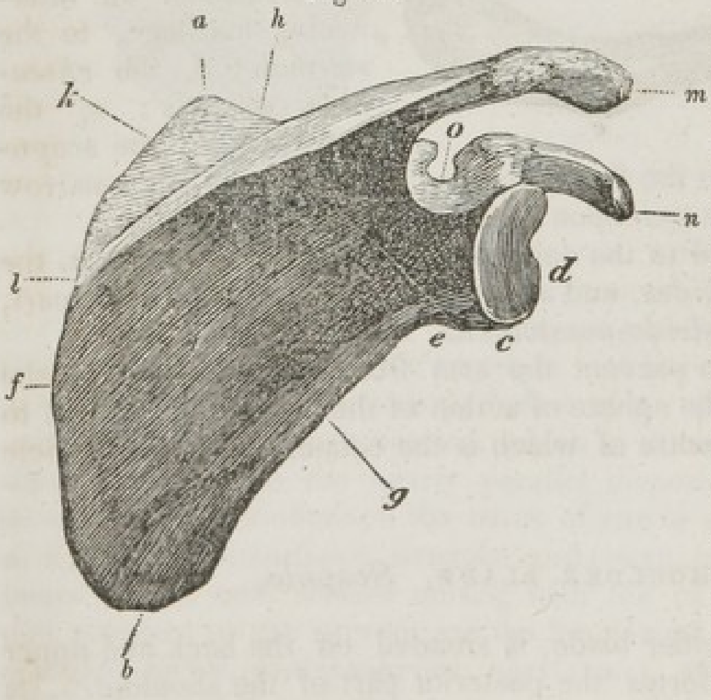


Fig. 48.



The scapula is usually described with reference to its triangular figure ; *a*, *a*, the *superior angle ; b*, *b*, the *inferior angle ;* the *outer angle*, having an oval concave articular surface ; *d*, *d*, the *glenoid cavity*, or socket in which the head of the arm bone is articulated ; around which the bone becomes contracted, at *e*, *e*, forming the *neck*. The sides of the triangle are thus denominated ; *f*, *f*, the *basis ; g*, *g*, the *inferior border*, or *costa ; h*, *h*, the *superior border* ; *i*, the *fossa* for the attachment of the infra-spinatus muscle ; *k*, the *fossa* for the attachment of the supra-spinatus muscle ; *l*, *l*, the commencement and course of the *spine*, terminating in a flat projection ; *m*, *m*, the *acromion*,* which we see extended over the glenoid cavity, protecting the joint, and forming the point of the shoulder to which the collar bone is articulated. There is another projection, *n*, *n*, compared to the beak of a crow, therefore termed the *coracoid process ;* this also guards the shoulder joint, and with the acromion gives advantageous points of attachment to muscles which move the arm. Between the coracoid process and the superior border is *o*, *o*, an indentation, the *semilunar notch*, which is formed into a foramen by a

* The point of the shoulder.

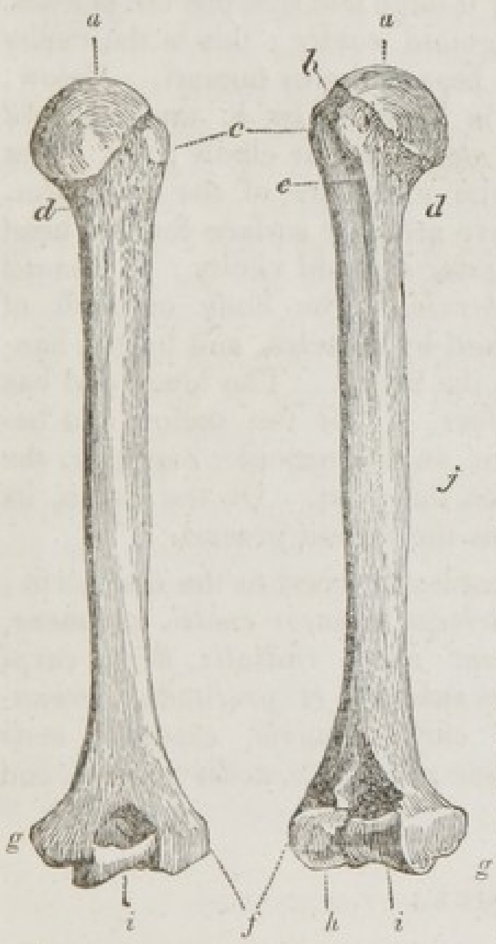
ligament, and affords a passage for the supra-scapular artery, vein, and nerve.

The muscles attached to this bone are sixteen in number; viz., to the spine above, the *trapezius*, and below, the *deltoides*; to the base, the *levator scapulæ*, *rhomboideus minor et major*, and *serratus magnus*; to the notch in the superior border, the *omo-hyoideus*; to the fossæ, the *supra-spinatus*, *infra-spinatus*, and *subscapularis*; to the inferior border, the *teres minor*, and *the long head of the triceps extensor cubiti*; to the inferior angle, the *teres major*; and to the coracoid process, the *coraco-brachialis*, *pectoralis minor*, and the *short head of the biceps flexor cubiti*, the *long head* of which muscle has an attachment to the glenoid cavity.

THE UPPER ARM. *Os brachii.*

The upper arm consists of a single bone, called also *os humeri*. Fig. 49 represents the back, Fig. 50 the front view; *a*, *a*, the *head*,

Fig. 49. Fig. 50.



is hemispherical, standing obliquely backwards from the bone, and when received into the glenoid cavity of the scapula constitutes a ball and socket joint; *b*, the *smaller tubercle*; c, the *greater tubercle*; they are separated by *e*, a *channel** in which the tendon of the long head of the biceps muscle plays. The bone is contracted at *d*, *d*, and forms the *neck*. The body of the bone is nearly cylindrical. The lower extremity of the bone is flattened, and constitutes with the ulna a perfect hinge joint; *f*, the *outer condyle*; *g*, *g*, the *inner condyle*, more projecting than the outer, as it gives attachment to the flexor muscles of the fingers. The lowest part of the bone has *two articular surfaces*: that on the outside, *h*, convex, for the head of the radius; that on the inside, *i*, concave from side to side, but convex from back to front, for the reception of the sigmoid cavity of the ulna. Above the articulation, and in front, Fig. 49, there is a depression of the coronoid process of the ulna. Behind, Fig. 50, is another depression for the olecranon of the ulna; *j*, the *foramen*, *for the medullary artery*, which supplies the circulation of blood to the marrow of the bone.

* The bicipital groove.

There are twenty-four muscles attached to the os humeri ; viz., the *deltoides*, *supra-spinatus*, *infra-spinatus*, *teres minor*, *subscapularis*, *pectoralis major*, *latissimus dorsi*, *teres major*, *coraco-brachialis*, *triceps extensor cubiti*, *brachialis internus*, *palmaris longus*, *flexor carpi radialis*, *flexor carpi ulnaris*, *flexor digitorum sublimis*, *flexor longus pollicis*, *pronator radii teres*, *supinator radii longus et brevis*, *extensor carpi radialis longior et brevior*, *extensor carpi ulnaris*, *extensor digitorum communis*, and *anconeus*.

THE FORE ARM

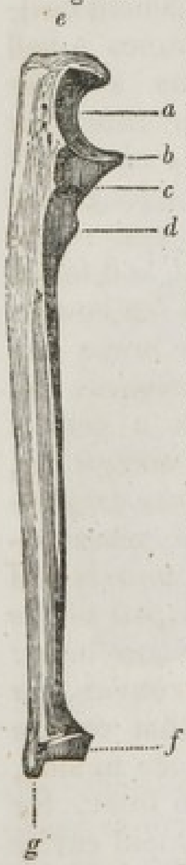
Consists of two bones, the *ulna* and *radius*.

THE ULNA OR LARGER BONE OF THE FORE ARM.

Fig. 51.

The ulna is placed on the inside of the fore arm by the side of the radius. The upper extremity is large and scooped out in front, *a*, forming the *greater sigmoid cavity* ; this is the cavity which articulates with the base of the os humeri. Below, this apparent excavation is bounded by *b*, the *coronoid process*, above, by *e*, the *olecranon*, or elbow ; this point serves as a lever for the extensors of the fore arm. There is a smaller concave articular surface for the head of the radius at *c*, the *lesser sigmoid cavity* ; *d*, a small eminence, called the *tubercle*. The body or shaft of this bone is strongly marked by muscles, and by the ligament interposed between the bones. The lower end has a *rounded articular surface*, *f*, for the radius, and beneath, a shallow cavity for an interarticular cartilage, the medium of connexion with the wrist. On the inside, its lengthened point, *g*, forms the *styloid process*.

Fig. 51.

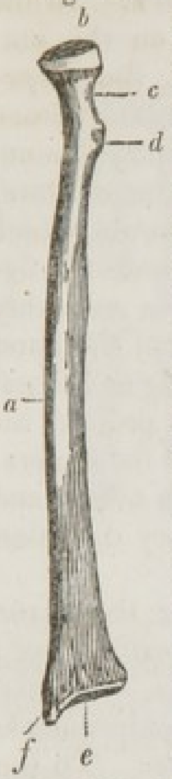


There are fourteen muscles attached to the ulna ; viz., the *brachialis internus*, *triceps extensor cubiti*, *anconeus*, *pronator radii teres*, *flexor carpi radialis*, *flexor carpi ulnaris*, *flexor digitorum sublimis et profundus*, *pronator quadratus*, *extensor carpi ulnaris*, *extensor ossis metacarpi pollicis*, *extensor primi internodii pollicis*, and *indicator*.

THE RADIUS.

The *radius*, or smaller bone of the arm, is supposed to be so named from its imaginary resemblance to the spoke of a wheel, or to a measure used by the ancients. It is placed on the outside of the fore arm ; *a*, the *body* of the bone, inclines to a triangular form ; *b*, the upper extremity, or *head*, presents a circular cavity, articulating with the

Fig. 52.



smaller condyle of the humerus; its circumference joins with, and turns into the smaller sigmoid cavity of the ulna; below, at *c*, the bone is contracted, forming a *neck*, which terminates in *d*, the *bicipital tubercle*, to which is fixed the biceps muscle. The lower end has *e*, a *superficial cavity*, articulating with the scaphoid and semilunar bones of the wrist. On the inner side there is a narrow concavity, in which the lower extremity of the ulna rotates. The extreme point, *f*, is termed the *styloid process*.

There are eight muscles attached to the radius; viz. the *supinator radii longus et brevis*, *pronator teres et quadratus*, *biceps flexor cubiti*, *flexor digitorum sublimis*, *flexor longus*, *extensor ossis metacarpi pollicis*.

PALEY has not passed unobserved the remarkable mechanical contrivance of the fore arm. For the perfect use of the fore arm two motions are wanted; a motion at the elbow backward and forward, which is called a reciprocal motion; and a rotatory motion, by which the palm of the hand, as occasion requires, may be turned upward. How is this managed? The fore arm consists of two bones lying along side each other, but touching only near the ends. One, and only one, of these bones is joined to the humerus at the elbow; the other alone to the wrist. The first, at the elbow, by means of a hinge joint, which allows of motion in the same plane, swings backward and forward, carrying along with it the other bone, and the whole fore arm. In the mean time, as often as there is occasion to turn the palm upward, the bone, to which the hand is attached, rolls upon the first, by help of a groove or hollow near the end of one bone, to which is fitted a corresponding prominence in the other.

The first is at liberty at one end, the second at the other; by which means two actions may be performed together. The os brachii may be swinging with its hinge joint at the elbow, at the very time that the radius, which carries the hand, may be turning round in its groove.

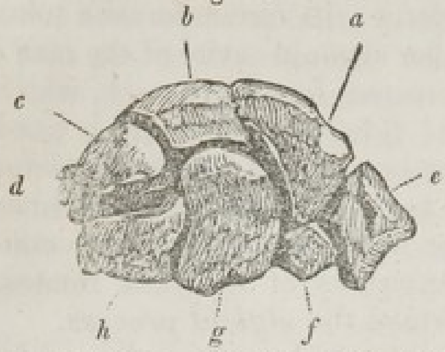
THE HAND.

The last division of the superior extremity is the hand; it includes the wrist, the palm of the hand, and the fingers.

THE BONES OF THE WRIST. *Carpus.*

The wrist or *carpus* consists of eight small bones disposed in two rows, forming an arch supported by ligaments. Fig. 53 is the back of the wrist, (as the shape of the several bones is best seen in this direction;) *a*, the boat-shaped or *scaphoid bone*; *b*, the half moon or *semi-lunar* bone; *c*, the wedge-like or *cuneiform* bone; *d*,

Fig. 53.



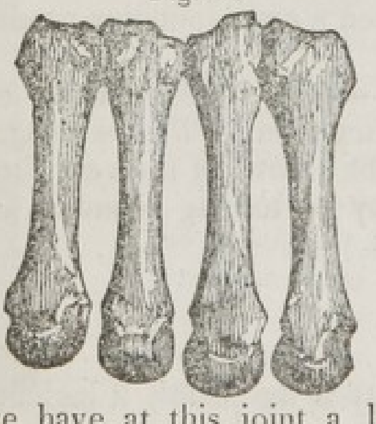
the *pisiform* bone, from its size and figure resembling a large pea. In the second range we observe on the outside, e, the *trapezium ; f*, the *trapezoid* bone ; these last two are named from their figure ; g, the large bone, *os magnum ; h*, the *unciform bone*, named from its hook-like process, which projects into the hand. From the figure before us we may form a tolerably correct idea of their union and arrangement : on the back of the hand the wrist bones are convex, in front concave, the arch giving additional strength, while the projecting *pisiform* bone and unciform process increase the concavity for the passage of the flexor tendons of the fingers.

The bones of the carpus have a gentle motion on each other, and on the fingers ; they also admit of a limited motion in every direction with the bones of the arm.

There are two muscles attached to the os pisiforme ; viz. the *flexor carpi ulnaris*, and *abductor minimi digiti :* to the trapezium four ; viz. the *flexor ossis metacarpi pollicis*, *abductor pollicis*, *abductor indicis*, and *extensor ossis metacarpi pollicis.* The only muscle attached to the trapezoid bone is the *flexor brevis pollicis.* To the os magnum also the same muscle is attached. The muscles inserted into the unciform bone are three ; viz. the *flexor brevis pollicis*, *flexor proprius pollicis*, and *abductor minimi digiti.*

THE BONES OF THE PALM OF THE HAND. *Metacarpus.*

Fig. 54.



The bones called the metacarpus, Fig. 54, form the palm and back of the hand ; they sustain the fingers. We observe each bone long and rounded, the ends larger than the bodies. Their upper ends have *plane surfaces* to unite with the carpus ; and where the metacarpal bones are contiguous to each other, they have also flat articular surfaces ; their lower ends articulate with the fingers by *convex heads*, to allow of a free motion in every direction ; we have at this joint a lateral motion, as well as flexion and extension.*

There are eleven muscles attached to the metacarpal bones, viz. *seven interossei*, common to all ; to that of the fore finger, the *flexor carpi radialis* and *extensor carpi radialis longior ;* to that of the middle finger, the *extensor carpi radialis brevior ;* and to that of the little finger, the *extensor carpi ulnaris.*

* Those anatomists who reckon five metacarpal bones include the first bone of the thumb.

THE BONES OF THE FINGERS. *Phalanges digitorum.*

Fig. 55.

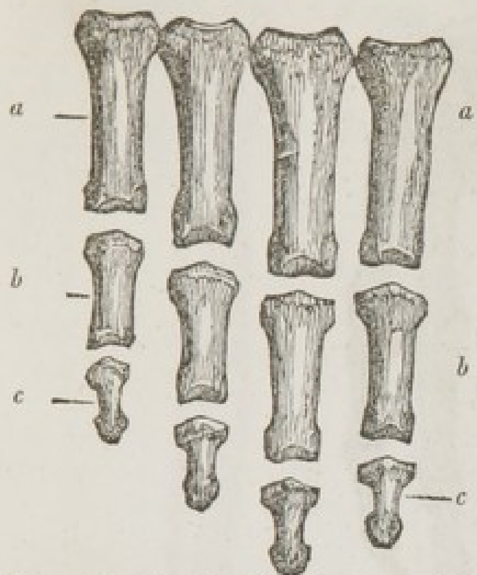


Fig. 55. The fingers consist of twelve bones, arranged in three rows, termed *phalanges.* They are rounded on the back, as we see in this figure, but flat and somewhat concave in front, as may be observed in Fig. 56.

The *first phalanx* or row, *a*, *a*, has sockets at the superior extremities to articulate with the metacarpal bones; the inferior extremity is convex from back to front, concave from side to side.

The *second phalanx*, *b*, *b*, has on the upper ends concave articular surfaces, with a little rising in the middle, dividing them into two smaller concavities, adapted to the lower extremities of the first phalanx. The lower ends of the second phalanx are similar to the lower ends of the first.

The *third phalanx*, *c*, *c*, has a joint similar to the second; the points are rough in front, but rounded at the backs to receive the nails.

There are eighteen muscles attached to the phalanges, or finger bones; viz. in front, the *flexor digitorum sublimis et profundus; flexor longus et brevis, adductor, et abductor indicis; flexor proprius, et abductor minimi digiti;* four *lumbricales* and seven *interossei.* At the back the *extensor digitorum communis* and *indicator.*

THE BONES OF THE THUMB.

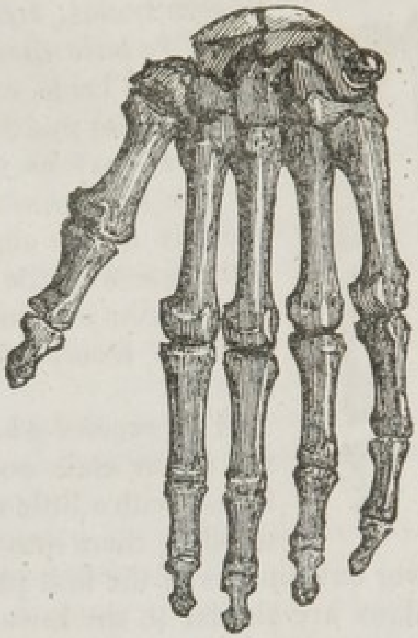
Fig. 56.

The bones of the thumb, Fig. 56, *a*, *b*, *c*, very much resemble the bones of the fingers; but as the thumb is the antagonist of the fingers, it is much thicker and stronger. The first bone is connected by a double articular surface to the trapezium.

The muscles attached to the front of the thumb, are the *flexor brevis et flexor ossis metacarpi pollicis,* and *abductor indicis;* to the back of the thumb, the *extensor primi internodii pollicis.*

Fig. 57, a front view of the bones of the hand.

Fig. 57.



CHAP. V.

THE BONES OF THE LOWER EXTREMITY.

The lower extremity consists of the thigh, leg, and foot.

THE THIGH BONE. *Os femoris.*

The thigh has one bone ; it is the longest of the human skeleton, and is remarkable for its strength, supporting the whole trunk and upper extremities, and often with the addition of burdens greater than the weight of the body itself. This bone is placed obliquely,* from the great breadth of the pelvis ; and this obliquity of the shaft of the bone is necessary to bring it more immediately under the centre of gravity, and to render our steps not only more direct, but more quick and secure.†

* See Tab. i, ii.

† "Whilst a man stands on both his legs, the thigh bones are oblique to the gravitation of the body ; but when one foot is raised, the whole body being then balanced on one foot, a change takes place in the position of the thigh bone, and the obliquity of that bone is diminished ; or in other words, now that it has the whole weight to sustain, it is perpendicular under it, and has therefore acquired great strength." — *Animal Mechanics.*

Fig. 58.

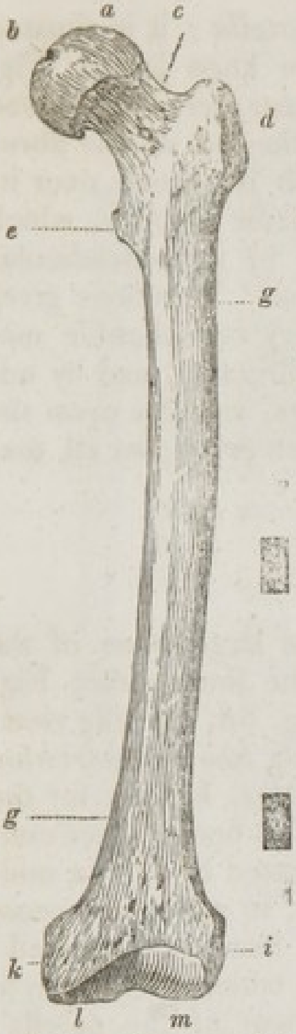


Fig. 59.

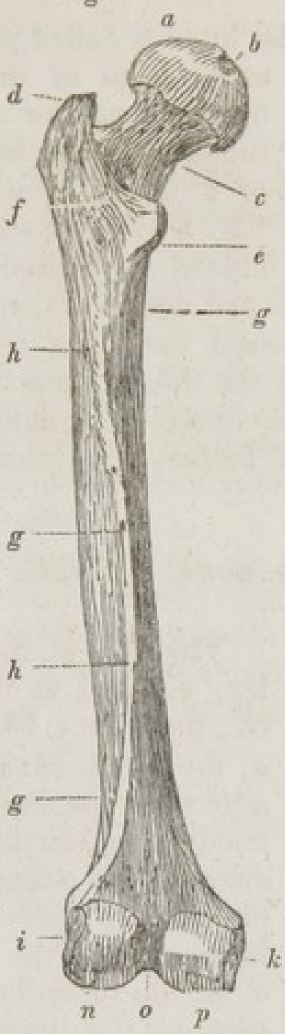


Fig. 58 is the front, and Fig. 59 the back of the *femur* or thigh bone ; *a*, *a*, the *head* of the bone, forming the greater portion of the sphere ; it articulates with the hip, and is the most complete instance of the ball and socket joint that we can produce. Besides a surrounding ligament, common to all joints, it has an additional security in a short, strong, yet flexible ligament, inserted by one end into the ball, at the *depression*, *b*, *b*, by the other end into a cup, or acetabulum of the hip bone ; *c*, *c*, the *neck ; d*, *d*, a large process, called the *trochanter major ; e*, *e*, a smaller projection, the *trochanter minor*. The curved line at *f*, Fig. 59, the *linea quadrata*, extending from one trochanter to the other, shows the attachment of the capsular ligament, and the quadratus femoris ; *g*, *g*, the body of the bone ; *h*, *h*, a long, rough, elevated line, the *linea aspera ; i*, *i*, the *outer*, and *k*, *k*, the *inner condyle ;* these have four articular surfaces ; *l*, *m*, the two upper on the fore part, for the patella or kneepan ; *n*, *o*, the two lower, for the large bone of the leg. The latter articular surfaces are separated by *p*, a *deep recess*, into which the cross ligaments are inserted ; it also affords protection to the large vessels and nerves passing to the leg. The medullary artery enters at *q* about the middle of the bone.

There are nineteen muscles attached to this bone, viz. the *gluteus medius et minimus* to the trochanter major ; the *psoas magnus* and *i acus internus* to the trochanter minor ; the *quadratus* to the linea quadrata ; the *obturator internus et externus*, *gemini*, and *pyriformis*,to the fossa trochanterica ; the *gluteus maximus*, *pectineus*, and *triceps femoris*, *vasti*, and *biceps flexor cruris*, to the linea aspera ; the *gastrocnemii*, *plantaris*, and *popliteus*, to the condyles ; the *cruræus*, *sartorius*, *gracilis* and *tensor vaginæ femoris*, are situated on the fore part of the femur, but are not adherent to it.

THE KNEE PAN. *Patella.*

The small round bone at the knee is called *patella ;* it is situated at the front of the knee joint. Fig. 60, the *anterior surface*, convex and rough from the adhesion of the fibres of a tendon which is spread over it. Fig. 61, the *posterior surface*, which indeed is divided by a perpendicular ridge into *two slightly concave articular surfaces.* This bone gives to the tendons which bring forward the leg a very considerable mechanical advantage, by altering the line of their direction, and by advancing it further out from the centre of motion, and this upon the principles of the resolution of forces, upon which principles all machinery is founded.

Fig. 60.

Fig. 61.

THE SHIN BONE. *Tibia.*

Fig. 62.

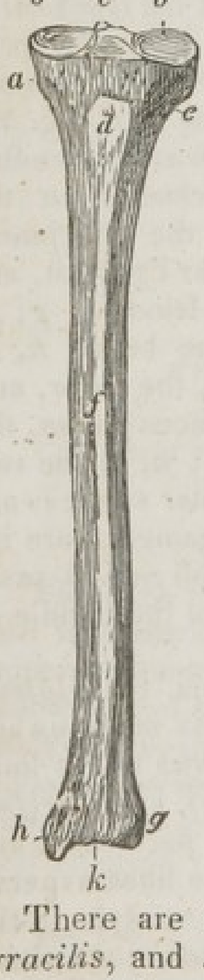
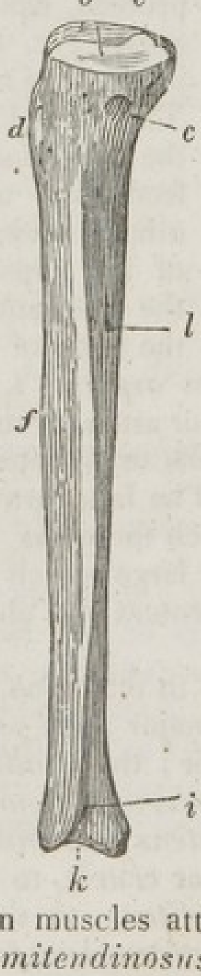


Fig. 63.



The tibia is the large bone of the leg, situated at the inner side ; Fig. 62, the front ; Fig. 63, the side view. *a*, the *head*, having *two semicircular articular concavities*, *b*, *b*, *b*, for the condyles of the thigh bone ; these concavities are separated by *c*, *c*, a middle ridge or *spine*, to which the cross ligaments of the knee are secured ; *d*, *d*, the tubercle which gives attachment to the ligament of the patella ; *e*, *e*, a small articular surface for the head of the fibula or small bone of the leg ; *f*, *f*, the *spine* or shin ; *g*, the outer side of the base, having *i*, a depression, or articular surface for the lower extremity of the fibula ; *h*, the inner ankle, called the *inner malleolus*, on the under and back part of which is a groove, for the passage of the tendon of the tibialis posticus muscle ; *k*, *k*, the *surface* for connecting it with the astragalus, or bone of the foot ; *l*, the *foramen for the medullary artery.*

There are ten muscles attached to the tibia, viz. the *sartorius gracilis*, and *semitendinosus*, immediately below the tubercle ; the *semimembranosus*, to the back part of the head of this bone ; the *popliteus*, *soleus*, *tibialis posticus*, and *flexor longus digitorum pedis*, to the back part of its head and body ; the *tibialis anticus* and *extensor longus digitorum pedis*, are situated on the fore part of its head and body.

THE SPLINT BONE. *Fibula.*

Fig. 64.

Fig. 64. The small bone of the leg is called *fibula*, from its resemblance to the pin of a brooch; it is placed on the outside of the leg; the shape of the bone is irregularly triangular; *a*, the *head* or upper extremity; it has a smooth *articular surface* at *b*, on its inner side, to join with the tibia. The body presents several ridges and depressions for the lodgment and attachment of muscles; *c*, the *inferior* extremity, lengthened to form the outer ankle, or *external malleolus;* *d*, an oblique *articular surface*, for the outside of the astragalus.

The ankle joint is strengthened and defended from injuries by those remarkable prolongations of the tibia and fibula which we name the external and internal malleoli, the outer and inner ankle. If the joint is in danger of dislocation outward, it is curbed by the inner projection, i. e. that of the tibia; if inward, by the outer projection, i. e. that of the fibula; between both it is locked in its position.

Eight muscles are inserted into this bone, viz. to the upper extremity the *biceps flexor cruris;* to the fore part of its body, the *extensor longus digitorum* and *extensor proprius pollicis pedis;* on the outside the *peroneus longus et brevis;* and behind, the *soleus, the tibialis posticus*, and *flexor longus pollicis pedis.*

THE BONES OF THE FOOT.

Fig. 65.

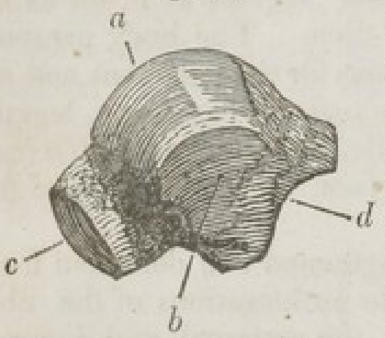
Fig. 65 is a general view of the skeleton of the foot, which consists of twenty-six bones; *d*, *e*, *f*, *g*, *h*, and two intervening bones, called the *tarsus* or instep; *a*, the *metatarsus* or middle row of bones of the foot; and *b*, *c*, *i*, the *three phalanges* of the toes. The bones of the foot somewhat resemble the hand, but they are stronger, larger, and less calculated for motion.

BONES OF THE TARSUS.

The tarsus or instep consists of seven bones, and when joined they form an arch, under which tendons, vessels, and nerves pass into the sole of the foot.

THE ASTRAGALUS.

Fig. 66.

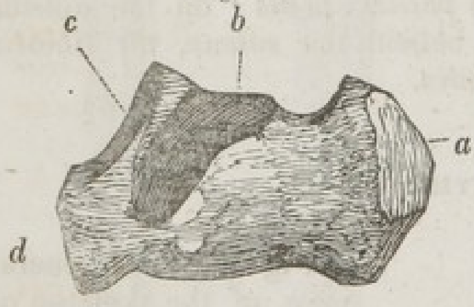


1st. The *as'ragalus*, so called from its resemblance to an ancient die; or rather, I am inclined to think, because a game of dice was played with the talus or buckle bone of animals to which this corresponds. *a*, a large *articular surface:* above, it is convex from front to back, forming its largest articular surface for the base of the tibia; *b*, the *articular surface* for the lower extremity of the fibula: on the opposite side is a surface for articulating with the inner malleolus; the fore part of the bone, *c*, is rounded to articulate with the scaphoid bone; the under part, *d*, rests on the heel bone by two articular surfaces, separated by a deep groove.

The only muscle attached to this bone is the *tibialis posticus*.

THE HEEL BONE. *Os calcis.*

Fig. 67.



2d. The *os calcis* is the largest bone of the foot; *a*, the *tuberosity* or heel; on the fore part are *two articular surfaces*, at *b*, *c*, for the astragalus; *d*, an *articular surface* for the cuboid bone.

There are eleven muscles attached to the os calcis, viz. to the upper part, the *extensor brevis digitorum pedis*; to the under part, the *adductor*, *flexor brevis*, *abductor pollicis pedis*, *flexor brevis digitorum*, *flexor digitorum accessorius*, and *abductor minimi digiti pedis;* posteriorly, the *gastrocnemii*, *soleus*, and *plantaris*.

THE SCAPHOID, *or navicular bone.*

Fig. 68.

Fig. 69.

3d. The *os scaphoides*, or boat-shaped bone, is placed on the inner part of the foot, before the astragalus; at *b* it is concave to articulate with that bone; in front at *a*, its general aspect is convex, but its convexity is divided into *three flat articular surfaces*, for the three cuneiform bones. See Fig. 69, *a*, *b*, *c*.

The *tibialis posticus* muscle is attached to this bone.

THE CUNEIFORM BONES.

The cuneiform or wedge-like bones are three in number, denominated from their position the *inner*, the *middle* and the *outer* cuneiform bones. They are applied to each other like the stones of an arch.

THE INNER CUNEIFORM BONE.

4th. This bone is the largest of the three ; it has four articular surfaces ; one behind, to form part of the articulation for the scaphoid bone ; another before, with a plain articular surface for the metatarsal bone of the great toe ; its outer surface, i. e. the side towards the centre of the foot, has a flat articular surface for the middle wedge-like bone, and a smaller surface for the metatarsal bone of the second toe ; posteriorly, the three cuneiform bones form a cup, into which is received the rounded articular surface of the scaphoid bone ; anteriorly, they join with the three large metatarsal bones, and, in consequence of the shortness of the middle cuneiform bone, they are locked together like a mortice and tenon. The middle bone articulates on the inside with the inner, and on the outside with the outer cuneiform bones ; and the outer cuneiform is connected by its outer surface with the cuboid bone.

Fig. 70.

There are five muscles attached to these bones, viz. to the inner, the *tibialis anticus* and *peroneus longus ;* to the outer, the *flexor brevis* and *abductor pollicis pedis ;* and the *tibialis posticus* to all three bones.

THE MIDDLE CUNEIFORM BONE.

Fig. 71.

5th. This is the smallest of the cuneiform bones ; it has four articular surfaces ; one behind for the scaphoid bone, one before for the metatarsal bone of the second toe, and one on each side for the first and third cuneiform bones.

THE OUTER CUNEIFORM BONE.

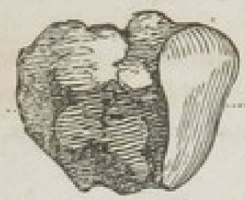
Fig. 72.

6th. This bone has five articular surfaces ; one behind for the scaphoid, one before for the third metatarsal bone, two for the inside, i. e. for the middle cuneiform and second metatarsal, and one on the outer surface for the cuboid bone.

THE CUBOID BONE. *Os cuboides.*

7th. Though this bone is so named from its shape, it is a very irregular cube : it has three articular surfaces, *a*, the largest of which, is posterior, and connected to the os calcis ; *b*, the anterior, for the fourth metatarsal bone ; the smallest is articulated on the inner surface to the scaphoid and outer cuneiform bones. This bone is convex on its upper surface, and on the lower surface it has a deep groove, in which the tendon of the peroneus longus muscle plays.

Fig. 73.



There are two muscles attached to the os cuboides, viz., the *flexor brevis minimi digiti* and *adductor pollicis pedis*.

THE METATARSAL BONES.

a, The *metatarsus* consists of five bones. Fig. 74, *a*, the first, or that of the great toe, is the largest and thickest ; the other metatarsal bones are long and slender. Fig. 75, *a*, the second, is the longest ; the others decrease in length to the fifth or little toe. Each bone has flat articular surfaces to unite with the tarsus, and a rounded articular surface for the first bone of the toe. The metatarsal bones also have flat articular surfaces at the posterior extremities for connecting them with each other.

Fig. 74.

Fig. 75.

There are fourteen muscles attached to these bones, viz., the *seven interossei* and *transversales pedis*, common to all ; the *tibialis anticus* and *peroneus longus* are attached to the first metatarsal bone ; the *adductor pollicis pedis* to the second ; the *peroneus brevis adductor*, and *flexor brevis minimi digiti*, to the fifth.

BONES OF THE TOES.

There are fourteen bones of the toes ; two to the great toe, Fig. 74, *b*, *c* ; three to each of the other toes, Fig. 75, *b*, *c*, *d* ; their division and arrangement are similar to that of the fingers.

There are nineteen muscles attached to the phalanges of the toes, viz., on the upper surface the *extensor proprius pollicis* and *extensor longus*, *et brevis digitorum pedis*, and *seven interrossei*. On the lower surface, the *flexor longus et brevis*, and *abductor pollicis*, the *flexor longus et brevis digitorum pedis*, and *four lumbricales*.

SESAMOID BONES.*

Besides the bones we have described, there are others seldom preserved in the skeleton ; such are the *sesamoid bones*, which are very small, and found at the roots of the first joint of the thumb and of the great toe. These are under or rather in the flexor tendons : they serve as pulleys for increasing the angle of insertion, therefore add considerably to the force of the muscles, and protect the articulations.

These bones give insertion to the *flexor brevis pollicis manus*, and the *flexor brevis, adductor et abductor pollicis pedis.*

THE TONGUE BONE. *Os hyoides.*

Fig. 76.

Fig. 76. There is another bone not immediately connected with the skeleton, situated at the root of the tongue, the *os hyoides.*† It serves for the attachment of the muscles of the tongue, and of deglutition ; *a*, *a*, the *great cornua ; b*, the *smaller cornua ;* c, the *basis.*

The os hyoides is not immediately connected with any other bone, but is kept in its situation by numerous muscles and ligaments.

There are ten muscles attached to this bone, viz., the *hyo-glossus, constrictor pharyngis medius, sterno-hyoideus, omo-hyoideus, stylo-hyoideus, genio-hyoideus, thyro-hyoideus, genio-hyo-glossus, digastricus*, and the *mylo-hyoideus.*

CHAP. VI.

THE TEETH.

THE teeth are the most solid parts of the body ; in their formation they bear a certain analogy to the horns of animals, and thus differ in many respects from the bones. Some anatomists have described them as an appendage to the skin, since they are, in fact, exterior to it, and are exposed in a greater part of their surface to the contact of the air, and to the mechanical and chemical action of bodies. The greater part of their surface is inclosed in alveoli or sockets, which tightly embrace them, and form the articulation termed gomphosis. That part which is thus contained in the socket is named the *root ;* the middle, which is somewhat contracted, is the *neck;* and all above,

* Because they resemble the grains of *sesamum*, or Indian corn. This term occurs in several parts of descriptive anatomy " Sesamoid bones are sometimes found at the origin of the gastrocnemii muscles, and occasionally they are connected with the ossa pubis."—MONRO.

† So called from its resembling the Greek letter *v*.

the *crown*. All the teeth have a form more or less elongated, terminating in a pointed manner, and in this point or end of the root is a small hole. This openining leads to the *hollow of the tooth* or *dental cavity*, an excavation which extends from the point of the root to the crown ; and this cavity represents the form of the tooth, and lodges its vessels and nerves.

The teeth, when all are developed, are thirty-two in number, sixteen in each jaw.

STRUCTURE OF THE TEETH.

They are formed of two substances : one exterior, called *enamel;* the other interior, and of the same texture as bones.

ENAMEL OF THE TEETH.

The enamel is only found round the crown of the tooth ; it covers the whole surface of the crown, is moulded exactly upon it, and thus represents all its inequalities. It is thickest on that surface where trituration takes place, and diminishes in this respect towards the neck. This disposition is a protection to the surface which is most worn in mastication. The fibres of the enamel are small, parallel to each other, and perpendicular to the surface of the tooth ; by this arrangement the enamel is not liable to scale off, and is better calculated to resist attrition. In Fig. 77, may be seen the enamel, marked *a*, and extending to *b*.

THE OSSEOUS SUBSTANCE OF THE TEETH.

This forms the most considerable portion of the tooth, as the whole of the root and the interior of the crown. It is composed of an exceedingly dense and compact tissue, bearing an analogy to ivory ; for it has no cancelli, and its fibres, when seen by the assistance of a microscope, appear concentric, parallel to the surface of the tooth.

By chemical analysis, the osseous substance gives nearly the same results as the other bones, with the exception of a small quantity of fluate of lime.

Like the medullary organs of the bones, the central part of the teeth contains a soft spongy substance, formed by a network of vessels and nerves. The vessels are derived from the internal maxillary artery ; the nerves, from the second and third branches of the fifth pair. Fig. 77, is a section of an incisor and molar tooth, showing the cavity which contains the nerve and vessels marked *c, c.*

Fig. 77.

CLASSES OF TEETH.

The teeth are divided into three classes : incisors, canine teeth, and grinders.

INCISORS.

The front or cutting teeth are eight in number, four in each jaw. They vary from the others in the form of the crown, which is like a wedge. They are convex in front, concave posteriorly. The layer of enamel which covers the crown is thinner behind than in front. The roots of these teeth are always single, very long, and of a conical form, slightly compressed at the sides, and a little thicker before than behind.

Fig. 78, 79.

Fig. 78, shows a front, and Fig. 79, the profile of an incisor. The lower incisors are smaller than the upper, their roots larger, and laterally more compressed, sometimes deeply furrowed.

CANINE TEETH.

These are called also *cuspidati*, from their being spear-pointed. There are two in each jaw, placed next in order at the sides of the incisors. They have each but one root, which is longer than the corresponding portion of any of the other teeth. Fig. 80, the front, Fig. 81, the profile. The canine teeth of the upper jaw have longer roots than those of the lower, and are vulgarly called eye-teeth, and those of the lower jaw stomach-teeth.

Fig. 80, 81.

THE GRINDERS,

Or *molar teeth*, are twenty in number, ten in each jaw, five on each side.

The first two pairs of grinders are called *bicuspidati*. Their crowns are surmounted by two conical tubercles; the root of each is generally simple, but has a well-defined groove on each side of its lateral surfaces. Fig. 82, a front view, and Fig. 83, the profile of a small grinder.

Fig. 82, 83.

The next three, which terminate the row, are called *multicuspidati*. They are remarkable for their great size, and on the surface of their crowns are four pyramidal tubercles, separated by very distinct grooves; the roots are divided into two, three, four, or five parts or fangs, each of which presents an aperture for the passage of the dental nerve and vessels. Fig. 84, a view of a large grinder. The root of the last grinder, *(dens sapientiæ,)* in the lower jaw is simple, short, and conical; but in the upper it is generally divided into four short roots.

Fig. 84.

OF THE FORMATION OF THE TEETH.

The teeth are formed in a manner different from that of any other part of the body, and their development presents many remarkable phenomena.

Before they are visible, they are formed in the interior of the maxillary bones. They are developed in small rounded sacks, which are composed of two membranes ; both these membranes are vascular, according to Meckel and Fox, but the external is the more so. The internal membrane is the firmest, but thinner than the external ; its connexions with the teeth are more intimate, for strictly speaking, this is the formative organ. The dental vessels branch out on it ; and when they are injected, it appears entirely red. The external is of a more spongy, looser, softer, and thicker texture, than the internal ; it is continuous with the gums, lines the interior of the alveoli, and forms their periosteum.

At the first, these small sacks simply inclose a reddish fluid ; but at about the fourth month of pregnancy, there appears from the base of the internal membrane a small body, which is vascular and soft. This is the germ, or pulp of the tooth. Numerous nerves and vessels, supplied by the internal membrane, ramify in this pulp, which gradually assumes the appearance of a tooth, this being the nucleus around which a tooth is moulded.

The ossification of the tooth commences about the middle term of pregnancy, and begins on as many points of the pulp as the future tooth will have eminences on its surface ; thus the incisores and cuspidati commence with one point, and the molares with several. The several points increase until they come in contact, then the tooth grows as an entire body. The pulp elongates at its base to form the root. In those teeth which have only one root, a conical shell of bone is formed around the pulp, which continues to increase in length in proportion as the ossification advances ; while in those which have several roots, a division of the pulp takes place at this part into a corresponding number of processes.

The outer lamina of bone is first completed ; and then lamina after lamina is deposited, one within the other, the pulp still receding, until at length there remains only the permanent cavity of the tooth, lined with its proper membrane, and filled with the remaining portion of the pulp, which now serves as the bed, upon which the vessels and nerves ramify previously to their entering the bony substance of the tooth.

The secretion of the enamel begins shortly after the development of the bony matter ; this substance is secreted by the internal face of the internal capsule which envelops the crown of the tooth, so that it is moulded exactly to the projections and depressions on that part. The fluid which is poured out from this internal membrane is thickish, and is soon consolidated into a dark chalky substance, which afterwards becomes white and hardened by more perfect crystalization. This is the enamel ; but at an early period this enamel is not very hard, and can be easily separated, and can in its perfect state be readily detached by heat. The glandular apparatus which forms this substance is not demonstrable.

OF THE DECIDUOUS TEETH.

Infants have teeth, which are the deciduous or milk teeth, twenty in number, ten in each jaw, five on each side, viz. two incisors, one cuspidatus, and two molares. These commence to appear ordinarily about the sixth month, and generally in pairs, those of the lower jaw first, and then the similar ones in the upper ; and the whole twenty appear at about the thirtieth month.

OF THE PERMANENT TEETH.

The deciduous teeth drop from the gums, and are followed by the permanent ; and the whole process of dentition is not completed until about the age of twenty years, the last appearing being the dentes sapientiæ. These permanent teeth are developed, and appear nearly in the same order as the milk teeth.

Nature has limited the duration of life in the teeth more than in the other bones. The power of nutrition becomes gradually enfeebled in these organs, and they perish by their nutritious foramina being obliterated. Being no longer retained in their alveoli by any organic connexion, they become loose and fall out ; their sockets are absorbed. But the tone of the stomach being weakened naturally at this advanced period of life, man is thereby reduced to feed upon soft substances, accommodated to the languid state of the gastric powers and the loss of the teeth.

CHAP. VII.

THE MEDULLARY SYSTEM,

OR THE MARROW OF BONES.

I SHALL first describe the deposition of marrow occupying the cellular structure of the short and flat bones, and the extremities of the long bones. The medullary membrane of this structure appears to be a continuation and expansion of the vessels that penetrate the foramina, and which, on reaching the internal surface of the spongy part of the bone, ramify ad infinitum, and unite a thousand different ways. Their interweavings give to the interior of the cellular tissue its peculiar florid aspect, which is more evident as we examine it nearer to the period of infancy, because the vascular system of bones is then very conspicuous, while it gradually contracts and fades away as age advances.*

* The blood vessels of bones are much more numerous than we should expect from their color, for the earth of the bone conceals them ; and hence they are not apparent even after being filled with a red injection, until by immersion in diluted muriatic acid, the earth of the bone has been destroyed. When a bone has been thus prepared, and put into oil of turpentine, its vascularity is shown to great advantage.

This vascular extension can be distinctly seen in the injected bone, forming, as it were, a membrane throughout the innumerable cellulæ of the bone ; and the exhalation of the medullary fluid or marrow, which fills the interstices I have just mentioned, seems to proceed from this vascular net-work.

The medullary system of the middle of long bones, whose largest cavity it fills, somewhat differs from the preceding, in having less vascularity ; while a thin transparent membrane lines the whole cavity, and is repeatedly folded upon itself, giving rise to numerous extensions, some of which surround the very minute filaments of the cancelli of the sides of the cavity, others pass from the one side of the membrane to the other, without adhering to any ossified portion, the whole of which forms spherical cells filled with marrow, and when viewed through a microscope resembles a cluster of pearls.

The medullary system of bones, in a healthy state, possesses little sensibility, or only such a degree of organic sensibility as is indispensable to its functions. As a proof of this, the marrow may be irritated in a living animal without any signs of feeling being expressed. The sawing of the skull with the trephine, and the division of the bone in amputations, are not attended with pain.

Marrow, according to Berzelius, is a species of fixed oil, possessing peculiar properties, and something like butter. It consists of the following ingredients :

Pure marrow of fixed oil,	0,96
Skin and blood vessels,	0,01
Albumen, Gelatine. Extractive, Peculiar matter,	0,03
Water,	1,03

The use of the marrow in bones I believe to be the same, as the use of the fat in or about other parts of the human body, viz. it is a mere deposit of superfluous nutritious matter.

ART. II.

CHAP. I.

CARTILAGINOUS SYSTEM, OR THE GRISTLE OF BONES, ETC.

In order to render the motions of the bones on each other more easy, the ends are incrusted with a substance of a white or pearly color, hard, yet very elastic. This is a peculiar substance found in various parts of the body, especially on the articular surfaces of bones, the end of the nose, the edges of the eye-lids, the ear, the wind-pipe and air passages, the ends of the ribs, etc. Cartilage forms a considerable share of those parts, where flexibility and firmness are to a certain degree combined, in order that the organ may, after being bent, recover its determined form.

The cartilaginous tissue is a net-work of fibres, so closely interwoven that at first sight it appears completely homogeneous, and formed of a mass of albumen without any particular order or direction ; however, a more attentive examination will discover longitudinal fibres, crossed by others in a transverse direction. The fibrous arrangements of the cartilage of joints are perpendicular to the surface of the joint, and after maceration for six or eight weeks, may be observed to be placed at right angles in respect to the bone to which they are united.

The surfaces of cartilages which are in contact are finely polished, that by its smoothness it may facilitate the sliding motion of the two bones on each other. The elasticity reflects a considerable part of the motion, which by a little yielding becomes extended, and thus moderates the effects of violent shocks to which the limbs are often liable in active exertions.

The elasticity of cartilage is very conspicuous, particularly in youth and adult age. If the blade of a scalpel is thrust into cartilage, the two edges of the division will re-act upon it, and repel the instrument ; when pressed it becomes flattened, but resumes its primitive shape as soon as the cause of compression is removed. Thus has nature placed cartilages where, to answer particular purposes, it is requisite that a physical property should be united to the vital powers, as in the larynx ; and in the nasal partition, to produce a kind of vibration in the passage of air ; at the ends of the ribs, to maintain that kind of contortion indispensable to mechanical respiration ; and in the articular extremities, to resist the effects of external violence ; for in those situations they serve as a kind of elastic cushions, yielding on compression, and regaining their form on that compression being removed.

During life this elasticity of cartilage is most apparent, although it remains after death.

The cartilages are divided into *articular*, *interarticular*, *connecting cartilages*, and *cartilages of particular cavities.*

Articular cartilages cover the surfaces of bones in the movable joints.

Interarticular cartilages are interposed between the ends of bones to form a movable socket, which, like the friction wheels of machinery, aid the motion of the joint.

Connecting cartilages unite the articular surfaces of bones by an immovable union, as in the sutures of the skull, the connexions of the bones of the pelvis, etc.

Cartilages of cavities are such as form the larynx, trachea, part of the nose, etc.

The number and the thickness of cartilages interposed between each bone, render the acts of running, jumping, and performing other feats of activity, much more easy. Severe blows on the ribs do not break them, for their cartilaginous extremities recoil, and yield to the violence ; as, however, in age the quantity of cartilage diminishes, and some cartilages entirely disappear, so the bones lose that elastic medium, and their extremities are unyielding and inelastic, and any degree of violence is frequently attended with fracture. For instance, a child falling twice its height, from the elasticity of its frame would receive little or no injury ; the condition of old age is very different : the bones are consolidated, and a fall of the same nature might prove most disastrous.

The blood-vessels, nerves, and absorbent vessels of cartilage, are so small as to elude observation ; but there cannot be a doubt of their existence, of which there is the clearest evidence from the phenomena of its inflammation and absorption in disease ; but in its natural state its vitality is very obscure, sensibility and contractility being such only as are necessary for its growth and nutrition. When divided, if the edges be brought into contact, after a length of time re-union will take place, as I have observed in wounds of the cartilage of the nose and of the ear.

ART. III.

CHAP. I.

FIBROUS SYSTEM.

All the fibrous organs are absolutely of a similar nature, and the same fibres contribute to the composition of all the forms ; yet, in their arrangement, they vary in an astonishing degree ; and it is the variety in their form, situation, and office, that has caused them to be denominated and designated by the names of tendons, aponeuroses, ligaments, etc.

The fibrous parts of the human system everywhere display a whitish, or shining silvery appearance. The basis is a dense fibre of a peculiar nature, rather elastic, insensible, hardly admitting of contractibility, sometimes arranged in juxta-position, and assembled together in bundles parallel to each other, as in the tendons and ligaments ; at other times they are intersected and spread out in sheets, the fibrous web of which turns in diversified directions, as in the membranes, the capsules, the fibrous sheaths, etc.

The strength of the fibrous tissue renders every organ it composes fitted to sustain the utmost efforts its uses require. Thus the ligaments strongly retain the articular surfaces in apposition. The aponeuroses prevent the displacement of the muscles, and give attachment to their fibres. The tendons, incessantly exposed to the contraction of the muscles, are placed between the power they conduct and their attachments, offering a resistance that frequently proves stronger than the bone itself. For by muscular exertions the patella, the olecranon, and the os calcis, have been sometimes fractured.

The several forms of the fibrous membranes are —

1st. Those which include the periosteum, the dura mater, the tunica sclerotica, the tunica albuginea, the proper membranes of the kidneys, spleen, etc. They are generally intended to cover certain organs, to the texture of which they contribute.

2d. The fibrous capsules, very different, as will be shown, from the synovial surfaces, are a kind of cylindrical bags that are found around some articulations, especially around those of the humerus and the femur, where they are connected with the scapula and ilium, inclosing both their articular surfaces.

3d. The fibrous sheaths are intended to confine the tendons in their situation, particularly on their passing over the bones, where they undergo flexion, as in the fingers and toes ; for without this contrivance they would be liable to deviate, and thus transmit but imperfectly muscular motion. The fibrous sheaths have been divided into two species; those which confine a number of tendons, as at the wrist, instep, etc., others, like those of the fingers, are intended for an isolated tendon, or for the reception of two only.

4th. The aponeuroses are a kind of fibrous canvas, more or less extended, and always connected with locomotion, and disposed in such a manner that they sometimes form coverings for different parts, and at other times they provide the muscles with points for insertion.

The fibrous organs formed in fasciculi are —

1st. The tendons found at the extremities, or in the centre of muscles; these are either single, in the form of extended strings, or compound, as in the rectus femoris, flexors, etc.

2d. The ligaments which secure the articulations, around which they are placed; these are formed of regular fasciculi, as the ligaments of the jaw, elbow, knee, etc., or of irregular fasciculi, as those of the ribs, pelvis, &c.

CHAP. II.

PERICHONDRIUM.

This is a membrane perfectly similar to the periosteum; it covers the cartilages in the same manner, and serves the same general purposes to cartilage as the periosteum does to bone. The perichondrium of the larynx, the ribs, &c., is a thin tissue of fibres, intersected in every direction, is highly vascular, and can be injected. But the vessels of this membrane, where it covers the articular surfaces, cannot be demonstrated; indeed it adheres so closely as to appear like the cartilage itself, although it can be proved to be a reflection of the synovial membrane of the joint.

CHAP. III.

THE LIGAMENTS.

The ligaments are those fibrous substances which connect the articular ends of the bones and cartilages, by which they are all united into one admirable structure, the individual parts of which are firmly maintained in such particular relative situations, as are best calculated to admit with safety the numerous motions that are required.

The bones are united by strong investing membranes, and by flexible and elastic bands, composed of dense fibres intimately interwoven with each other, and passing in different directions, the greater number of which pass in direct lines between the parts which the ligaments connect. The ligaments then may be described as an assemblage of strong fibres, firmly joining together the articular surfaces of bones, and giving that security which will prevent displacement, and yet such a latitude of motion as will admit of the easy movement of one bone on the other.

The ligaments receive their supply of blood from the vessels in their immediate vicinity ; they possess but a very small share of elasticity, and in a sound state are nearly destitute of sensibility. BICHAT asserts that no nerves can be discovered in them ; but Dr. MONRO traced them distinctly into their substance, and we know under diseased excitement they are extremely sensible.

CAPSULAR LIGAMENTS.

I have mentioned the periosteum as covering the bone ; the same periosteum, as it were, is continued over the joint, and forms a loose bag termed the *capsular ligament*, which contains the glairy fluid* with which the joint is lubricated. The capsular ligaments are strengthened by the addition of irregular fasciculi of fibres which cross over the joints in different directions ; not to mention that the further security of the joint is provided for by the muscles and tendons which pass over it.

LATERAL LIGAMENTS.

These ligaments are strong skeins of fibres, firmly united to the periosteum, and passing from one extremity of bone to another, and are always found in the hinge-like joints. The lateral ligaments moderate, and in some measure limit, the movements of the joint.

LIGAMENTS WITHIN THE JOINTS.

These ligaments are for giving additional strength, and regulating the movements of certain articulations, as the round ligament of the hip, and the cross ligaments of the knee.

These are the principal species of ligaments of the body ; there are, however, others that unite the bones which do not move on each other, as the os sacrum and os innominatum. There is also an elastic substance, which is an antagonist to the muscles, and by which they are restored to their original situation, or supported in it. These sometimes form part of the muscles ; thus the head is supported by a strong elastic ligament appended to the muscles of the back. In those animals which have long necks, this is particularly strong, as in the ox and the horse ; for the head, acting at the end of a long lever, could not be supported for any length of time, or would be in danger of dislocation, were it not for this elastic tape which supports the

* The synovial membrane which produces this fluid must be distinguished from the capsular ligament. The former is allied by structure and function to the serous membranes, the latter to the fibrous.

head without the expense of muscular power. Those ligaments usually denominated *interosseous ligaments*, placed between the radius and ulna, tibia and fibula, etc., are simply aponeurotic membranes, serving for the attachment of muscles; and thus supplying the place of bones, save an unnecessary weight and incumbrance.

CHAP. IV.

PARTICULAR LIGAMENTS.

LIGAMENTS OF THE HEAD.

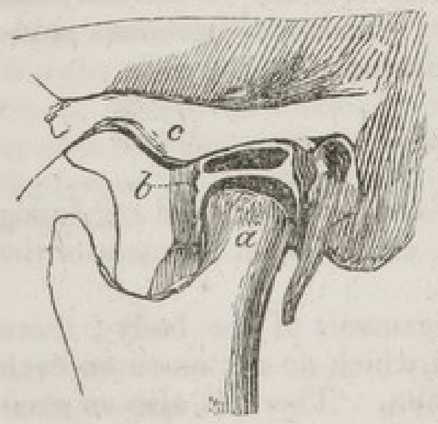
THESE may be divided into two classes; the first connects the lower jaw to the temporal bones; the second, the head to the neck.

LIGAMENTS OF THE LOWER JAW.

The condyles of the jaw are fixed to the articular cavities of the temporal bone by a capsular and two lateral ligaments, with the addition of an interarticular cartilage.

CAPSULAR LIGAMENT.

Fig. 82.



The capsular ligament consists of dense fibres, which are superiorly attached to *c*, the margin of the zygomatic eminence, and to the fissure in the glenoid cavity. It is again attached to the edge of *b*, the interarticular cartilage, and inserted inferiorly at *a*, into the neck of the condyle of the lower jaw. Fig. 82 exhibits a section of the joint.

INTERARTICULAR CARTILAGE.

This cartilage, *b*, forms a sort of movable cover over each condyle of the jaw, separating the capsule into two parts, by its circumference adhering strongly to it.

INTERNAL LATERAL LIGAMENT.

Fig. 83.

This ligament is attached above at *a*, the edge of the glenoid cavity; below at *b*, the margin of the posterior dental foramen, in the ramus of the jaw.

STYLO-MAXILLARY LIGAMENT.

This ligament is extended from *c*, the styloid process of the temporal bone, to *e*, the angle of the jaw.

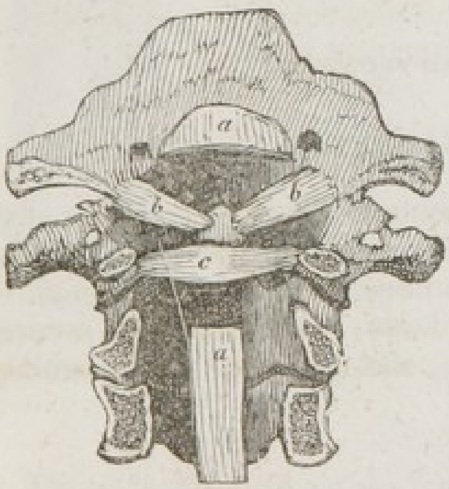
EXTERNAL LATERAL LIGAMENT.

Fig. 84.

This ligament passes obliquely across the capsular ligament, from *a*, the zygoma, to the posterior part of *b*, the neck of the jaw.

LIGAMENTS CONNECTING THE HEAD AND NECK.

Fig. 85.



The ligaments connecting the head to the neck may be arranged as follows: — the capsular, perpendicular, and lateral ligaments.

TWO CAPSULAR LIGAMENTS.

These ligaments connect the condyles of the occipital bone to the articulating cavities of the atlas.

ANTERIOR PERPENDICULAR LIGAMENT.

A broad ligament attached superiorly to the anterior edge of the foramen magnum, and inferiorly to the ring of the atlas ; its fibres extend some distance down the cervical vertebra.

POSTERIOR PERPENDICULAR LIGAMENT.

A broad and strong ligament, extending from the posterior edge of the occipital foramen to the upper vertebra of the neck. Its direction and attachments are shown in Fig. 85, from *a, a*, though a part of it is removed to show other ligaments.

TWO LATERAL LIGAMENTS.

These ligaments, Fig. 85, *b, b*, are seen extending from the margin of the occipital foramen to the odontoid process of the dentata or second vertebra.

CHAP. V.

LIGAMENTS OF THE VERTEBRÆ.

The spinal column is composed of numerous bones, so wonderfully connected to each other, that motion is permitted to a requisite extent, without the safety of the spinal marrow, or the strength of the column, being in the least impaired. Several ligaments are required to effect these important purposes : these differ from each other in form and in use ; some are common to all the vertebræ, others are confined to two of them, others again are peculiar to the cervical vertebræ.

LIGAMENT OF THE SECOND VERTEBRA.

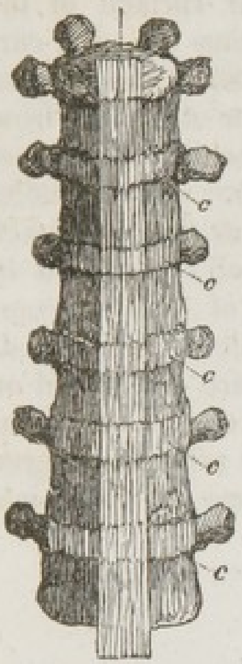
TRANSVERSE LIGAMENT.

This is a strong fasciculus of ligamentous fibres, Fig. 85, *c*, extending from one side of the articular process of the atlas to the opposite side ; it is narrow at the extremities, but wide in the centre, where it is almost of a cartilaginous hardness. This ligament secures the odontoid process in its proper place, and prevents the possibility of its pressure on the spinal cord.

LIGAMENTS COMMON TO ALL THE VERTEBRÆ.

ANTERIOR COMMON LIGAMENT.

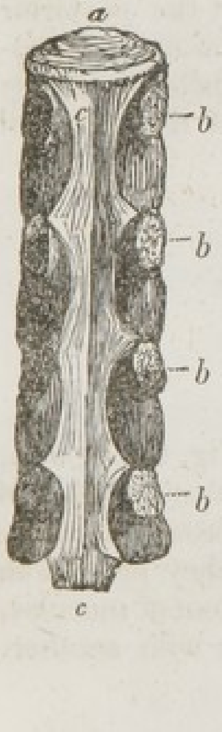
Fig. 86.



This is a smooth, resplendent, broad ligament, *a, a,* which extends along the anterior, convex surface of all the vertebræ. This ligament is composed of parallel fasciculi, which, however, seldom extend beyond two or three vertebræ, where one set terminates and another commences; thus its entire extent receives an excess of fibres from almost every vertebra it covers. It is attached only to the anterior part of the spinal column, though occasionally it sends off small oblique processes, which are lost on its sides. A profile of this ligament is seen in Fig. 91, *c*.

POSTERIOR COMMON LIGAMENT.

Fig. 87.



This is somewhat similar to the anterior, except that it passes along the inner, concave part of the bodies of the vertebræ, aud terminates at the sacrum; *a*, the intervertebral fibro-cartilage, cut transversely; *b, b, b, b,* the part from which the arch of the spinal canal is removed; *c, c,* the *posterior vertebral ligament*, situated behind the bodies of the vertebræ, smooth and resplendent, broader on a level with each fibro-cartilage than with the body of the vertebra.

These are numerous short and strong ligamentous fibres crossing each other obliquely, joining the vertebræ together upon the outer edges of the vertebral substance, called by Fyfe *crucial intervertebral ligaments.*

INTERVERTEBRAL LIGAMENT.

Fig. 86, *c, c, c, c, c.*

There is placed between the bodies of the vertebræ a peculiar substance, described by most authors as a texture between cartilage and ligament, partaking of the property of both, hence sometimes very properly called *intervertebral fibro-cartilage.* It is composed of white shining fibres, arranged in laminæ of different thicknesses, but in very regular order. If this substance is divided by a horizontal section, its fibrous structure is very distinctly seen, the laminæ running in regular concentric circles, or rather the circle is a little concave posteriorly, corresponding to the form of the articular surface of the bodies of the vertebræ. Although the external laminæ are of a cartilaginous firmness, and offer great resistance on pressure, the internal laminæ are more soft and delicate, and at a greater distance from each other, in the interstices of which there is a peculiar substance, not so firm as cartilage, nor quite so soft as gelatin. The smaller circles of fibres are gradually softer in their texture as they approach the centre, where nothing is seen except a nucleus of semi-liquid or mucous form. Thus each vertebra resting on a sort of fluid fulcrum, or pivot, the motion to either side is easy, and quickly performed. The motions of the back bone or bones, therefore, are performed on an almost fluid centre, surrounded by a perfectly elastic medium, which remarkable union of flat surfaces admits of the requisite degree of motion, and prevents injury to the delicate texture of the spinal cord and brain in violent exercise.

LIGAMENTA SUBFLAVA.

These ligaments are of a pale yellow color ; they are attached superiorly and inferiorly to the opposite margins of the arch of the spinous processes of the vertebræ, completing those deficiencies of the spinal canal, which are observed in the skeleton at the posterior part of the spine, and extending as far forwards as the oblique processes, the articulations of which they strengthen. These ligaments possess great elasticity, yet resist too much flexion of the vertebral column.

INTERSPINOUS LIGAMENTS.

Fig. 88.

The interspinous ligaments, Fig. 88, *b*, *b*, *b*, are attached to the upper and lower margins of each spinous process. Like interosseous membranes of the fore arm and leg, they present an extensive surface for the attachment of muscles, and connect one spinous process with another.

SUPRASPINOUS LIGAMENTS.

The supraspinous ligaments, Fig. 88, *a*, *a*, are extended from the point of one spinous process to that of another, in the whole line from the seventh cervical vertebra to the sacrum.

LIGAMENTS OF THE OBLIQUE PROCESSES.

The articulations of the oblique articular processes of the vertebræ are secured by a strong capsular ligament, composed of short fibres, which permit but little motion, except between the first and second vertebræ, the articular processes of which are very large, and the ligament allows of a considerable rotary motion.

CHAP. VI.

LIGAMENTS OF THE THORAX.

LIGAMENTS OF THE RIBS WITH THE VERTEBRÆ.

CAPSULAR LIGAMENTS.

Fig. 89.

THE capsular ligaments are attached to the heads of the ribs ; and as there are two articular surfaces to the head of each rib, so there are two regular capsular ligaments, which are opened in the figure, *a*, *a* ; their fibres are radiated, one portion of its fasciculi being extended to the vertebra above, another to that below. The fibres of the capsule extend along the bone for some way, and mix with their anterior common ligament. The back of the rib is articulated to the transverse process ; consequently there is a *capsular ligament* belonging to this joint also.

INTERARTICULAR LIGAMENT.

The interarticular ligament, Fig. 89, *b*, is fixed to the central projecting angle on the head of each rib, connecting it to the intervertebral substance. This ligament has no existence in the first and two last ribs : as the capsular ligaments are single, each has but one articular surface on its head, and is connected with one vertebra only.

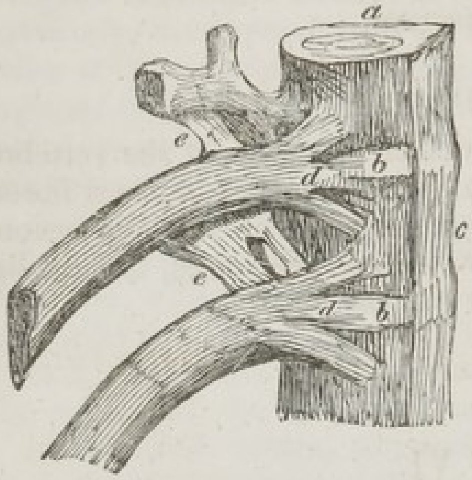
MIDDLE TRANSVERSE LIGAMENT.

Fig. 90.

This ligament, *a*, consists of irregular fasciculi of fibres, which occupy the interval between the rib at *c*, and the anterior surface of the corresponding transverse process at *b*. It cannot be well seen until the rib is forcibly separated from its attachments.

INFERIOR TRANSVERSE LIGAMENT.

Fig. 91.



This ligament, *e*, *e*, is composed of two fasciculi, the one extending from the lower edge of the transverse process of the vertebra to the upper edge of the rib above, near its articulation with the body of the vertebra. The other fasciculus is smaller, and is attached to the base of the transverse process, and is extended to the head of the rib beneath.

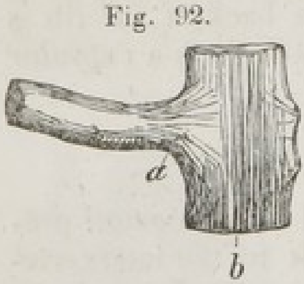
ANTERIOR OR RADIATED LIGAMENT.

This ligament, Fig. 91, *d*, *d*, is formed of three flat fibrous fasciculi, which are fixed separately to the two vertebræ, and to *b*, the fibro-cartilage ; these strongly secure the rib, by converging and attaching themselves to its head and neck. The eleventh and twelfth ribs, however, in this situation, present only a single order of fibres.

LIGAMENTS OF THE CARTILAGES OF THE RIBS WITH THE STERNUM.

The cartilages of the seven superior ribs are joined at *b*, the sternum, by strong ligamentous bands at *a*, which cover the synovial membranes ; although this articulation has but a very obscure motion, it has a regular socket and capsule. These cartilages are united to the ribs by symphysis, or an immovable articulation.

Fig. 92.



The upper part of the sternum receives some ligamentous fibres from its articulations with the clavicles. The sternum is also covered, both on its anterior and posterior surfaces, by a strong aponeurosis, which is inseparably connected to the periosteum ; its fibres are very conspicuous anteriorly, and resemble tendinous bands, taking a longitudinal direction, and uniting those portions of the bone which in young persons it is found to consist of.

Some fasciculi extend beyond the margins of the sternum, and are attached to the cartilages of the ribs. The aponeurosis which covers the internal surface of this bone is more smooth and polished, and its fibres take a longitudinal course.

The xiphoid or ensiform cartilage is connected to the sternum by the above-mentioned aponeurosis, and has radiated ligamentous fasciculi connecting it with that bone, and with the cartilage of the seventh rib.

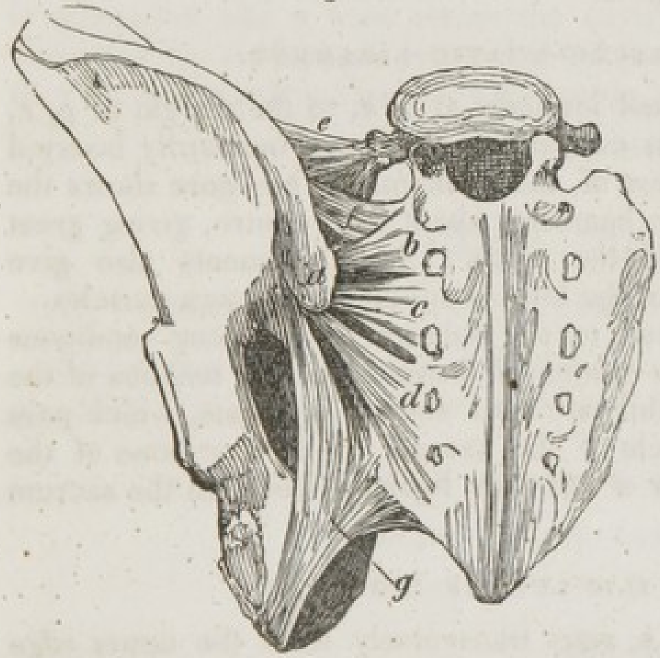
CHAP. VII.

LIGAMENTS OF THE PELVIS.

These consist of the ligaments connecting the ossa innominata, the sacrum, and coccyx.

LONG POSTERIOR LIGAMENT OF THE ILIUM.

Fig. 93.



This ligament is attached outwardly, at *a*, to the posterior superior spine of the ilium, descends obliquely inwards, and is inserted, at *d*, into the third and fourth transverse tubercles of the sacrum; *g*, the great sacro-sciatic ligament.

SHORT POSTERIOR LIGAMENT.

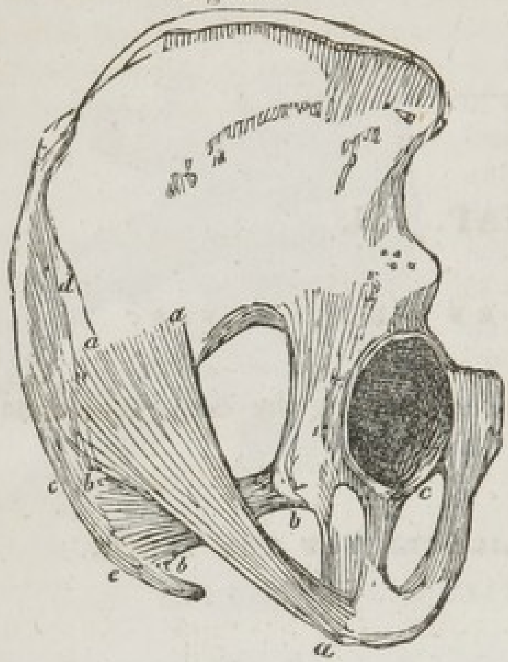
This ligament is attached inwardly in common with the preceding, and extends to the third tubercle of the sacrum, at *c*.

POSTERIOR LATERAL LIGAMENT.

This is a narrow ligament, extending from the internal surface of the same spinous process of the ilium, at *a*, to the lower margin of the first division of the sacrum, *b*.

GREAT SACRO-SCIATIC LIGAMENT.

Fig. 94.



This ligament is situated at the lower and posterior part of the pelvis; it is of a triangular form attached superiorly at *a*, *a*, the posterior and inferior iliac spine, to the fourth and fifth tubercles of the sacrum, to the lower portion of this bone and to the coccyx. The fibres converge, and pass obliquely outwards and downwards to be inferiorly attached at *a*, the tuber ischii.

SMALLER SACRO-SCIATIC LIGAMENT.

This ligament is attached inwardly at *b*, *b*, to the margin of *e*, *e*, the sacrum and coccyx; its converging fibres are outwardly inserted at *b*, into the spinous process of the ischium. The figure shows the crossing of the sacro-sciatic ligaments about their centre, giving great support to the contents of the pelvis; these ligaments also give attachment to some fibres of the levator ani and coccygeus muscles.

The coccyx is connected to the sacrum by a strong tendinous aponeurosis, *e*, *e*, which is continued down from the tendons of the lumbar muscles; beneath this are two strong ligaments, which pass from the last spinous tubercle of the sacrum to the first bone of the coccyx; and there is also a capsular ligament between the sacrum and coccyx.

SUPERIOR ILIO-LUMBAR LIGAMENT.

This ligament, Fig. 93, *e*, runs transversely from the upper edge of the ilium to the transverse processes of the two last lumbar vertebræ.

INFERIOR ILIO-LUMBAR LIGAMENT.

This ligament, *f*, is situated immediately below the former, runs the same course, and has nearly the same attachments.

ILIO-SACRAL LIGAMENTS.

The anterior part of the surface of the sacrum and ilium are mutually connected by cartilage, the posterior by strong ligaments, which pass in every direction from one bone to the other. This synchondrosis in front, and syndesmosis behind, is so very strong, as to prevent any motion between the ilium and sacrum.

SYMPHYSIS OF THE OSSA PUBIS.

The fibro-cartilaginous connexion of these bones consists of concentric layers, which unite the two oval surfaces which the ossa pubis present anteriorly, and they are further secured by strong ligamentous fibres, crossing from one side to the other; an examination of which must lead us to deny the possibility of any separation taking place in parturition.

MEMBRANE OF THE THYROID FORAMEN.

This is a fine, smooth, tense membrane, attached to the circumference of this opening; it consists of two laminæ, the use of which is to give origin to the external and internal obdurator muscles.

LIGAMENT OF FALLOPIUS OR POUPART.

This has been considered as a tendon at the inferior border of the external oblique muscle; it may, however, be strictly considered as a distinct ligament, extending from the anterior superior spinous process of the ilium to the ossa pubis.* To its upper edge the abdominal muscles are attached, and to its lower the fascia lata of the thigh. It is subtended like a cord across the cavity between the spine of the ilium and the pubis, thus protecting the femoral vessels and nerves as they leave the pelvis along with the psoas and iliac muscles.

CHAP. VIII.

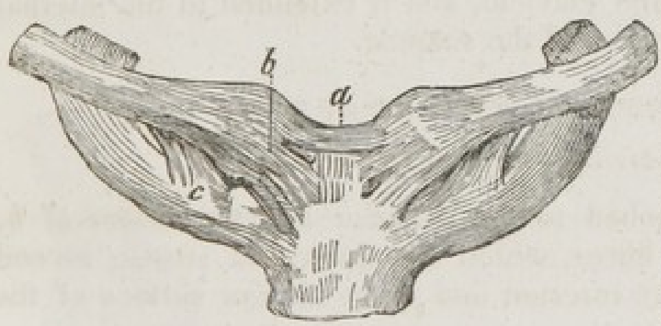
LIGAMENTS OF THE SUPERIOR EXTREMITIES.

Under this head I shall describe the ligaments of the clavicle, shoulder, arm, fore arm, wrist, and hand.

LIGAMENTS OF THE CLAVICLE.

INTERCLAVICULAR LIGAMENT.

Fig. 95.



The interclavicular ligament, *a*, is a fasciculus of strong ligamentous fibres, extending in a transverse direction above the sternum, from one clavicle to the other, connecting them together, and attaching those bones to the sternum.

* It has three insertions.

1st. Insertion into the symphysis pubis and pubis of the opposite side. This forms the superior column or pillar of the abdominal ring.

2d. Insertion into the spine of the pubis, forming the inferior column or pillar.

3d. Insertion passes backwards to be attached to the crest of the pubis, and is the ligament known by the name of *Gimbernat's*.

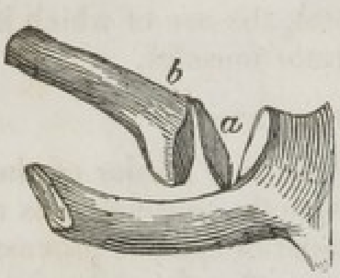
STERNO-CLAVICULAR LIGAMENT.

This ligament, *b*, forms an imperfect capsule, its fibres extending over the articulation from the triangular or sternal end of the clavicle, to the anterior and posterior surfaces of the sternum ; a few fibres are also attached to the first rib.

INTERARTICULAR CARTILAGE.

This is an apparatus similar to the articulation of the jaw ; it is a movable cartilage, *a*, thick at its circumference, and thin in the centre, adapting the extremity of one bone to the other. It is fixed at one edge to *b*, the clavicle ; and the capsular ligament is adherent to the root of the border. In the figure this ligament is cut, and the bones separated, to exhibit the cartilage.

Fig. 96.



COSTO-CLAVICULAR LIGAMENT.

The chasm between the clavicle and first rib is closed by this ligament, Fig. 95, *e*. It is of a rhomboidal figure, extending from the inferior surface of the clavicle near its sternal end, to the upper and anterior part of the cartilage of the first rib. Some fibres also adhere to the interarticular cartilage.

ACROMIO-CLAVICULAR LIGAMENT.

This ligament, Fig. 97, *f*, is attached to the superior and outer rough surface of the clavicle, extending a considerable length, to connect the corresponding surface of the acromion scapulæ.

CORACO-CLAVICULAR LIGAMENT.

This ligament, *d*, is very strong, and is formed by a conoid fasciculus of diverging fibres fixed to the tuberosity on the outer extremity of the inferior surface of the clavicle, and is extended to the internal part of *b*, the coracoid process of the scapula.

LIGAMENTS OF THE SCAPULA.

ACROMIO-CORACOID LIGAMENT.

This ligament, *e*, is attached to the superior convex surface of *b*, the coracoid process ; its fibres, which are thick and strong, ascend obliquely outwards, and are inserted into *f*, the inferior surface of the acromion scapulæ.

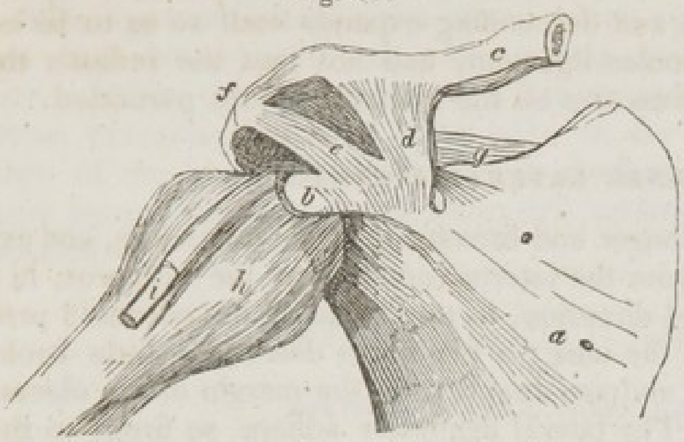
CORACOID LIGAMENT.

This is merely a ligamentous cord, *g*, extended over the semilunar notch so as to convert the latter into a foramen. The supra-scapular vessels and nerves pass under this ligament.

LIGAMENTS BETWEEN THE SCAPULA AND HUMERUS.

CAPSULAR LIGAMENT.

Fig. 97.



This ligament, *h*, consists of an oblong sack, surrounding the neck of the scapula, and inclosing the head of the humerus; the capsule is perforated by *i*, the long tendon of the biceps muscle passing through it, i.e. between the fibrous and synovial membrane, to be attached to the edge of the glenoid cavity of the scapula.

ACCESSORY LIGAMENT.

The accessory ligament is formed of a strong fasciculus attached to the coracoid process of the scapula, and directing itself forwards and outwards; it is expanded over the upper and anterior part of the joint, giving the capsule additional strength.

The capsular ligament forms but a loose and weak connexion between the humerus and shoulder, were it not for the several muscles whose tendons adhere to and strengthen it; the infra-spinatus and teres minor by their united tendons cover it externally, the supra-spinatus superiorly, and the subscapularis internally; in addition to these muscles, the deltoid, the coraco-brachialis, and biceps, all co-operate in no small degree to strengthen the connexion between these two bones.

There is a fibro-cartilaginous rim which increases the depth of the glenoid cavity of the scapula, termed by Cloquet the *glenoid ligament*; although I consider it merely a cartilaginous border to the socket of the scapula, not only useful in rendering the socket deeper, but for preventing fractures of the rim in robust exercises, to which, were it bony, it would be very liable.

LIGAMENTS BETWEEN THE HUMERUS AND BONES OF THE ARM.

CAPSULAR LIGAMENT.

The capsular ligament, *a*, envelopes the entire articulation of the elbow joint; on the posterior surface of the humerus it is attached to the margin of the great sigmoid notch which receives the ulna, and passing obliquely downwards beneath the condyles, round to the fore part of the bone, descends to the ulna; it is inserted into the olecranon process, into the margin of the sigmoid cavity, and into the orbicular ligament which connects the radius to the ulna. Externally this capsule is rough, and strengthened by bands which run in irregular directions; internally it is lined by the smooth synovial membrane. It is very loose anteriorly and posteriorly, to admit of a free flexion and extension; but on either side it is tense, and strengthened by lateral ligaments, which prevent any lateral motion.

Fig. 98.

EXTERNAL LATERAL LIGAMENT.

This ligament, Fig. 98, *e*, is attached to the most prominent point of the external condyle, and descending expands itself so as to be inserted into *f*, the orbicular ligament, and not into the radius : the rotatory motion of the fore arm on the humerus is thus permitted.

INTERNAL LATERAL LIGAMENT.

Fig. 99.

This ligament, *b*, is longer and broader than the preceding, and extends from the internal condyle of the humerus, in a radiated direction, to the inside of the coronoid process of the ulna ; a few fibres descend a little backwards, and are attached to the margin of the olecranon. The lateral ligaments adhere so firmly to the capsular, that they appear to form part of its texture.

The two ligaments called the *anterior* and *posterior*, are both thin and irregular fibrous bands, the one placed in front and the other behind the articulation ; the former is fixed in front to the internal condyle of the humerus, and to the annular ligament of the radius ; the latter to the posterior part of the external and internal condyles of the humerus.

LIGAMENTS BETWEEN THE RADIUS AND ULNA.

SUPERIOR ARTICULATION.

ORBICULAR LIGAMENT.

This ligament, Fig. 98, *f*, surrounds the upper extremity of the radius, and with the small sigmoid cavity forms a sort of ring, in which the radius turns with ease. The superior margin is attached to the capsular ligament, the inferior to the neck of the radius. Its use is to confine the head of the radius in its proper situation.

ANTERIOR AND POSTERIOR ACCESSORY LIGAMENTS.

These are ligamentous fibres which run in various directions upon the fore and back part of the joint, and contribute exceedingly to its strength ; the anterior extending from the coronoid process to the orbicular ligament ; the posterior from the lower border of that ligament to the lateral smooth surface of the olecranon.

MIDDLE ARTICULATION.

ROUND LIGAMENT.

CHORDA TRANSVERSALIS CUBITI.

This is a small round fibrous chord, Fig. 99, c, extending from the outer side of the tuberosity of the ulna to the radius, a little below the tubercle for the insertion of the biceps. It prevents too great a degree of supination of the radius.

INTEROSSEOUS LIGAMENT.

This ligament occupies the space which exists between the radius and ulna, although it is not quite so long, being deficient at its upper part. It has the appearance of a thin aponeurotic resplendent membrane, extending from the sharp edge of the radius to the opposite edge of the ulna. It constitutes a medium of connexion between these bones, and affords an extensive surface for the attachment of muscles.

INFERIOR ARTICULATION.

INTERARTICULAR CARTILAGE.

CARTILAGO INTERMEDIA TRIANGULARIS.

This is a fibro-cartilage, placed transversely between the lower extremity of the radius and ulna; the superior surface is continuous with the cartilaginous covering of the end of the radius, and together with this bone completes the cavity for receiving the upper part of the carpus; each extremity is connected by strong ligaments to the radius and carpus. The apex of this cartilage is firmly attached to the depression which separates the styloid process of the ulna from the articular surface of that bone.

CAPSULAR OR SACCIFORM LIGAMENT.

This ligament passes from the radius to the ulna, forming between them a very losse cul-de-sac, which allows the radius to turn upon the ulna.

EXTERNAL LATERAL LIGAMENT.

This ligament, Fig. 100, extends from the styloid process of the radius to the scaphoid bone and annular ligament of the carpus.

INTERNAL LATERAL LIGAMENT.

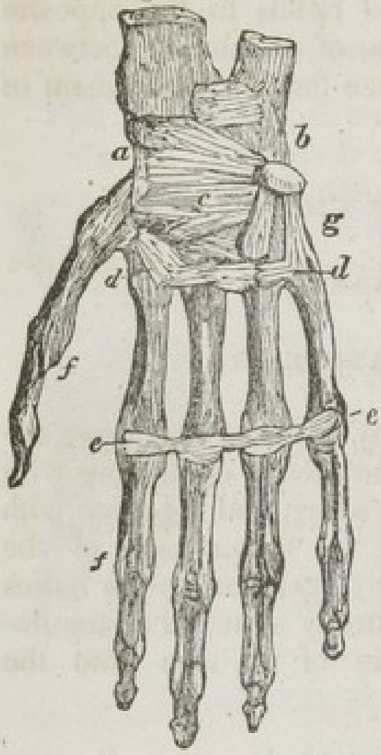
This ligament, *b*, extends from the styloid process of the ulna to the cuneiform bone and annular ligament of the carpus. There are other and more delicate fibres, termed the *anterior and posterior ligaments*, there is a *synovial membrane* for the whole articulation.

LIGAMENTS OF THE CARPUS.

LIGAMENTS OF THE FIRST ROW OF THE CARPAL BONES.

Fig. 100, *a*, *b*, *c*, *d*.

Fig. 100.



The three upper bones of the carpus are united together, 1st, by *interosseous ligaments* placed in the intervals between the scaphoid, semilunar, and cuneiform bones; 2d, by *dorsal ligaments* extending transversely, the one between the scaphoid and semilunar bones, the other between the latter and the cuneiform bone; 3d, by *palmar ligaments*, *c*, similar to the preceding. The pisiform bone is articulated to the cuneiform by a loose *capsular* or *synovial membrane*, strengthened by some irregular bands of fibres.

LIGAMENTS OF THE SECOND ROW OF THE CARPAL BONES.

These are united: 1st, by *dorsal* and *palmar ligaments*, three on either side, which extend inwards and backwards; and 2d, by *interosseous ligaments*; of these there are only two; both are irregular fasciculi, intermingled with adipose tissue.

LIGAMENTS OF THE TWO ROWS OF CARPAL BONES.

1st. There are two short lateral ligaments, the one *external*, the other *internal*. 2d. Two fibrous fasciculi, one in front, the other behind, termed the *anterior* and *posterior ligaments*; these last mentioned ligaments form a fibrous membrane, enveloping the whole carpus. 3d. There is also a synovial membrane which lines the surface, by means of which the two rows of the carpal bones are in contact. Lastly, we find at *g*, *two ligaments of the pisiform bone*, connecting it to the cuneiform bone and the metacarpal bone of the little finger.

THE ANNULAR LIGAMENT OF THE CARPUS.

The annular ligament is situated on a plane much anterior to that of the other ligaments of the carpus ; it is composed of strong and tense fibres, which are attached principally to the cuneiform bone internally, and the trepezium externally; near the latter, some of the fibres are also fixed into the scaphoid bone, and assist in completing the annular passage or channel in which the flexor tendons of the fingers pass, covering and confining them in their course.

LIGAMENTS OF THE HAND.

The metacarpal bones are very securely joined to the carpus, not only by their wedge-like surfaces, but also by strong ligaments.

CAPSULAR LIGAMENTS.

These ligaments are seen distinctly to surround the upper extremity of each metacarpal bone, and are inserted into the opposite bones of the carpus ; they are secured by *accessory bands*, which pass in various directions.

SUPERIOR TRANSVERSE LIGAMENTS.

These ligaments, *d*, *d*, extend across the upper extremities of the four metacarpal bones, and are attached to each of them.*

INFERIOR TRANSVERSE LIGAMENTS.

These ligaments, *e*, *e*, present exactly the same arrangement, connecting the inferior extremity of the four metacarpal bones with each other, not indeed so closely as at the upper end, for there is greater freedom of motion at the lower than at the upper part. The metacarpal bones are also united to each other by a strong transverse aponeurosis, which is connected with the sheath of the flexor tendons, and covers the tendons of the lumbricales and interossei muscles.

LIGAMENTS OF THE FINGERS.

The first phalanges or rows of the finger bones are attached to the metacarpal bones by loose but strong *capsular ligaments*, which are strengthened anteriorly by a *semicircular ligament* embracing the anterior part of each articulation, and posteriorly by the extensor ten-

* The *capsular ligament* is the only ligament which connects the trapezium with the metacarpal bone of the thumb. This joint, however, derives much strength from a number of small muscles around it, as well as by accessory bands.

dons, which expand very much while passing over these articulations; also at the sides by *lateral ligaments*, *f*, *f*, which are attached to slight depressions on the lower end of the metacarpal bones, and into the condyles of the first phalanx. Similar ligaments to these exist at the articulations of the finger bones with each other, viz., each joint has an anterior ligament, two lateral ligaments, and a capsular ligament or synovial membrane.

The flexor tendons also are confined in their course along the fingers by *circular* and *vaginal ligaments*. The former adhere on each side of the tendon to the proper ligaments of the joint, the latter inclose the flexor tendons of each finger in a strong sheath : each sheath is composed of circular fibres, and strengthened by oblique and cuneiform bands, and are attached on each side to the ridge which separates the anterior concave from the posterior or convex surface of each phalanx ; by this means the tendon is confined in the mesial line of the finger. All these sheaths are lined by a smooth synovial membrane.

CHAP. IX.

LIGAMENTS OF THE LOWER EXTREMITY.

ILIO-FEMORAL LIGAMENTS.

The hip joint has great freedom of motion, and requires powerful ligaments ; it is therefore furnished with a synovial membrane, a capsular ligament, an interarticular ligament, and a cotyloid ligament.

COTYLOID LIGAMENT.

This is a fibro-cartilaginous substance, attached to the whole circumference of the acetabulum, except at its internal and inferior part, where the bony part also of the margin is deficient ; it projects a considerable distance beyond the bone, so as to deepen the cavity very much.

There is another strong band of fibres situated at the lower and internal part of the acetabulum, where the last described ligament is deficient : it is attached to the pubis, where this bone forms the sinus over the obturator ligament, and into the ischium or inferior margin of the notch of the acetabulum : this ligament is superficial to the former, and between both, an oblique fissure is left for the passage of vessels to and from the cavity of the joint.

CAPSULAR LIGAMENT.

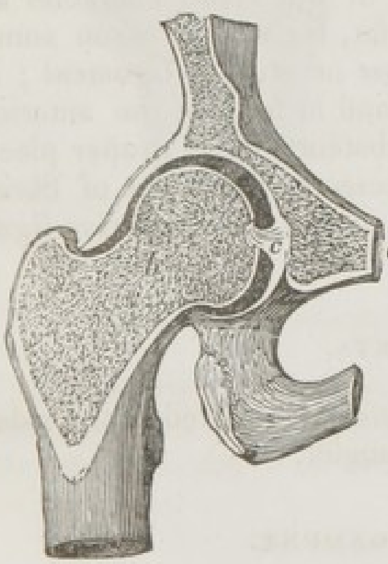
Fig. 101.

The capsular ligament, *o*, embraces the whole articulation of the hip. Excepting the capsular ligament of the knee, it surpasses all similar ligaments in strength, extent, and capacity : it is attached at a considerable distance from the margin of the cavity, particularly in front, where it extends as far as *d*, the inferior spine of the ilium ; inferiorly it is inserted into the femur, incloses the neck of that bone, and descends as far as *c*, the line which lies between the two trochanters. The *synovial membrane* does not descend so low as the external capsule, but is reflected on all sides towards the head of the bone ; in this course it is bound by folds, and immediately behind the head of the femur it is confined by circular bands. There is a fasciculus of fibres, *o*, taking an oblique course over the capsule towards the lesser trochanter, sometimes called the *accessory ligament* ; it adds strength to this part of the capsule.

INTERARTICULAR LIGAMENT.

Ligamentum teres.

Fig. 102.



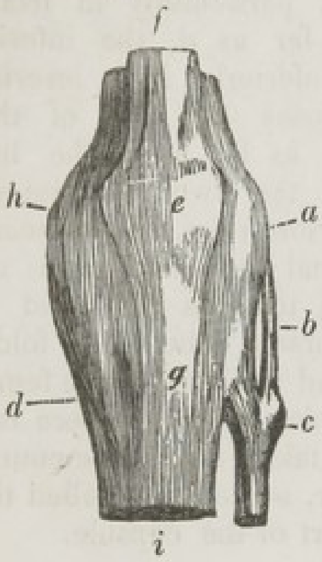
The interarticular ligament is a strong triangular fasciculus of fibres, perfectly concealed within the cavity of the acetabulum ; in the figure there is a section of the head and neck of the femur, *b*, and os innominatum, *e*, *e*, to show the attachments of *c*, this ligament, to the bottom of the acetabulum and to the head of the femur.

LIGAMENTS OF THE KNEE JOINT.

CAPSULAR LIGAMENT.

This ligament or membrane is of great extent, since the knee joint is the largest of the whole body; it is attached at *b*, *h*, *d*, to the whole circumference of the condyles of the femur; anteriorly to *e*, the patella; inferiorly to the tibia, and to the semilunar cartilages. Above the hollow for the reception of the patella it lines *f*, the tendon of the extensor muscles: it adheres also to the articular surface of the patella in such a manner, that this bone seems to form part of the capsule of the joint; lastly, it is reflected over the articular surface of *i*, the tibia, and ligaments within the joints. It is very loose on either side, but tense posteriorly, where it is closely connected with the flexor tendons and posterior crucial ligaments. These connexions, as well as the lateral ligaments, serve to confine this membrane in its situation, and to preserve it, in the motions of the joint, from being compressed between the bones.

Fig. 103.



This capsule of the knee, which in itself is very fine and weak, receives considerable strength from additional fibres, termed *accessory ligaments*. These appear like duplicatures of the capsule at the sides of the patella; they are also called *ligamentum alare, majus et minus*. There is a fold of the capsular membrane of the same character as those just described, but inclosing a little fat, for which reason some anatomists have given it the name of *adipose* or *mucous ligament*; it is situated very near the external condyle, and in front of the anterior crucial ligament; it retains the synovial substance in its proper place in the actions of the joint. Another accessory fasciculus of fibres covers the capsular membrane posteriorly, called the *posterior ligament of Winslow*.

LATERAL LIGAMENTS.

The lateral ligaments, as the name implies, are situated at the sides of the joint, and adhere to the capsular ligament.

EXTERNAL LATERAL LIGAMENT.

The external lateral ligament, Fig. 103, *a*, is a thick round chord, attached to a tubercle on the upper part of *b*, the external condyle of the femur; it is adherent to the semilunar cartilage on that side, and is inserted into *c*, the fibula, a little below its head.

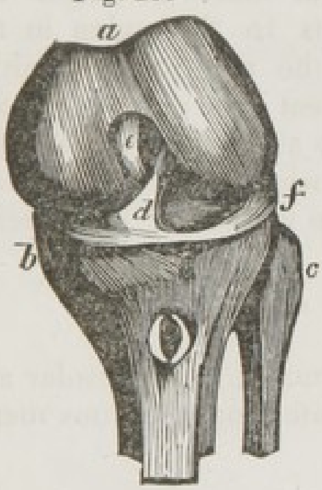
INTERNAL LATERAL LIGAMENT.

Fig. 104.

The internal lateral ligament, *a*, is attached superiorly to the internal condyle, inferiorly to the tibia, the fibres passing obliquely forward till they have reached the head of the bone, *b*, *c*, *d*, the ligament of the patella.

CRUCIAL LIGAMENTS.

Fig. 105



The crucial ligaments, *e*, *d*, are exposed in this figure by throwing down the patella, and removing the adipose substance ; they are very strong fibrous cords, crossing each other : hence their name.

ANTERIOR CRUCIAL LIGAMENT.

The anterior crucial ligament, *d*, is extended from the depression between the two condyles of the femur to the spine in the middle of the articular surface of the head of the tibia.

POSTERIOR CRUCIAL LIGAMENT.

The posterior crucial ligament, *e*, is also extended from the depression above named, to a groove behind the spine on the tibia. In Fig. 106, *a*, the crucial ligaments are separated from the femur, to show their direction and insertion into the head of the tibia.

The ligament of the patella, Fig, 103, *f*, *g*, is merely a continuation of the tendon of the extensor muscles of the leg, in the substance of which, *e*, the patella seems to be formed in a similar manner to the sesamoid bones. In Fig. 105, the patella is represented turned down over the head of the tibia ; *h*, a synovial bursa opened ; this is a remarkable bag, extremely loose, and plentifully supplied with synovia.

INTERARTICULAR OR SEMILUNAR CARTILAGES.

Fig. 105, *b*, *f*, Fig. 106, *b*, *c*.

These are two fibro-cartilages, placed between the condyles of the femur and the superior extremity of the tibia; they are of a crescent shape, flexible and elastic ; each of these cartilages is broad in the middle, and narrower at its extremities ; the outer convex edge is thick, the inner concave edge thin, thus rendering the cavities for the condyles of the femur deeper, and adapting the tibia more accurately to that bone. The extremities of these cartilages are fixed by ligaments to the spine in the centre of the articular surface of the tibia ; the anterior extremities are joined to each other by a transverse ligament ; the outer edges adhere to the capsular and the other ligaments, so as to allow a little play or slight motion upon the tibia, which by favoring the general motion of the joint, has been compared to the friction wheels of machinery.

Fig. 106.

LIGAMENTS BETWEEN THE TIBIA AND FIBULA.

The tibia and fibula are united at their extremities by capsular and other ligaments, and in the middle by an intervening fibrous membrane.

CAPSULAR LIGAMENT.

The capsular ligament of the upper end of the fibula is continuous with the periosteum ; some irregular fibres have been called *anterior* and *posterior ligaments*. This articulation is moreover secured by the external lateral ligaments of the knee, and by the tendon of the biceps flexor cruris, part of which passes from the fibula to the tibia.

INTEROSSEOUS LIGAMENT.

The interosseous ligament of the leg resembles that which is between the radius and ulna ; it is a thin aponeurotic membrane, composed of oblique fibres extended from the outer edge of the tibia to the inner edge of the fibula. This membrane presents several apertures for blood vessels.

LIGAMENTS OF THE LOWER END OF THE TIBIA AND FIBULA.

These ligaments are *anterior* and *posterior*, which may be divided into superior and inferior, according to their situations.

The *superior ligaments* are attached to the fibula and tibia, where these two bones are in contact: the anterior having a triangular form, the fibres being the shortest.

The *inferior ligaments* have the same direction as the superior; they are not so broad, but are thicker and longer; they both extend from the extreme point of the tibia to the lowest part of the external malleolus. These four ligaments connect the tibia and fibula so closely to one another, that they appear as one firm piece, whose base is supported by two projections called malleoli, between which the astragalus and os calcis, and of course the whole foot, are firmly secured.

LIGAMENTS OF THE A JOINT.

Strong ligaments pass from the malleoli to the bones of the tarsus; there is also a *capsular membrane* for the whole articulation.

LIGAMENTS BETWEEN THE FIBULA AND TARSUS.

The ligaments between the fibula and tarsus are three in number; the *anterior* passing from the point of the external malleolus forward to the upper part of the astragalus. The *middle* is a strong fasciculus of fibres, which descends perpendicularly from the lowest point of the fibula to the side of the os calcis. The *posterior* is concealed by the tendo Achillis: it passes from the external malleolus horizontally inwards, to the back part of the astragalus.

LIGAMENTS BETWEEN THE TIBIA AND TARSUS.

DELTOID OR TIBIO-TARSAL LIGAMENT.

Fig. 107.

This ligament, *b*, is an assemblage of fibres extending from the internal malleolus to the astragalus; inferiorly, its fibres diverge, and are attached to the os calcis, and by *c*, to the os naviculare.

CAPSULAR LIGAMENT.

The capsular ligament, *a*, *a*, is situated within the former ligaments; it covers the opposed surface of the bones which enter into the articulation, and is very loose : the synovial membrane which lines it contains a great quantity of synovia.

LIGAMENTS OF THE TARSUS.

The seven bones of the tarsus have a very limited motion between one another, or only such a degree of motion as gives pliancy and elasticity in walking, running, etc. They are united in a manner peculiarly strong, and well adapted to support the weight of the trunk in standing, or in the different motions of the body. See Fig. 107.

LIGAMENTS BETWEEN THE OS CALCIS AND ASTRAGALUS.

Fig. 108.

There is, 1st, a *capsular membrane*, *b*, *c*, connected to the edges of the articular surfaces of the two bones ; it is closely covered by the lateral ligaments of the ankle, and by the sheaths of the tendons ; 2d, an *interosseous ligament*, formed of a thick fasciculus of fibres, attached by one part to the groove which separates the surfaces of the astragalus, and by the other to that which is between the surfaces of the os calcis ; 3d, by a *posterior ligament*, composed of parallel fibres, *a*, inserted into the posterior part of the astragalus and into the adjacent part of the os calcis.

LIGAMENTS BETWEEN THE ASTRAGALUS AND OS NAVICULARE.

This articulation has considerable motion ; for the convex head of the astragalus is received into the cavity of the navicular bone, in which it is secured by a *capsular* and *accessory ligaments*.

LIGAMENTS BETWEEN THE OS CALCIS AND NAVICULARE.

We find two ligaments passing from one of these bones to the other ; they are also connected by a fibro-cartilaginous trochea, or *inferior ligament*, supporting the side of the head of the astragalus, and affording a passage for the tendon of the tibialis posticus muscle ; below this ligament there are two *external ligaments*, which proceed from the anterior internal part of the os calcis to the external inferior part of the os naviculare.

LIGAMENTS BETWEEN THE OS CALCIS AND OS CUBOIDES.

There is, 1st, a *superior ligament*, extending from the anterior part of the os calcis to the superior part of the os cuboides ; 2d, an *inferior ligament*, composed of a superficial and deep-seated fasciculus of fibres, passing from one bone to the other, and partly to the extremities of the third and fourth metatarsal bones ; 3d, a *capsular* or *synovial membrane*, covering the articular surfaces, and the two preceding ligaments.

LIGAMENTS BETWEEN THE NAVICULAR AND CUBOID BONES.

These bones are connected by a *dorsal ligament*, *l*, composed of transverse fibres, extending from the navicular to the cuboid bone ; by a *plantar ligament*, extending obliquely from the inferior part of one bone to the neighboring part of the other.

LIGAMENTS BETWEEN THE NAVICULAR AND CUNEIFORM BONES.

The three surfaces of the os naviculare are articulated with those of the three cuneiform bones, 1st by *three dorsal ligaments*, *g*, *i*, *k* ; 2d, by *three plantar ligaments*, similar to the preceding, extending from the inferior part of the os naviculare to the inferior surfaces of the three cuneiform bones ; 3d, by a *synovial membrane*, folded on the articular surfaces, and on the plantar and dorsal ligaments.

LIGAMENTS BETWEEN THE CUNEIFORM BONES.

The cuneiform bones are maintained in apposition by *synovial membranes* ; and by three *superior ligaments*, *e*, *f*, *k*, extending transversely over their superior surfaces ; and by *inferior ligaments*, similar to the preceding, but less distinct.

LIGAMENTS BETWEEN THE CUBOID AND EXTERNAL CUNEIFORM BONES.

The cuboid and external cuneiform bones are unifed together by strong ligamentous fasciculi, *h*, which pass from the edge of one bone to that of the other. The superior are termed *dorsal*, the inferior *plantar ligaments*.

LIGAMENTS OF THE TARSUS WITH THE METATARSUS.

The tarsal and metatarsal bones are articulated together in a similar manner to the carpus and metacarpus ; i. e. there are, 1st, *capsular* *membranes* ; 2d, *dorsal*, *m* ; 3d, *transverse ligaments*, *l*, each of the metatarsal bones receiving one from the tarsal bone with which it is connected ; 4th, *plantar ligaments :* these are equal in number to the preceding, and disposed nearly in the same manner.

LIGAMENTS OF THE METATARSAL BONES WITH EACH OTHER.

All the bones of the metatarsus, except the first, are articulated together at their posterior extremities by small cartilaginous surfaces, covered by prolongations of the capsular membranes of the preceding articulations, and maintained, 1st, by *dorsal* and *plantar ligaments ;* these extend transversely in each region from the second to the third, and from the third to the fourth, and from the fourth to the fifth metatarsal bones ; 2d, by *interosseous fibres*, found between the inarticulated points of the posterior extremities of these bones ; and 3d, by *transverse metatarsal ligaments*, *o*, situated at the anterior extremities of the metatarsal bones, and are in all respects similar to those I have described as belonging to the heads of the four last metacarpal bones.

LIGAMENTS OF THE METATARSUS WITH THE PHALANGES OF THE TOES.

The posterior extremities of the first phalanges are connected to the metatarsal bones at *n* by capsular and lateral ligaments.

LIGAMENTS OF THE PHALANGES OF THE TOES.

These ligaments are similar to those of the fingers.

The tendons of the foot also are provided with nearly the same *sheaths* and *ligaments* as those in the hand, for the purpose of confining them in their situation, and directing them in their proper course. The tendons which pass in front and at each side of the ankle joint, are firmly secured by ligaments and tendinous sheaths, which are attached to the adjacent bones ; anteriorly, the extensor tendons are bound down by a strong *annular ligament*, whose fibres take a circular direction.

The *plantar aponeurosis* is composed of strong ligamentous fibres, extending from the os calcis as far as the first phalanges of the toes, where it is lost in the tendinous sheaths. Each of the flexor tendons is confined by a strong *ligamentous sheath*, which is continued along the phalanges, in the same manner as in the hand ; each sheath is strengthened by *circular bands* at different situations. On the sides of each articulation of the phalanges with the metatarsus, a fascia is sent off from the extensor tendon ; it is composed of glistening fibres, which run towards the sole of the foot, and unite with the plantar aponeurosis ; these fasciæ are of important service in retaining the extensor tendons in their situation.

ART. IV.

CHAP. I.

MUSCULAR SYSTEM.

THE organs, which we distinguish by the term muscles, are composed of that substance which is commonly known by the name of flesh ; those, therefore, who have not seen the muscles of the human body, may form a very good idea of them by an examination of the flesh of quadrupeds.

The muscles are instruments or active agents in producing the various movements of our body ; by their means we are endued with the power of moving from place to place, and of performing every manual exercise or bodily exertion. Not only are they the prime moving powers in locomotion, but speech, singing, and the acts of chewing, swallowing, etc., are performed by them ; indeed, by means of these organs the blood is circulated, the stomach and intestines urge on their contents, and the different conduits of the glands propel their fluids.

The most characteristic property of muscles is *contractility* ; in whatever position our limbs may repose, it must be muscular contraction to produce their action. Muscular contractility is displayed in the amputation of a limb ; for immediately as soon as the muscles are divided, the two ends contract in opposite directions, leaving between them a space proportionate to the retraction of the muscles, which is more or less, according to the length of the muscular fibres.

This contractility of muscles constitutes muscular action, and consists in drawing the more movable towards the most fixed point to which it is connected. Every movable point in the animal frame is constantly situated beween two muscular powers opposed to each other ; between those of flexion and extension, of elevation and depression, of adduction and abduction, etc. ; this opposition is a condition essential to motion ; for in whatever direction the limb is to be moved, the *movable point* must necessarily be in the opposite direction ; the act of flexion requires that it should be first extended, and *vice versa*. But when flexors and extensors are both in a state of action, they counterbalance each other ; there is a rigid state of the muscles, and the limb is fixed. The effect of every muscle that contracts, is not only to act upon the bone into which it is implanted, but also on the opposite muscle, and this constitutes the phenomena of antagonist muscles ; the muscles are so situated that the one class cannot be extended without the other contracting, and reciprocally. I shall be pardoned if I give the familiar but clear explanation of PALEY in reference to antagonist muscles ;—" Every muscle is provided with an adversary. They act like two sawyers in a pit, by an opposite pull; the nature of the muscular fibre being what it is, the purposes of the animal could be answered by no other. And not only the capacity for motion, but the aspect and symmetry of the body, is preserved by the muscles being thus marshalled according to this order; e. g. the mouth is holden in the middle of the face, and its angles kept in a state of exact correspondency, by several muscles drawn against and balancing each other. In hemiplegia, when the muscles on one side of the face are weakened, the muscles on the other side draw the mouth awry."

The muscles on contracting, become evidently harder; they increase in thickness and decrease in length, but their volume remains nearly the same; what is lost in length is compensated in thickness. PREVOST and DUMAS describe their fibres, in a state of repose, as straight lines; but, when acting, all at once bending themselves in a waved direction, and presenting in an instant a great number of angular and regularly opposed undulations, thus, ; if the cause which led to the contraction ceases, the right lines of the fibres are restored with the same rapidity as the waved lines were produced.

This contractility, on which depend all the phenomena of animal motion, and which also promotes many of the exterior and interior functions, is exclusively seated in the muscular system. It possesses the faculty of moving under the influence of the brain, whether that influence be determined by the will or by other causes. If the brain of a man is compressed, the faculty of contracting the muscle ceases. The intensity of muscular contraction, that is, the degree of power with which the extremities of the fibres approximate, is in proportion to the excitement of the brain; it is generally regulated by the will, according to certain limits, which are different in different individuals. When the organization of the muscles is strongly fibrous, and they are of a deep red color, such muscles, with an equal power of the will, produce much more powerful efforts than muscles whose fibres are fine, pale, and smooth. The cerebral influence and the structure of the muscular tissue, therefore, are the two elements on which depends the intensity of muscular contraction.

Irritability of muscles, called by HALLER the *vis insita*, is the latent power inherent in the muscular fibres, producing that tremulous motion which is often felt in various parts of the body, without any evident cause, and independent of the will. It is to be distinguished from muscular contractility by being more permanent, and by occurring on the application of chemical or mechanical stimuli. A muscle may be separated from the limb, or the heart removed from the body, and for some time afterwards, on pricking it with a needle or passing the electric shock through it, there will be seen convulsive twitchings of its fibres. The irritability of a muscle is present after death; and, though doubtless a phenomenon worthy of study, is not to be confounded with the muscular contraction I have just described.

FORM OF THE MUSCLES.

The muscles, like the bones, with reference to their forms, may be divided into long, wide, and short muscles.

THE LONG MUSCLES.

These muscles are generally placed on the limbs, to the conformation of which they very much contribute. Separated from the skin by a strong membrane called aponeurosis, and from the bone by periosteum, they are contained in a fibrous envelope, which strictly maintains them in their respective situations, and in which they are disposed in layers more or less numerous. In proportion, however, as they are deeper seated they also become shorter ; they are separated by cellular layers, loose in parts in which extensive motions are performed, and tight wherever the motion is more confined. The long muscles are in some instances a single bundle of fibres, in others they result from an assemblage of many ; scarcely any of the fibres run the whole length of the fleshy mass ; in most of the muscles they are disposed in an oblique direction, between two aponeuroses, or between a tendon and an aponeurosis. Some muscles have tendinous intersections, which are placed at different distances in the course of the fibres.

THE WIDE MUSCLES.

These muscles are generally situated on the parietes of the cavities, especially on those of the chest and abdomen, whose parietes are chiefly formed by them ; they protect the internal organs, aid their functions, and move the body or limbs according as the one or the other is the fixed point. They have always short tendons.

The wide muscles are not very thick ; the greatest part of them representing muscular membranes, sometimes disposed in layers, as on the abdomen, at other times applied over the long muscles, as on the back. When the wide muscles are attached to, or are inserted into one of the great cavities, they preserve in all the parts nearly the same width ; but if from a cavity a muscle extends to a long bone, the fibres concentrate by degrees, grow narrower and thicker, and the muscle terminates in a tendon, and thus contracts into a narrow compass the fibres which are largely disseminated. The pectoral and great dorsal muscles are instances of this form and disposition.

THE SHORT MUSCLES.

These muscles are commonly met with in parts where considerable power on the one hand, and a limited extent of motion on the other, is required, as in the movements of the jaw, the hip, the thumb, and the foot ; and most of them have a square or triangular shape. Numerous muscles attached to the spine, as, the interspinales, recti, etc., display the form I am here describing. They are the most powerful of all the muscles, and are placed where great force is required, as at the articulation of the jaw, in the vertebral column, &c. Though the division of the muscles into long, wide, and short, is similar to that of the bones, and is generally applicable, yet it is liable to a multiplicity of modifications : since nature varies according to the functions which the organs are intended to perform.

There are further distinctive characters of muscles, viz., they are *simple* when the fibres have a parrallel direction, as the sartorius or the quadratus lumborum ; if they proceed from an extended surface, and converge to a small tendon, they are termed *radiated*, as the temporal muscle. When the tendon occupies the middle of the muscle, and the fibres are placed obliquely to the tendon like a feather, the muscle is named *penniform*, as the rectus femoris ; where the muscular fibres are placed on one side of the tendon, it is called *half-penniform*, as the peroneus longus. In the *compound* muscles there is a single mass of muscular fibres and several tendons, like the flexors of the fingers, or there are several muscular and tendinous portions, as in the sacro-lumbalis, etc. Sometimes the bundles of the fibres and tendons are variously and often intricately woven, as in the lingual muscles.

VOLUNTARY, INVOLUNTARY, AND MIXED MUSCLES.

The division of the muscles into voluntary and involuntary is sufficiently accurate to convey a distinct idea of the two classes of exciting causes. In ordinary circumstances those under the influence of the will must be *voluntary muscles*, such as the muscles of locomotion. But there are other muscles over which the will has no dominion : the vital organs, the heart, stomach, and intestines, afford examples of this description, and are brought forward by writers on natural theology as marks of the Divine wisdom ; for were the actions of these organs within the control of the will, and the vital function left to man's government, I need not say they would be subject to a thousand interruptions ; these organs, therefore, are furnished with *involuntary muscles*. There is another class of muscles, which are termed *mixed*, as the diaphragm and other muscles of respiration, the orbicularis oculi, etc. ; of the action of these muscles we are not sensible, unless the attention of the mind be directed to them ; yet we have the power of increasing or suspending their action for a certain length of time.

TEXTURE OF MUSCLES.

The muscular or fleshy fibres are soft, red, downy, linear, and possess a small degree of elasticity ; they retain little tenacity in the dead body, and are easily torn asunder, but during life they resist very great force without breaking. A muscle is composed of a number of muscular *fasciculi*, which are formed of fibres still smaller ; these result from fibres of less volume ; at least, by progressive division, we arrive at a fibre no longer practically divisible, but which were our means of division more perfect, possibly might be reduced to such a degree of tenuity as to elude even the microscope. However, the last of these filaments which can be perceived is the *muscular fibre*. Numberless researches have been made to determine with certainty the volume of this fibre ; I need not mention the result of these researches : the correctness cannot be relied on, and the investigation could add nothing to our notions respecting muscular motion.

Every muscular fibre runs its extent without ramifying ; it is merely in juxta-position with the adjoining ones. The intimate nature of this fibre upon which so much has been written, is still unknown to us. PROHASKA* found the muscular fibre $\frac{1}{4000}$ part of an inch in diameter, while Mr. BAUER† estimates it at only $\frac{1}{2000}$. The latter describes the fibres as moniliform, that is, consisting of globules lineally and closely arranged, like the beads of a necklace. Sir E. HOME is inclined to consider these globules to be the remains of the globules of the blood from which they have originated, an opinion which the facts of the case by no means warrant ; and all that has been affirmed respecting the continuation of the muscular fibre with the nervous or vascular organs, is supported by no positive proofs, and is unworthy of claiming a moment's attention. "To arrive at correct conclusions, we must study nature where she comes within the cognizance of our senses."‡

CELLULAR TISSUE OF MUSCLES.

The fibres of muscles are united by this substance ; it is one of the most important elements of the animal system, consisting of very minute, soft, white filaments, crossing each other in a multitude of different directions, and leaving between them certain interstices which serve for the reception of fat. The muscles are abundantly supplied with this cellular web ; it forms a very considerable layer round every muscle ; it is most generally loose or filled with fat ; sometimes it is tighter, and actually spread in the form of a membrane, and then the dissection becomes difficult for the young student. Besides affording this general covering to the muscles, it extends into the substance of these organs themselves, and largely contributes to their structure ; each fasciculus is provided with a continuation of sheaths of cellular tissue, and not only surrounds and binds the muscles together, but also unites each of their fibres with those adjoining. These coverings accommodate the motions of the fibres, which they separate from each other, either by the fat which they contain, or by the serum of the cellulæ.

The quantity of intermuscular cellular tissue varies very considerably ; sometimes it is so abundant among the muscles as to divide

* Operum minorum pars i. p. 198.
† Phil. Trans. 1818. p. 175.
‡ Bichat.

them into separate portions, and consequently has confused anatomists in the division of these organs.*

BLOOD-VESSELS OF MUSCLES.

With the exception of certain viscera, as the lungs, liver, spleen, etc., few organs, in proportion to their size, receive more blood than the muscles ; the blood being essentially necessary to keep up excitement, and by this fluid the human muscles are colored. The arteries are exceedingly apparent ; they penetrate their substance from all points of their surface. The principal branches creep at first between the largest fasciculi of fibres ; then they divide and subdivide into an almost infinite number of ramifications, which, reduced to capillary tubes, supply the secondary skeins, twine among the most minute fibres, and deposite the nutritive substance of the muscle.

The veins of muscles constantly attend the arteries, but surpass them, as they do in all other parts of the body, in number and magnitude.

The absorbent vessels may be traced, but not without difficulty. They are most readily injected in the muscles of the face, the tongue, and the diaphragm.

NERVES OF MUSCLES.

The muscles are liberally endowed with nerves ; indeed, excepting the skin and organs of sense, no part of the body is so abundantly supplied with them. Each branch, on reaching the fleshy fibres, first divides, then subdivides in the interstices, until it entirely disappears. Dr. Monro thought that each individual fibre had its corresponding nervous filament ; and the observation of Bichat may induce one to believe it, namely, that on the principal nervous branch being irritated, every fibre of the muscle comes into play.

TENDONS OF MUSCLES.

The tendons are a part of the muscle : they are a kind of fibrous cord, conducting the motions of the muscle to the bone, particularly where there is not room for the insertion of the muscular fibres which are necessary for the motion of the joints ; they frequently concentrate the whole power of a very large muscle on a small bony surface ; indeed, without such a medium of attachment, the articulations would be encumbered in their actions. The tendons are composed of small white fibres, closely united to each other, having a beautiful shining silvery appearance ; they differ from the ligaments chiefly in this particular, that one of their extremities is attached to the muscle.

* In consequence of these cellular intersections, some authors have divided the deltoid muscle into three distinct muscles. As another instance, I may mention also the pectoralis major, which is thus divided into a clavicular and sternal portion.

Tendons possess very little elasticity or sensibility ; they have few blood-vessels, in fact none are observed in their ordinary state ; nor have nerves or lymphatics been traced into them.

Some muscles form a complete circle, and have no tendinous structure, and are termed *sphincters*.

Usually the tendons are at the extremities of muscles, but sometimes are found in the middle, as in the digastric muscles, the diaphragm, omo-hyoideus, &c.

APONEUROSIS.

Aponeuroses are precisely similar to tendons ; frequently they seem to result from the expansion of a tendon. They may be divided into two classes ; 1st, *Aponeuroses of insertions*, those fibrous expansions which receive fleshy fibres, so as to afford the greatest advantage in multiplying prodigiously the points of insertion, without increasing the extent of bony surface, as the tensor vaginæ femoris ; others collect the muscular power into a line of attachment, as in the oblique and transverse muscles of the abdomen. 2d, *Enveloping aponeuroses* ; these are found around the limbs where they maintain the muscles in their respective situations, so that in great exertions, the muscles are not liable to displacement ; their inner surfaces often send fibrous partitions between the muscles which extend to the periosteum of the neighboring bone ; and at the same that they retain the muscular fibres in their situation, give points for their insertion. Like the tendons, their hue is of a resplendent white ; in a healthy state they have little vascularity, and may be considered as destitute of sensibility.

CHEMICAL COMPOSITION OF MUSCLES.

Owing to the difficulty of separating the muscular fibres from the fat, blood, cellular membrane, etc., with which they are very intimately blended, the organic elements of the muscular tissue are still involved in obscurity ; but when freed as much as possible from those substances which adhere to them, they consist of albumen, a great quantity of fibrin, and a principle of a peculiar nature, colored, soluble in alcohol, giving to broth its taste and smell, name *osmazome*. There also occur in these organs a coloring matter, carbonate, hydrochlorate, and phosphate of soda, phosphate of lime, and oxide of iron.

SHEATHS OF TENDONS.

In general these sheaths form a semi-cylindrical canal, completed by the bone in the opposite part in such a manner, that the tendon slides in a canal, which is partly bony and partly fibrous ; this canal is lined with a synovial membrane. On their external surfaces the fibrous sheaths correspond to the adjacent parts, with which they are united, and adhere to them by loose cellular tissue. All the sheaths are composed of dense and strong fibres ; indeed, stronger than might be supposed to be sufficient to restrain the efforts of the tendons that act upon them ; the tendons are thus kept down in their proper places, and are prevented from deviating from their destined course. Some of these sheaths, as those at the wrist and on the instep, contain the united tendons of several muscles : these bear the name of *annular ligaments* ; the tendons of the hand and foot having to pass a narrow space, it was indispensably necessary they should be there maintained. Other sheaths, as those of the fingers, are intended for a single tendon, or for two only. Besides these uses, the sheaths in some cases change the direction of the tendon, as we observe in the trochlea of the eye, and the sheaths of the tendons of the thumb and little finger.

STRENGTH OF MUSCLES.

The natural strength of muscles probably depends on the number of fibres which enter into their composition ; but the effect of habit and exercise of the muscles in giving strength, mobility, and dexterity, is astonishing. The muscles grow stronger in proportion as they are used, provided they are well used, and not exhausted by violence or over exertion ; but the same muscles in different individuals, though of the same length and thickness, and, as far as we are able to examine, composed of the same number of fibres, are by no means uniform in the degree of power they are capable of exercising. Under particular excitement the muscular efforts may be carried to a wonderful degree ; we know the strength of an enraged person, of maniacs, and of persons in convulsions ; but such violent contractions cannot be carried beyond a certain time, after which a painful feeling of weariness takes place, which goes on increasing until the muscle refuses to act : by rest, however, the feeling of fatigue subsides, and the muscles recover their wonted energies. If, however, the brain of a man be compressed, the faculty of contracting the muscle ceases ; the nerve of a muscle being cut, the muscle loses all power of contracting, thus showing that muscular action depends on the brain, and that it is generally regulated, to a certain degree, by the will.*

ACTIONS OF MUSCLES.

Many muscles acting together, producing the same kind of motion, are called *congeneres ;* those which act in the opposite direction are termed *antagonistes.* The first ordinarily arise from the same fixed point or from the same region, the second or antagonists from the opposite.

* "There are many muscles given to us, which the common customs and habits of life seldom render it necessary to exert, and which, in consequence, grow stiff and immovable. Tumblers and buffoons seem to be aware of this fact ; and it is principally by the cultivation of these neglected muscles, that they are able to assume those outrageous postures and grimaces, and exhibit those feats of agility, which so often amuse and surprise us." — *Dr. Good's Book of Nature.*

The various movements produced by the contraction of muscles are, *adduction* and *abduction*, *flexion* and *extension*, and *rotation*, etc. These various motions are not usually effected by the action of one muscle alone, but by the co-operation of several congeneres.

The flexors are commonly stronger than the extensors, and it is for this reason, that when the extremities are at rest, or in a state of freedom, or in paralysis, or during sleep, that they are bent or slightly flexed. And the flexors are attached further from the centre of motion than the extensors, and their direction is less parallel to the bone; consequently the angle is more open, and the power more favorably applied.

NOMENCLATURE OF THE MUSCLES.

The denomination of the muscles is derived from several considerations, as, viz., from their

Size, as great, small, long, broad, thin;

Figure, as triangular, scalenus, deltoid, orbicular, rhomboidal, etc.;

Direction, as straight, oblique, transverse;

Composition, as complexus, triceps, biceps, semimembranosus, perforans, etc.;

Attachment, as stylo-hyoideus, pterygoideus, sterno-cleido-mastoideus;

Uses, as flexors, adductors, rotators, etc.

The inconvenience from such a multiplicity of names from such different sources, has long been felt among anatomists, and many nomenclatures have been suggested to remove it. All the synonyms of muscles may be found in Lizar's System of Anatomy.

CLASSIFICATION OF THE MUSCLES.

The muscles have been distributed into classes, according to the different parts of the body which they occupy; each of these parts has received the name of *region*. The following table presents a general view of the names and classification.

CHAP. II.

TABLE OF THE MUSCLES.

The total number of the muscles amounts to 527, of which 257 are pairs, and lie on either side of the body. There are four single muscles situated on the middle line, independent of those muscles which perform the internal vital functions.

MUSCLES OF THE HEAD.

Region	Muscles
1. Cranial region.	Occipito-frontalis.
2. Auricular region.	Attollens auris. Attrahens auris. Retrahens auris.

MUSCLES OF THE FACE.

Region	Muscles
1. Palpebral region.	Orbicularis palpebrarum. Corrugator supercilii. Levator palpebræ superioris.
2. Ocular region.	Rectus superior. Rectus inferior. Rectus internus. Rectus externus. Obliquus superior. Obliquus inferior.
3. Nasal region.	Pyramidalis nasi. Compressor nasi. Levator labii superioris, alæque nasi. Depressor alæ nasi.
4. Superior maxillary region.	Levator labii superioris. Levator anguli oris. Zygomaticus major. Zygomaticus minor. Orbicularis oris.
5. Inferior maxillary region.	Depressor anguli oris. Depressor labii superioris. Depressor labii inferioris. Buccinator. Levator menti. Masseter.
6. Temporo-maxillary region.	Temporalis.
7. Pterygo-maxillary region.	Pterygoideus externus. Pterygoideus internus.
8. Lingual region.	Hyo-glossus. Genio-glossus. Stylo-glossus. Lingualis.
9. Palatine region.	Circumflexus palati. Levator palati. Levator uvulæ. Palato-pharyngeus. Constrictor isthmi faucium.

MUSCLES OF THE NECK.

Region	Muscles
1. Anterior cervical region.	Platysma myoides. Sterno-cleido-mastoideus.
2. Superior hyoidean region.	Digastricus. Stylo-hyoideus. Mylo-hyoideus. Genio-hyoideus.
3. Inferior hyoidean region.	Omo-hyoideus. Sterno-hyoideus. Sterno-thyroideus. Thyro-hyoideus. Crico-thyroideus.
4. Pharyngeal region.	Constrictor pharyngis inferior. Constrictor pharyngis medius. Constrictor pharyngis superior. Stylo-pharyngeus.
5. Region of the glottis.	Crico-arytænoideus posticus. Crico-arytænoideus lateralis. Thyreo-arytænoideus. Arytænoideus obliquus. Arytænoideus transversus. Thyreo-epiglottideus. Arytæno-epiglottideus.
6. Deep cervical region.	Rectus capitis anticus major. Rectus capitis anticus minor. Longus colli.
7. Lateral cervical region.	Scalenus anticus. Scalenus medius. Scalenus posticus. Rectus capitis lateralis.

MUSCLES OF THE TRUNK.

Region	Muscles
1. Anterior thoracic region.	Pectoralis major. Pectoralis minor. Subclavius.
2. Lateral thoracic region.	Serratus magnus.
3. Intercostal region.	Intercostales externi. Intercostales interni. Triangulares sterni. Levatores costarum.
4. Diaphragmatic region.	Diaphragma.

MUSCLES OF THE ABDOMEN.

Region	Muscles
1. Abdominal region.	Obliquus abdominis externus. Obliquus abdominis internus. Transversalis abdominis. Rectus abdominis. Pyramidalis.
2. Lumbar region.	Psoas magnus. Psoas parvus. Iliacus internus. Quadratus lumborum.
3. Anal region.	Levator ani. Coccygeus. Sphincter ani.
4. Genital region.	1st. (In the male.) Cremaster. Erector penis. Bulbo-cavernosus. Transversus perinæi. 2nd. (In the female.) Erector clitoridis. Constrictor vaginæ.

MUSCLES OF THE POSTERIOR PART OF THE TRUNK.

Region	Muscles
1. Lumbo-dorsal region.	Trapezius. Latissimus dorsi.
2. Dorso-cervical region.	Rhomboideus. Levator anguli scapulæ. Serratus posticus superior. Serratus posticus inferior. Splenius. Complexus. Trachelo-mastoideus.
3. Posterior occipito-cervical region.	Rectus capitis posticus major. Rectus capitis posticus minor. Obliquus capitis superior. Obliquus capitis inferior. Interspinalis cervicis.
4. Vertebral region.	Longissimus dorsi. Sacro-lumbalis. Transversus colli. Multifidus spinæ. Intertransversales colli et lumborum.

MUSCLES OF THE SHOULDER.

Region	Muscles
1. Posterior scapular region.	Supra-spinatus. Infra-spinatus. Teres minor. Teres major.
2. Anterior scapular region.	Subscapularis.
3. External scapular region.	Deltoides.

MUSCLES OF THE ARM.

Region	Muscles
1. Anterior brachial region.	Coraco-brachialis. Biceps flexor cubiti. Brachialis internus.
2. Posterior brachial region.	Triceps extensor cubiti.

MUSCLES OF THE FORE-ARM.

Region	Muscles
1. Anterior region of the fore-arm.	Pronator radii teres. Flexor carpi radialis. Palmaris longus. Flexor carpi ulnaris. Flexor digitorum sublimis vel perforatus. Supinator radii longus.
2. Anterior deep region of the fore-arm.	Flexor digitorum profundus vel perforans. Flexor longus pollicis manus. Pronator radii quadratus.

- 3. Posterior superficial region of the fore-arm.
  - Extensor carpi radialis longior.
  - Extensor carpi radialis brevior.
  - Extensor digitorum communis.
  - Extensor proprius minimi digiti.
  - Extensor carpi ulnaris.
  - Supinator radii brevis.
  - Anconeus.
- 4. Posterior deep region of the fore-arm.
  - Extensor ossis metacarpi pollicis manus.
  - Extensor primi et secundi internodii pollicis manus.
  - Indicator.
- 5. Radial region.
  - Supinator radii longus.
  - Supinator radii brevis.
  - Extensor carpi radialis longior.
  - Extensor carpi radialis brevior.

MUSCLES OF THE HAND.

- 1. External palmar region.
  - Abductor brevis pollicis manus.
  - Opponens pollicis.
  - Flexor brevis pollicis manus.
  - Abductor pollicis manus.
- 2. Internal palmar region.
  - Palmaris brevis.
  - Abductor minimi digiti.
  - Flexor proprius minimi digiti.
  - Adductor ossis metacarpi minimi digiti.
  - Lumbricales.
- 3. Middle palmar region.
  - Interossei.
    1. Abductor indicis.
    2. Adductor indicis.
    3. Abductor digiti medii.
    4. Adductor digiti medii.
    5. Abductor digiti annularis.
    6. Adductor digiti annularis.
    7. Abductor minimi digiti.

MUSCLES OF THE HAUNCH AND THIGH.

- 1. Region of the hip.
  - Gluteus maximus.
  - Gluteus medius.
  - Gluteus minimus.
- 2. Pelvi-trochantric region.
  - Pyriformis.
  - Obturator internus.
  - Obturator externus.
  - Gemellus superior.
  - Gemellus inferior.
  - Quadratus femoris.
- 3. Anterior femoral region.
  - Tensor vaginæ femoris.
  - Sartorius.
  - Rectus femoris.
  - Triceps extensor cruris.
    - Vastus externus.
    - Vastus internus.
    - Cruralis.
- 4. Internal femoral region.
  - Pectineus.
  - Gracilis.
  - Adductor longus.
  - Adductor brevis.
  - Adductor magnus.
- 5. Posterior femoral region.
  - Biceps femoris.
  - Semitendinosus.
  - Semimembranosus.

MUSCLES OF THE LEG.

- 1. Anterior region of the leg.
  - Tibialis anticus.
  - Peroneus tertius.
  - Extensor longus digitorum pedis.
  - Extensor proprius pollicis pedis.
- 2. Peroneal region.
  - Peroneus longus.
  - Peroneus brevis.
  - Peroneus tertius.
- 3. Posterior region of the leg.
  - Gastrocnemius externus.
  - Gastrocnemius internus.
  - Soleus.
  - Plantaris.
  - Popliteus.
  - Flexor longus digitorum pedis.
  - Tibialis posticus.
  - Flexor longus pollicis pedis.

MUSCLES OF THE FOOT.

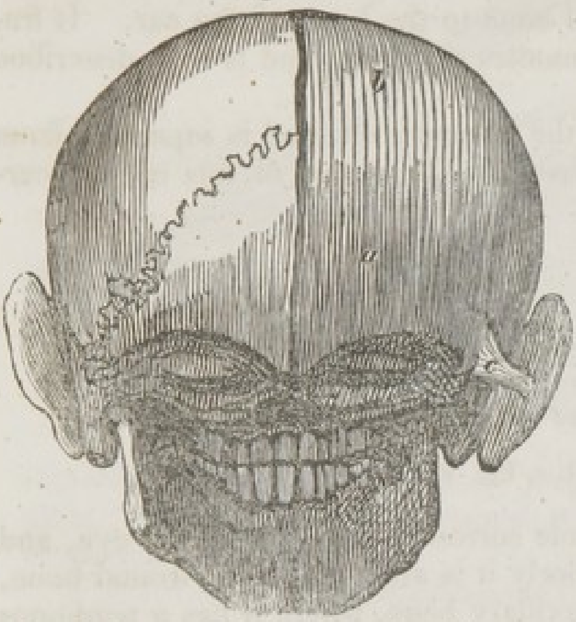
- 1. Dorsal region.
  - Extensor brevis digitorum pedis.
  - Interossei externi.
- 2. Plantar region.
  - Flexor brevis digitorum pedis.
  - Abductor pollicis pedis.
  - Abductor minimi digiti pedis.
  - Flexor digitorum accessorius.
  - Lumbricalis pedis.
  - Flexor brevis pollicis pedis.
  - Adductor pollicis pedis.
  - Flexor brevis minimi digiti pedis.
  - Transversus pedis.
  - Interossei interni.

MUSCLES OF THE HEAD.

CRANIAL REGION.

OCCIPITO-FRONTALIS.

Fig. 109.



This is the only muscle which properly belongs to the scalp ; it consists of two distinct parts, an anterior and a posterior, which are united by an aponeurosis or tendinous membrane. The posterior portion, *a*, has an aponeurotic and fleshy attachment to the transverse ridge of the occipital bone ; it forms, *b*, the cranial aponeurosis, a broad fibrous expansion which covers the whole upper part of the cranium : the anterior portion, seen in Fig. 111, *a*, is attached to *c*, the circular muscle of the eyelid, and to the skin ; and by *b*, to the inner angle of the frontal bone, and the os nasi. The *outer surface* of this muscle is covered by the integuments, the *inner* rests on the cranium.

The anterior portion of this muscle raises the brow, wrinkles the forehead, and brings forward the integuments of the head ; the posterior draws back the skin to its original situation. The direction of the muscular fibres and the aponeurosis are also seen, Fig. 112, *a*, *b*.*

AURICULAR REGION.

ATTOLLENS AURIS.

Fig. 112. The attollens auris, *c*, is of a triangular figure, situated on the temple above the ear ; superiorly it is attached to the cranial aponeurosis, and inferiorly to the cartilage of the ear. The *outer surface* of this muscle is covered by the skin, the *inner* covers the temporal aponeurosis.

The action of this muscle raises the ear.

ATTRAHENS AURIS.

The attrahens auris, *d*, is situated before the ear, and has the same form as the preceding ; anteriorly it is attached to the border of the cranial aponeurosis, and posteriorly to the cartilage or anterior helix of the ear.

* This is sometimes divided by anatomists into two muscles, the *occipital* and *frontal* muscles.

This muscle draws the ear forward and upward. The *outer surface* of this muscle is covered by the skin ; the *inner* is situated upon the temporal muscle and temporal artery.

RETRAHENS AURIS.

This muscle, *e*, is situated behind the ear, and is extended from the mastoid process of the temporal bone to the back of the ear. It frequently consists of two small bundles of fibres, and is then described as two muscles.

This muscle is covered by the integuments, and is separated from the temporal bone by cellular tissue. The action of this muscle carries the ear backwards.*

MUSCLES OF THE FACE.

PALPEBRAL REGION.

ORBICULARIS PALPEBRARUM.

Fig. 111, *c*, Fig 112, *f*.

The fleshy fibres of this muscle surround the orbit of the eye, and form part of the eyelids ; superiorly it is attached to the frontal bone, and inferiorly to the superior maxillary bone, where it has a tendinous point of insertion into the nasal process.

The *anterior surface* of this muscle is covered by the integuments ; the *posterior* is applied upon the corrugator supercilii, the fibro-cartilage of the upper eyelid, the malar bone, the muscles of the superior maxillary region, the ligament and fibro-cartilage of the lower eyelid, the ascending process of the superior maxillary bone, and the lachrymal sack.

This muscle shuts the eye, by bringing down the upper eyelid and raising the lower, the fibres contracting towards the inner angle ; it also depresses the eyebrow at the sume time it raises the cheek.

CORRUGATOR SUPERCILII.

Fig. 111.

This muscle, *p*, is placed on the arch of the orbit, in the thickness of the eyebrow ; it is attached on the one part to the superciliary ridge, and on the other to the occipito-frontalis and orbicularis muscles.

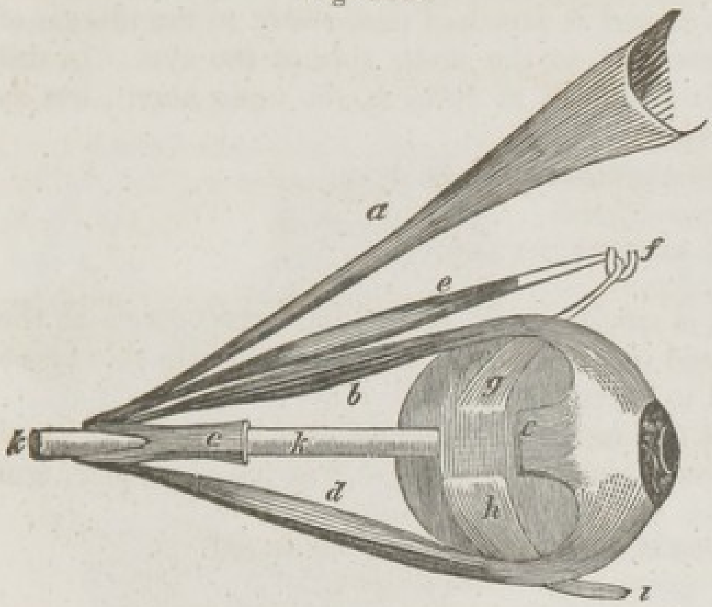
The *anterior surface* of this muscle is covered by the orbicularis palpebrarum, the occipito-frontalis, and the pyramidalis nasi muscles ; the *posterior* is in contact with the frontal bone, the superciliary artery, and the frontal branch of the ophthalmic nerve.

This muscle draws down the brow in the expressions of anger and the malevolent passions.

* The other muscles of the ear will be described with the organ of hearing.

LEVATOR PALPEBRÆ SUPERIORIS.

Fig. 110.



This muscle, *a*, is situated in the superior part of the orbit, and is fixed to the bottom of it; it is then spread out into a broad tendon, which is attached to the cartilage of the upper eyelid, as is seen also in Fig. 111, *n*.

The *superior surface* of this muscle is connected with the orbit and frontal branch of the ophthalmic nerve; and anteriorly it is separated from the orbicularis palpebrarum by the palpebral ligament; the *inferior* is connected with the rectus superior and membrana conjunctiva.

The action of this muscle raises the upper eyelid.

OCULAR REGION.

RECTUS SUPERIOR.

Fig. 110.

This muscle, *b*, is situated in the orbit above the eye, under the levator palpebræ; it is broad and thin, tendinous at its extremities, and fleshy in the rest of its extent. Posteriorly it is attached to the optic foramen, and anteriorly to the membrana sclerotica.

The *superior surface* of this muscle is covered by the preceding; the *inferior* is placed upon the optic nerve, the ophthalmic artery, and the nasal branch of the ophthalmic nerve, in front upon the eye itself.

The action of this muscle raises the eye.

RECTUS INFERIOR.

The figure and structure of *d*, the rectus inferior, is like the preceding; posteriorly it is attached to the inferior part of the optic foramen, and anteriorly to the sclerotic membrane.

The *inferior surface* of this muscle is separated from the floor of the orbit by adipose tissue; the superior is in connexion with the optic nerve, a branch of the third pair of nerves, and the eye.

This muscle is the antagonist of the rectus superior, and draws the eye downwards.

13

RECTUS INTERNUS.

This muscle, *c*, *c*, is similar to the two described; it is situated on the inner side of the eye, and is attached posteriorly to the margin of the optic foramen; anteriorly, to the inner side of the eye. In this figure the central part is removed to show *k*, the optic nerve, but its attachments are preserved.

This muscle draws the eye towards the nose.

RECTUS EXTERNUS.

The rectus externus is similar in its figure and attachments to the other recti, but is situated on the outer side of the eye. In this figure the muscle is supposed to be removed.

The *outer surface* of this muscle is in apposition with the orbit and lachrymal gland; the *inner* with the optic nerve, the sixth pair, and the lenticular ganglion.

The office of this muscle is to carry the eye outward.

OBLIQUUS SUPERIOR.

This muscle, *e*, is situated at the internal and superior part of the orbit; posteriorly it is attached to the optic foramen, passes forward horizontally to the internal orbitar process, where it forms a thin, round tendon, which passes through *f*, a cartilaginous ring;* runs obliquely downwards and backwards, and is inferiorly attached at *g*, by a radiated tendon, to the globe of the eye. On the inside of the pulley or ring is a synovial capsule, which is reflected over the tendon.

This muscle is situated between the orbit and the optic nerve, the superior and internal recti muscles, and the globe of the eye.

The office of this muscle is to roll the eye, and to turn the pupil downwards and outwards.

OBLIQUUS INFERIOR.

This muscle is situated at the anterior part of the orbit. Anteriorly it is attached at *i*, the inner edge of the orbitar process of the superior maxillary bone, near its union with the os unguis; it is directed backwards and outwards, under *d*, the rectus inferior, and is attached posteriorly by *h*, a thin tendon to the sclerotic membrane.

The *inferior surface* of this muscle is placed on the floor of the orbit; the *superior* corresponds with the ball of the eye, and with the rectus inferior.

By means of the inferior oblique muscle the eye is turned upwards and inwards.

* At least this loop forms a ring with the superciliary notch.

NASAL REGION.

PYRAMIDALIS NASI.

Fig. 111.

This muscle, *b*, is confounded with the occipito-frontalis ; its figure is thin and triangular ; it is attached by its summit to the last named muscle, covers the nasal bones, and is fixed by its base to the compressor nasi. This muscle is sometimes regarded as merely a portion of the frontal muscle ; the upper part is certainly intermixed with it, but the lower part is very distinct.

The *anterior surface* is connected with the skin ; the *posterior* with the corrugator supercilii, the os frontis, and the proper bones of the nose.

This muscle assists in bringing down the integuments of the forehead, and raising the skin of the nose.

COMPRESSOR NASI.

Fig. 112.

This muscle, Fig. 111, *o*, Fig. 112, *h*, is attached on the outer side of the cartilage of the nose to the adjacent part of the bridge of the nose, where it meets its fellow.

The *anterior surface* is covered by the skin, the *posterior* lies upon the superior maxillary bone and upon the lateral cartilage of the nose.

This muscle compresses the nostrils ; it sometimes acts with the pyramidal and frontal muscles, to which it is connected, and then it raises the nostril.

LEVATOR LABII SUPERIORIS ALÆQUE NASI.

This muscle, Fig. 112, *i*, is attached by a small tendon to the nasal process of the superior maxillary bone, close by the tendon of the orbicular muscle of the eyelids ; as it approaches the nose it is spread out into two portions, one of which is inserted into the ala or cartilage of the nostril, the other into the upper lip.

The *anterior surface* is placed beneath the skin, and at its upper part it is concealed by the orbicularis palpebrarum. The *posterior* is connected with the preceding muscle, the nasal process of the superior maxillary bone, the border of the levator labii superioris, and the depressor nasi.

This muscle raises the ala of the nostril and the upper lip.

DEPRESSOR ALÆ NASI.

This muscle, Fig. 113, *e*, is a small fleshy fasciculus, placed beneath the ala or wing of the nose. Superiorly it is attached to it ; inferiorly to the superior maxillary bone immediately above the upper incisor teeth.

The fibres of this muscle are covered by those of the levator labii superioris alæque nasi, and by the mucous membrane of the mouth, and are applied to the superior maxillary bone.

The contraction of this muscle depresses the ala of the nose.

SUPERIOR MAXILLARY REGION.

LEVATOR LABII SUPERIORIS.

This muscle, Fig. 112, *k*, is situated in the middle of the face ; superiorly it is attached to the lower part of the orbit, inferiorly to the upper lip ; it contracts as it descends, and its fibres are confounded with the circular muscle of the lips, between the nose and angle of the mouth. At the *upper part*, this muscle is covered by the orbicularis palpebrarum, and at the *lower part* by the skin. The *posterior surface* is in connexion with the levator anguli oris, from which it is separated by the infra-orbitar vessels and nerves.

LEVATOR ANGULI ORIS.

This muscle, Fig. 112, *l*, is situated near the middle of the face ; superiorly it is attached to the canine fossa ; inferiorly to the angle of the mouth.

The *anterior surface* is connected, as we see in the figure, with other muscles of the face ; *the posterior surface* with the canine fossa, the mucous membrane of the mouth, and the buccinator muscle.

This muscle raises the angle of the mouth.

ZYGOMATICUS MAJOR.

This is a long and slender muscle, Fig. 111, *f*, Fig. 112, *m*, situated on the side of the face, and passing downwards and inwards; superiorly it is attached to the upper part of the cheek bone; inferiorly to the corner of the mouth.

ZYGOMATICUS MINOR.

This muscle, Fig. 111, *e*, Fig. 112, *n*, is not found in all subjects. It is situated on the inner side of the preceding muscle between *k*, the elevator of the upper lip, and *m*, the great zygomatic muscle. It passes in the same direction as the last-mentioned muscle, and has nearly the same attachments.

The *anterior surfaces* of the zygomatic muscles are generally covered by a great quantity of fat as well as skin; the *posterior surfaces* are placed on the malar bone and the buccinator muscle; their connexion with the other muscles of the face is obvious in the figure.

The zygomatic muscles raise the angle of the mouth, as in laughing, etc.

ORBICULARIS ORIS.

The form of this muscle, Fig. 111, *i*, Fig. 112, *t*, is elliptical; its fibres are found in the substance of the lips, and are completely interlaced and confounded with those of the other muscles which terminate near the angle of the mouth.

The skin adheres firmly to the *anterior surface* of this muscle; the *posterior surface* is lined by the mucous membrane of the mouth, and its free edge is invested with the red membrane of the lips. The connexion with the other muscles of the face is intricate.

This muscle is an antagonist to the ôther muscles of the lips; it is a true sphincter muscle, contracting the aperture of the mouth; its action is evident in playing the flute, in sucking, in masticating, &c.

INFERIOR MAXILLARY REGION.

DEPRESSOR ANGULI ORIS.

This muscle, Fig. 111, *k*, Fig. 112, *o*, is of a triangular form, and situated at the lower part of the face; superiorly it is attached to the lower jaw; inferiorly to the angle of the mouth, where the fibres are confounded with those of the levator anguli oris.

The *outer surface* adheres to the skin and the platysma myoides; the *inner* is connected with the buccinator and the depressor labii inferioris.

This muscle depresses the angle of the mouth, and its action expresses grief.

DEPRESSOR LABII INFERIORIS.

This muscle, Fig. 111, *m*, Fig. 112, *p*, is thin, and nearly quadrilateral ; its situation in the face is obvious in the figures referred to. Inferiorly it is attached to the lower jaw ; superiorly to the lower lip, where its fibres are confounded with the orbicularis.

The *anterior surface* is connected with the skin and part of the preceding muscle. The *posterior surface* is connected with the lower jaw, the mental vessels and nerves, the levator menti, and the labial muscles.

The use of this muscle is to pull the lip downwards.

BUCCINATOR.

This muscle, Fig. 112, *s*, is situated in the cheek ; superiorly it is attached to the sockets of the molar teeth of the upper jaw ; behind, it is connected with the constrictor muscle of the pharynx, and in front with the angle of the mouth. The middle fibres are horizontal, the superior and inferior a little converging to the angle of the lips. It is perforated in the middle by the duct of the parotid gland.

The *outer surface* is covered by a thick layer of fat, the zygomaticus major, the platysma myoides, the depressor anguli oris, the skin, and labial artery and vein. The *inner* is lined by the mucous membrane of the mouth.

This muscle is seen remarkably dilated in blowing the horn or trumpet ; its use is to force the air out of the mouth by contracting its cavity, to draw the angle of the mouth backwards, and in mastication to press the food within the line of the teeth.

LEVATOR MENTI.

This muscle, Fig. 112, *r*, is placed on the chin ; *superiorly* it is attached to the depression on the side of the symphysis of the jaw, under the alveoli of the incisor teeth. The fibres diverge downwards, and are inserted into the skin of the chin.

Anteriorly it is covered by the skin ; *posteriorly* by the mucous membranes of the mouth.

This muscle raises the chin.

MASSETER.

This muscle, Fig. 111, *h*, Fig. 112, *v*, is composed of aponeurotic and fleshy fibres, situated on the side of the face ; it is very thick, and attached superiorly to the two anterior thirds of the inferior part of the zygomatic arch, to its internal surface, and to the aponeurosis of the temporal muscle ; inferiorly to the angle of the lower jaw, to its external surface, and to the inferior border of the ramus of the same. The masseter is sometimes described as two distinct portions which decussate one another ; the anterior portion running backwards, is fixed into the side of the lower jaw as far as the angle ; the posterior portion passing forwards is united to the coronoid process.

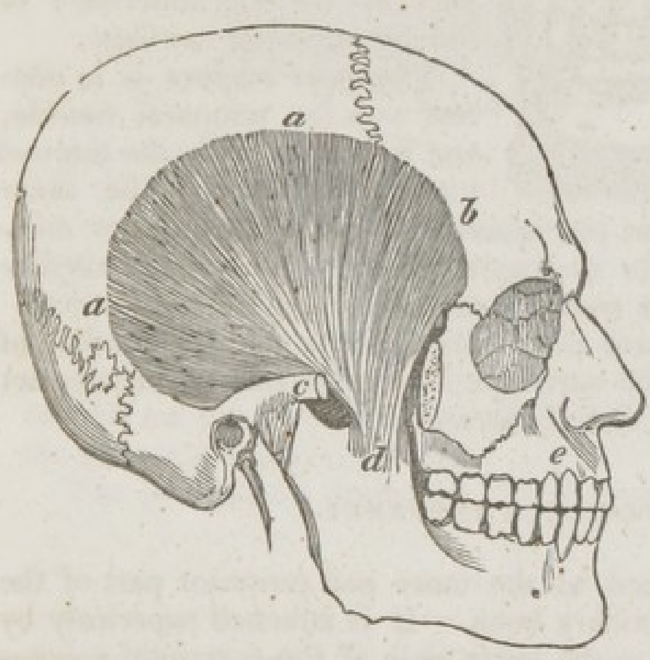
On the *outer side* is found the parotid gland and its duct, the platysma myoides, the facial nerve, the transverse facial artery, etc. The *inner surface* is placed on the ramus of the inferior maxilla, the tendons of the temporal and the buccinator muscles.

This muscle raises the lower jaw, and acts powerfully during mastication.

TEMPORO-MAXILLARY REGION.

TEMPORALIS.

Fig. 113.



The situation and direction of the fibres of this muscle are shown in the annexed figure ; a portion of *c*, the zygoma, is removed to show the whole of the muscle. It occupies the whole temporal cavity, and is covered with a strong aponeurosis, while another is placed in the midst of the fleshy fibres, dividing it into two planes, terminating inferiorly in a strong tendon. It is attached superiorly to the temporal fossa, and to *a*, *a*, *b*, the semicircular line bounding it ; inferiorly at *d*, the coronoid process of the inferior maxilla.

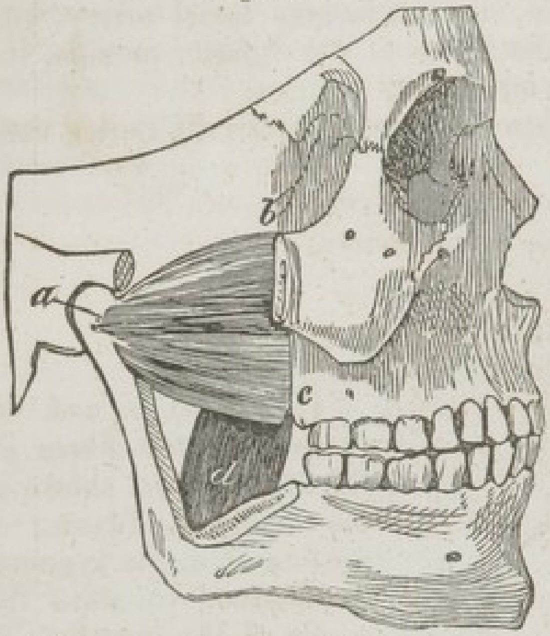
The *outer surface* of the temporal muscle is covered by the epicranial aponeurosis, the superior and anterior auricular muscles, and a portion of the orbicularis palpebrarum and masseter muscles ; the superficial temporal vessels and nerves also ramify over it. The *inner surface* is situated upon the temporal fossa and the internal maxillary artery. The pterygoideus externus, and buccinator muscles, are separated from it by a considerable quantity of fat.

The office of this muscle, as well as the preceding, is to draw the lower jaw upwards. In carnivorous animals, the temporalis is the strongest muscle in the whole body.

PTERYGO-MAXILLARY REGION.

PTERYGOIDEUS EXTERNUS.

Fig. 114.



This muscle is situated in the zygomatic fossa ; it is attached by one portion at *b*, *c*, to the external surface of the pterygoid process, and by the other to the zygomato-temporal surface of the sphenoid bone ; from thence the muscle is directed outwards and backwards, and is inserted into *a*, the anterior part of the neck of the condyle of the lower jaw, and into the fore part of the circumference of the interarticular cartilage.

The *outer surface* is in contact with the temporal muscle, and frequently with the internal maxillary artery. The *inner surface* corresponds with the pterygoideus internus, the inferior maxillary nerve, and the middle meningeal artery. The *upper surface* touches the zygomatic fossa and the temporal and masseteric nerves.

This muscle brings forward and to the opposite side the condyle of the jaw and the interarticular cartilage ; when the pair of muscles act together, the jaw is drawn directly forwards.

PTERYGOIDEUS INTERNUS.

This muscle, *d*, is placed at the inner and posterior part of the branch of the inferior maxillary bone. It is attached superiorly by tendinous and fleshy fibres to the inner plate of the pterygoid process of the sphenoid bone, and to the pterygoid process of the os palati, filling all the space between the two plates ; inferiorly it is attached by tendinous and fleshy fibres to the inside of the angle of the lower jaw.

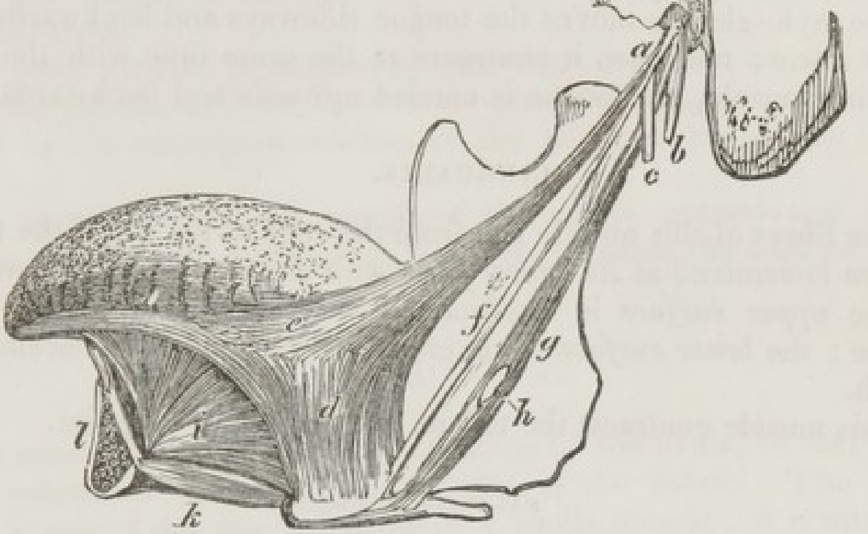
The *inner surface* is connected with the circumflexus palati, the constrictor pharyngis superior, and the sub-maxillary gland. The *outer surface* lies upon the inner part of the branch of the lower jaw, much in the same manner as the masseter does upon the outer part.

When the pair of muscles act together, they bring the jaw horizontally forwards ; when they act singly, the jaw is moved obliquely to the opposite side. The pterygoid muscles move the jaw from side to side, and perform the motion of grinding with the teeth.

LINGUAL REGION.

HYO-GLOSSUS.

Fig. 115.



This muscle, *d*, is situated at the front and upper part of the neck ; it is thin, flat, and quadrilateral. Inferiorly, its fibres are attached to the os hyoides ; superiorly, to the side of the tongue, and mix with *a*, *e*, the fibres of the stylo-glossus.

The *outer surface* is covered by the stylo-glossus, the mylo-hyoideus, the genio-hyoideus and digastricus, the hypo-glossal nerve, and the sub maxillary gland. The *inner surface* is connected with the constrictor pharyngis medius, the genio-glossus, the lingual artery, and the glosso-pharyngeal nerve.

The hyo-glossus draws the tongue inwards and downwards.

GENIO-GLOSSUS.

This muscle, *i*, *k*, is situated between the tongue and *l*, the lower jaw ; its fibres are radiated, extending from the mental process to the inferior surface of the tongue and the os hyoides.

The *external surface* of the genio-glossus is connected with the sublingual gland, and the stylo-glossus, hyo-glossus, lingualis, and mylo-hyoideus muscles ; the *internal surface* is in contact with that of the opposite side.

According to the direction of its fibres, so it moves the tongue ; those which go to the point draw it backwards ; those which pass backwards thrust the tongue out of the mouth ; and the central fibres have the power of rendering the upper surface of the tongue concave.

STYLO-GLOSSUS.

This muscle takes an oblique direction from above where it is attached, at *a*, to the styloid process of the temporal bone, and to *f*, the stylo-maxillary ligament ; the muscular fibres are finally lost at *e*, in the substance of the tongue.

The *outer surface* is covered by the digastricus, the lingual nerve, the sub-maxillary gland, and the mucous membrane of the mouth : the *inner surface* covers the constrictor pharyngis superior, the hyoglossus, and the lingualis.

The stylo-glossus moves the tongue sideways and backwards, when it acts alone ; but when it contracts at the same time with the corresponding muscle, the tongue is carried upwards and backwards.

LINGUALIS.

The fibres of this muscle run from the root to the tip of the tongue, and are intermixed at its lateral parts with the muscles just mentioned.

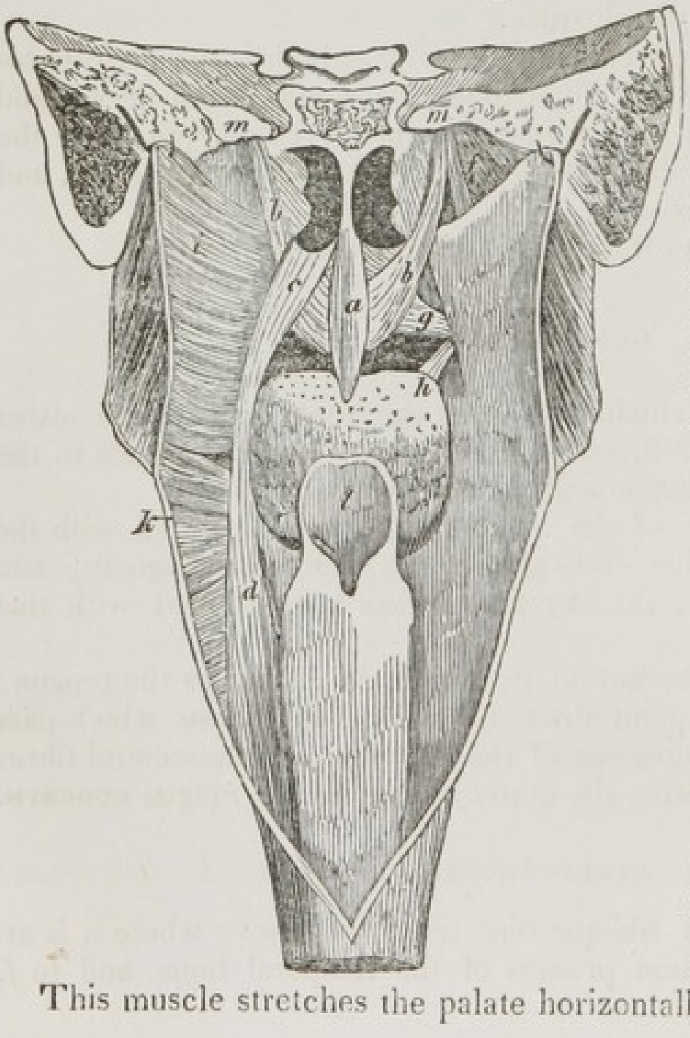
The *upper surface* is confounded with the fleshy texture of the tongue ; the *lower surface* is covered by the mucous membrane of the mouth.

This muscle contracts the tongue and depresses its point.

PALATINE REGION.

CIRCUMFLEXUS PALATI.

Fig. 116.



This muscle is placed in the substance of the velum of the palate. Superiorly it is attached to the wing of the sphenoid bone and to the Eustachian tube ; its tendon, *f*, passes round the hook of the internal plate of the pterygoid process of that bone, and spreads into *g*, a tendon at the semilunar edge of the os palati and velum palati.

The *external surface* is covered by the pterygoideus internus ; the *inner surface* is in apposition with the levator palati and constrictor pharyngis superior, the mucous membrane of the pharynx and of the velum palati.

This muscle stretches the palate horizontally.

LEVATOR PALATI.

The shape and direction of this muscle, *b*, *b*, is apparent in the figure. Superiorly it is attached at *m*, the petrous portion of the temporal bone ; the inferior fibres are inserted into *a*, the pendulous part of the palate, its fibres being confused with the other muscles in that situation.

The *outer surface* is connected with the circumflexus palati, the palato-pharyngeus, and the constrictor pharyngis superior ; the *inner* is lined by the mucous membrane of the pharynx and of the velum palati.

This muscle draws the curtain of the palate upwards and backwards in the time of swallowing, and thus prevents the food or drink from passing into the nose.

LEVATOR UVULÆ.

This muscle, *a*, occupies the substance of the uvula, or that small fleshy substance hanging in the middle of the palate. The uvula muscle is one of the four instances of a single muscle ; it is attached to the palate bones, and runs down the whole length of the uvula, adhering to the tendons of *g*, the circumflex muscle.

It is connected *anteriorly* with the levator palati, and is covered *posteriorly* by the membrane of the velum palati.

This muscle raises the uvula.

PALATO-PHARYNGEUS.

This muscle is placed in the substance of the velum palati and that of the pharynx ; superiorly it is attached, at *c*, to the arch of the palate ; inferiorly, at *d*, to the thyroid cartilage, and the bag of the pharnyx.

The *posterior surface* of this muscle is covered by the mucous membrane of the velum palati, and the constrictores pharyngis ; the *anterior surface* is connected with the aponeurosis of the circumflexus palati and the mucous membrane of the pharynx.

This muscle draws the uvula downwards and backwards, shuts the passage of the posterior nostrils, and assists in swallowing.

CONSTRICTOR ISTHMI FAUCIUM.

This is a small fleshy fasciculus, *h*, attached to the curtain of the palate and to the base of the tongue.

The action of this muscle lowers the velum palati, and assists in raising the tongue.

The *salpingo-pharyngeus* of Albinus is that part of the palato-pharyngeus, which arises from the mouth of the Eustachian tube.

CHAP. III.

MUSCLES OF THE NECK.

ANTERIOR CERVICAL REGION.

PLATISMA MYOIDES.

Fig. 117.

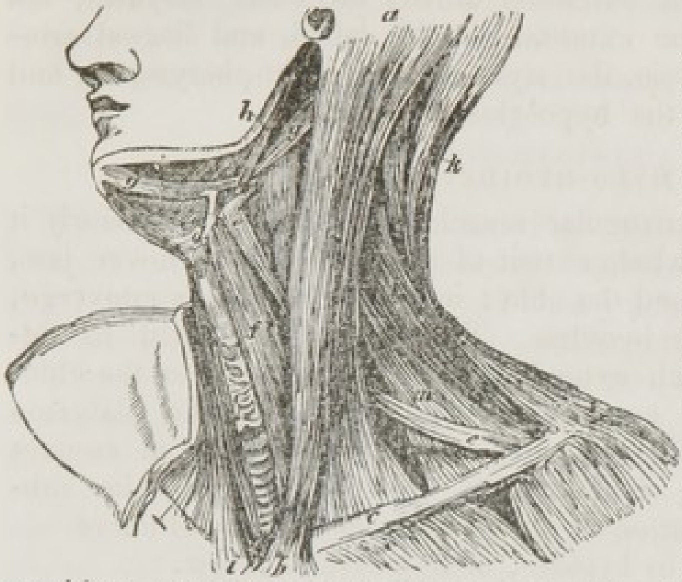
This is an extremely thin layer of fleshy fibres, spread over the other muscles, and attached to the cellular membrane of the neck; it requires some skill in dissection to display this muscle, for as it is merely a web of muscular fibres, it is frequently removed with the integuments unnoticed. Superiorly it extends to *a*, the face, where its fibres are lost in the cellular tissue of the cheek, and inferiorly to *b*; its fibres cover a portion of *c*, the pectoral, and of *d*, the deltoid muscles.

The *outer surface* of this is covered by the skin; the *inner* is placed over the deltoides, pectoralis major, and sterno-cleido mastoideus muscle, the clavicle, the muscles of the hyoidean and maxillary regions, and the sub-maxillary and parotid glands.

This muscle draws the skin of the cheek downwards, and when the mouth is shut, brings the skin under the lower jaw upwards.

STERNO-CLEIDO-MASTOIDEUS.

Fig. 118.



This muscle is situated at the side of the neck. Superiorly it is attached, at *a*, to the mastoid process of the temporal bone, and to a part of the occipital bone; inferiorly, at *b*, to the summit of the sternum, and at *c*, to the internal third of the superior border of the clavicle.

The *outer surface* is covered by the platysma myoides, excepting at its upper extremity, which lies under the skin and parotid gland; between it and the preceding muscle the external jugular vein and some nervous filaments of the cervical plexus are situated. The *inner surface* is connected to the articulation of the sternum with the clavicle, the sterno-thyroideus, sterno-hyoideus, and omo-hyoideus muscles, the internal jugular vein, the carotid artery, the pneumo-gastric nerve, the scaleni, the levator scapulæ, the splenius and digastric muscles.

DIGASTRICUS.

This muscle is so called from having two *bellies*, *g*, *g*, one of which is attached to the mastoid groove of the temporal bone, and becomes tendinous in the middle, traversing a perforation in *h*, the stylo-hyoideus muscle; the other is inserted into the inner part of the chin, Fig. 119, *h*. The central tendon is braced down by aponeurotic fibres to *d*, the os hyoides.

The *outer surface* is covered by the lesser complexus, splenius, and sterno-cleido-mastoideus muscles; the sub-maxillary gland is lodged in the angle formed by the tendon. The *inner surface* is placed upon the stylo-hyoideus, the stylo-glossus, and the stylo-pharyngeus muscles, the external and internal carotid arteries, the internal jugular vein, the hypo-glossal nerve, and the hyo-glossus and mylo-hyoideus muscles.

When the mouth is shut, the action of this muscle raises the os hyoides, and the pharnyx at the time of deglutition; when these parts are fixed, it opens the mouth.

STYLO-HYOIDEUS.

The form of this muscle, Fig. 118, *h*, is long and slender, having a tendinous attachment superiorly to the styloid process, and inferiorly to *d*, the os hyoides. Its perforation to admit the tendon of the digastricus has been mentioned in the preceding description of that muscle, and is also represented in Fig. 115.

The digastric muscle is extended across the *outer surface* ; the *inner* is connected with the external carotid, labial, and lingual arteries, the internal jugular vein, the stylo-glossus, stylo-pharyngeus, and hyo-glossus muscles, and the hypo-glossal nerve.

MYLO-HYOIDEUS.

This is a broad, thin, triangular muscle, Fig. 115, *i* ; superiorly it is attached to nearly the whole extent of the inside of the lower jaw, between the molar teeth and the chin ; inferiorly the fibres converge, and are inserted into the os hyoides. This muscle unites with its fellow in a middle line, which extends from the os hyoides to the chin.

The *outer surface* is covered by the digastricus, the platysma myoides, and the submaxillary gland ; the *inner* is placed in contact with the genio-hyoideus, genio-glossus, and hyo-glossus, the sublingual gland, the prolongation of this gland, and the lingual nerve.

This muscle raises the os hyoides, or depresses the jaw.

GENIO-HYOIDEUS.

This muscle, Fig. 115, *k*, Fig. 119, *i*, is placed above the preceding ; its figure is thin and narrow. Anteriorly it is attached to the mental process of the lower jaw ; posteriorly to the surface of the body of the os hyoideus.

The *anterior surface* is covered by the mylo-hyoideus ; the *posterior* is in contact with the genio-glossus and hyo-glossus ; the *inner edge* meets that of the opposite side.

The action of this muscle raises the os hyoides, carrying it forward, or it depresses the lower jaw.

INFERIOR HYOID REGION.

OMO-HYOIDEUS.

Fig. 119.

This muscle, *c*, *c*, and in the preceding figure, *e*, *e*, is situated at the side of the neck ; it is very long, thin, and narrow. Superiorly it is attached to the hyoid bone, descends obliquely across the neck, and forms a tendon in its centre, where it passes behind the sterno-cleido-mastoideus, and becoming fleshy again, is inserted into the root of the coracoid process and semilunar notch of the scapula.

The *outer surface* is covered by the trapezius, the platysma myoides, and the sterno-cleido-mastoideus ; we see in the figure the clavicle lying across it. The *inner surface* corresponds to the scaleni muscles, the anterior branches of the inferior cervical nerves, the primitive carotid artery, the internal jugular vein, the superior thyroidean vessels, the sterno-hyoideus and sterno-thyroideus muscles.

This muscle depresses the hyoid bone, drawing it a little backwards.

STERNO-HYOIDEUS.

This is a long, thin muscle, Fig. 119, *b*, presenting generally towards its middle an aponeurotic intersection. Superiorly it is attached to the body of the hyoid bone; inferiorly to the superior part of the sternum, the clavicle, and sometimes to the first rib.

The clavicle passes across the *anterior surface* of this muscle, and is covered by the sterno-cleido-mastoideus, the omo-hyoideus, the platysma-myoides, and by the common integuments. The *posterior surface* is in apposition with the sterno-thyroideus, crico-thyroideus, and thyro-hyoideus muscles, the thyro-hyoid membrane, the thyroid gland, and the superior thyroid vessels.

This muscle depresses the layrnx, and furnishes a fixed point for the depressors of the jaw.

STERNO-THYROIDEUS.

This muscle, *d*, is placed behind the former, and its form is like it; superiorly it is attached to the thyroid cartilage; inferiorly to the upper and posterior part of the sternum, opposite the cartilage of the first rib. It frequently presents at its lower part an oblique or transverse aponeurotic intersection.

The *anterior surface* is covered by the sterno-hyoideus, sterno-cleido-mastoideus, and omo-hyoideus muscles. The *posterior surface* covers the subclavian and internal jugular veins, the primitive carotid artery, the trachea, the thyroid gland, the crico-thyroid muscle and a part of the constrictor pharyngis inferior.

This muscle draws the larnyx downwards.

THYRO-HYOIDEUS.

This is a small oblong muscle, *e*, attached superiorly to the hyoid bone, and inferiorly to the thyroid cartilage.

The *anterior surface* of this muscle is covered by the sterno-hyoideus, the omo-hyoideus, and the platysma myoides; the *posterior* lies upon the thyroid cartilage, and the thyro-hyoid membrane.

This muscle brings the larnyx and hyoid bone towards each other.

CRICO-THYROIDEUS

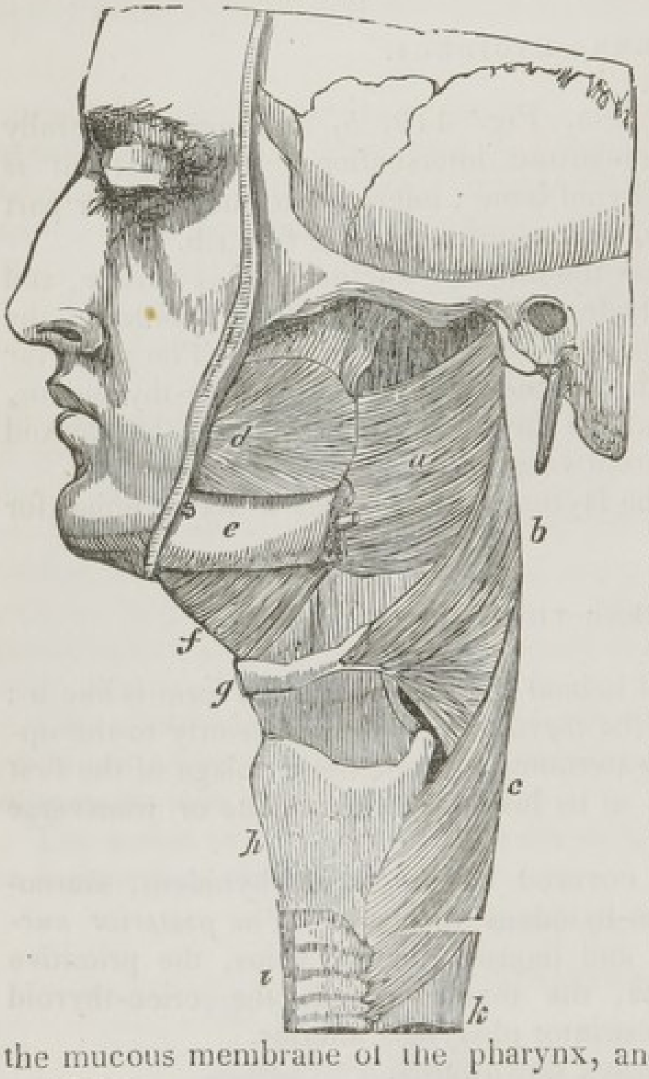
Is a very short muscle, passing from the upper edge of the cricoid to the lower margin of the thyroid cartilage, and there is also a portion attached to its inferior cornu.

This muscle depresses the thyroid, and elevates the cricoid.

PHARYNGEAL REGION.

CONSTRICTOR PHARYNGIS INFERIOR.

Fig. 120.



This is the largest muscle, *c*, of the pharnyx. It is broad and membranous ; anteriorly it is attached to *h*, the thyroid and cricoid cartilages, and to *i*, the upper rings of the trachea ; posteriorly it is united to its fellow, in a vertical tendinous line. The direction of the fibres is expressed in the figure.

The *exterior surface* is covered by the sterno-thyroideus, the thyroid gland, and the primitive carotid artery. The *posterior surface* is connected with the rectus capitis, anticus major, and longus colli muscles, and with the anterior vertebral ligament by cellular tissue. The *interior surface* is covered by the constrictor medius, palato-pharyngeus, and the stylo-pharyngeus muscles, the mucous membrane of the pharynx, and the thyroid and cricoid cartilages.

This muscle contracts that part of the pharynx which it covers.

CONSTRICTOR PHARYNGIS MEDIUS.

This muscle, *b*, is of a triangular shape situated at the middle part of the pharynx. It is attached anteriorly to the greater and lesser cornea of *g*, the hyoid bone, and to the stylo-hyoidean ligaments ; posteriorly to its fellow, in a tendinous line at the back of the pharynx, and superiorly it is fixed to the basilar process of the occipital bone. Observe the direction of its fibres in the figure.

This muscle is connected on its *outer surface* with the hyo-glossus muscle and the lingual artery, and by the inferior constrictor below ; in the rest of its extent it is connected with the muscles of the deep cervical region and the anterior vertebral ligament. The *inner sur-*

face is covered by the mucous membrane of *k*, the pharynx, the stylo-pharyngeus, palato-pharyngeus, and the superior constrictor muscles.

This muscle compresses that part of the pharynx which it invests.

CONSTRICTOR PHARYNGIS SUPERIOR.

Like the other constrictors, this muscle, *a*, is broad and thin; its figure is nearly quadrilateral. It is partly covered by the middle constrictor, and its connexions are most extensive. Superiorly, it is attached to the occipital bone before the large foramen; lower down, to the pterygoid process of the sphenoid bone, to the upper and under jaw near the last molar teeth, and to *k*, the buccinator muscle. Some fibres also are fixed to the root of the tongue, and palate. Posteriorly, like the two preceding, its fibres are united in a line to the corresponding muscle.

The *outer surface* is connected with the preceding muscle, the stylo-glossus, the stylo-pharyngeus, the internal carotid artery, the internal jugular vein, the pneumo-gastric, hypo-glossal and spinal nerves. These different parts occupy a triangular space, which is found between the constrictor pharyngis superior and the pterygoideus internus. The *inner surface* is connected with the palato-pharyngeus and the levator palati, and is lined by the mucous membrane of the pharynx.

This muscle compresses the pharynx at the upper part; the constrictors act in succession, and contract that portion of the alimentary canal when it is filled with food, and force it downwards into the œsophagus.

STYLO-PHARYNGEUS.

Fig. 121.

This muscle is situated at the side and back part of the pharynx; it is attached superiorly to *a*, the styloid process, and inferiorly it is expanded on the pharynx and back part of the thyroid cartilage.

The *outer surface* is covered by the stylo-hyoideus, constrictor medius, and external carotid artery; the *inner* is connected with the internal carotid artery, the internal jugular vein, the mucous membrane of the pharynx, and the superior constrictor and palato-pharyngeus muscles.

This muscle raises the pharynx, and also draws upwards the thyroid cartilage.

MUSCLES OF THE GLOTTIS.*

CRICO-ARYTÆNOIDEUS.

A small pyramidal muscle, which arises from the back part of the cricoid cartilage, and is inserted into the back of the arytenoid cartilage. Its *use* is to draw the arytenoid cartilage directly backwards.

CRICO-ARYTÆNOIDEUS LATERALIS

Arises from the side of the cricoid cartilage and is inserted into the base of the arytenoid cartilage. *Use*, — to open the rima glottidis.

THYREO-ARYTÆNOIDEUS.

This muscle arises from the back part of the thyroid cartilage, and is inserted into the fore part of the arytenoid cartilage. *Use*, — by pulling the cartilage forwards and sideways, it slackens the ligaments and widens the glottis.

ARYTÆNOIDEUS OBLIQUUS

Arises from the root of each arytenoid cartilage, and is inserted into the point of the opposite one. *Use*, — when both act, they draw the arytenoid cartilages together and close the rima glottidis.

ARYTÆNOIDEUS TRANSVERSUS.

This muscle arises from the whole length of one arytenoid cartilage and is inserted into the opposite one. *Use*, — to contract the glottis.

THYREO-EPIGLOTTIDEUS

Arises from the thyroid cartilage and is inserted into the epiglottis. *Use*, — to draw down the epiglottis.

ARYTÆNO-EPIGLOTTIDEUS.

This consists of a few muscular fibres, which arise from the sides of the arytenoid cartilage, and are inserted into the side of the epiglottis. *Use*, — to draw down the epiglottis.

DEEP CERVICAL REGION.

RECTUS CAPITIS ANTICUS MAJOR.

This muscle, Fig. 122, *a*, is placed on the anterior and lateral part of the cervical column ; superiorly it is attached to the basilar process of the occipital bone ; inferiorly by small tendons to the anterior tubercle of the transverse processes of the third, fourth, fifth, and sixth

* These muscles are figured and described in Art. XI, among the organs of the voice.

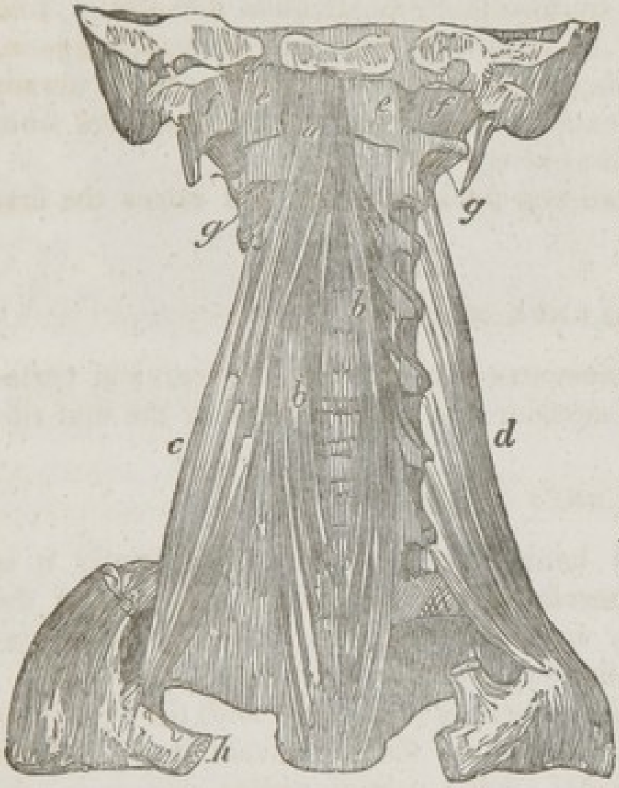
cervical vertebræ. It is a little drawn aside in the figure to show the muscle to be next described.

The *anterior surface* corresponds to the carotid artery, the internal jugular vein, the pneumo-gastric nerve, the superior cervical ganglion, and the pharynx; the *posterior surface* covers the longus colli, the rectus capitis anticus minor, the articulations of the atlas with the occiput, the articulation also of the axis or dentatus with the atlas, and also the transverse process of the cervical vertebræ.

If this muscle acts in conjunction with that of the opposite side, it bends the head forward; and laterally, if it acts by itself.

RECTUS CAPITIS ANTICUS MINOR.

Fig. 122.



This is a small and thin muscle, *e*, situated close to the uppermost vertebra; it is tendinous at its insertions, aponeurotic at its anterior surface, fleshy in the rest of its extent. Superiorly it is attached to the occipital bone near the condyle; inferiorly to the atlas, or first vertebra.

It is connected *anteriorly* with the preceding muscle; *posteriorly* with the articulation of the atlas and occiput.

This muscle assists the preceding in supporting or bending the head.

LONGUS COLLI.

This muscle, *b*, *b*, lies behind the œsophagus, and the great vessels and nerves of the neck. Superiorly it is attached to the tubercle on the interior arch of the atlas; inferiorly to the anterior surface of the bodies of the first three dorsal and last four cervical vertebræ, to the intervertebral fibro-cartilages, and to the anterior border of the transverse processes of the third, fourth, and fifth cervical vertebræ.

The *anterior surface* is covered by the rectus capitis anticus major, the pharynx, the carotid artery, the pneumo-gastric and great sympathetic nerves, and the œsophagus. The *posterior surface* covers the vertebræ and their fibro-cartilages to which it is attached: on a level with the first two dorsal vertebræ, its external border is separated from the anterior scalenus by a triangular space lodging the vertebral artery and vein.

The office of this muscle is to support the neck, to bend it forward and to one side.

LATERAL CERVICAL REGION.

SCALENUS ANTICUS.

This muscle, *c*, is situated at the inferior and lateral part of the neck. It is elongated and divided above into several portions; superiorly it is attached by tendons to the anterior tubercle of the transverse processes of the third, fourth, fifth, and sixth cervical vertebræ; inferiorly to the superior border of *h*, the first rib.

On the *anterior surface* of this muscle we find the subclavian vein, transverse and ascending cervical arteries, the diaphragmatic nerve, the omo-hyoideus and the sterno-cleido-mastoideus muscles. The *posterior surface* forms with the following muscle a triangular space, in which are lodged the subclavian artery and those cervical nerves which form the brachial plexus. The inner side is separated from the longus colli by the vertebral artery and veins.

This muscle bends the head and neck laterally, and raises the first rib.

SCALENUS MEDIUS.

This arises from all the transverse processes of the cervical vertebræ, and is inserted into the superior and outer surface of the first rib.

SCALENUS POSTICUS.

This muscle, *d*, is placed behind the preceding; superiorly it is attached to the posterior tubercle of the transverse processes of the last six cervical vertebræ, by six small tendons; inferiorly to the surface of the first rib, and, to the superior border of the second rib.

The *anterior surface* of this muscle is connected with the preceding muscle, from which it is separated by the subclavian artery and the anterior branches of the cervical nerves; the *posterior surface* is connected with the transversus cervicis, splenius, and levator scapulæ muscles; on the *inner side* with the first dorsal and summit of the six lower transverse cervical processes.

The anterior and posterior scaleni muscles bend the neck to one side; but when the muscles of both sides act, they incline the neck forwards; or when the neck is fixed, they have the power of raising the ribs and expanding the chest.

RECTUS CAPITIS LATERALIS.

This is a short, flat, and thin muscle, *f*, extending from the occipital bone to the transverse process of the atlas.

It is connected *anteriorly* with the jugular vein; *posteriorly* with the vertebral artery.

This muscle bends the head sideways.

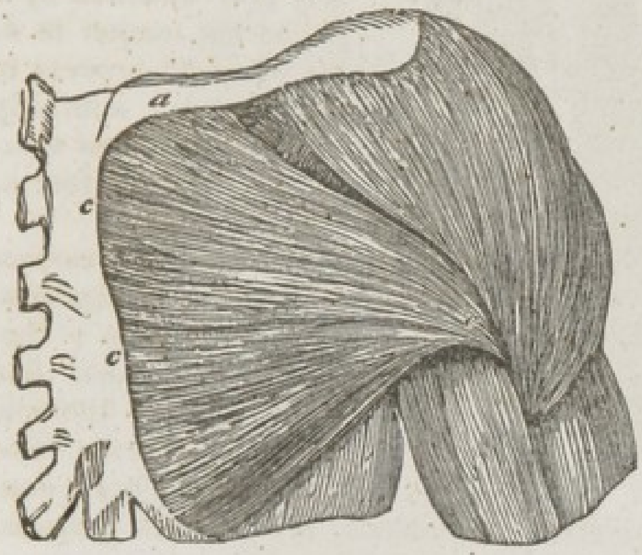
CHAP. IV.

MUSCLES OF THE TRUNK.

ANTERIOR THORACIC REGION.

PECTORALIS MAJOR.

Fig. 123.



This muscle is very large; its triangular form and the direction of its fibres are marked in the figure at *a*, *b*, *c*. 1st, it is attached to the inner half of *a*, the clavicle; 2d, to the middle part of *c*, *c*, the whole length of the sternum; 3d, at *b*, to the cartilages of the true ribs, excepting the first, and a little to the bony portion of the fifth rib; and lastly, from an aponeurosis common to it with the abdominal muscles. The fleshy fibres run obliquely across the breast, and converging from a small tendon which is fixed to the outer border of the bicipital groove of the os humeri.

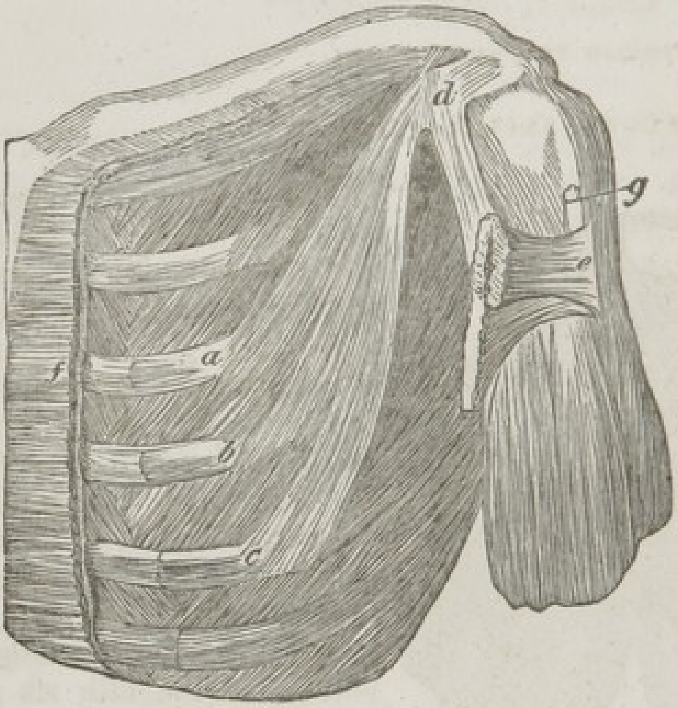
This tendon is shown in Fig. 124, broad and folded upon itself, and is thus composed of two laminæ, which with the insertion into the humerus on the inner side of *g*, the long tendon of the biceps, is very apparent.

The *anterior surface* of the pectoralis major is covered by the platysma myoides, see Fig. 119, by the mammary gland, and common integuments. The *posterior surface* is situated on the sternum, the cartilages of the ribs, a part of their osseous portions, the thoracic vessels and nerves, the subclavius, pectoralis minor, external intercostal, serratus magnus, rectus, and obliquus abdominis muscles. On the axilla it is connected with the axillary ganglia, the axillary vessels, the nerves of the brachial plexus, and a considerable quantity of cellular tissue.

The pectoralis major is a most powerful muscle in moving the arm; it carries the arm inwards and forwards, and when it lowers it, as in striking a blow. When the humerus is fixed it acts upon the thorax, and becomes a muscle of inspiration; or it can raise the trunk upon the limbs, when holding by the hands in climbing a tree, &c.

PECTORALIS MINOR.

Fig. 124.



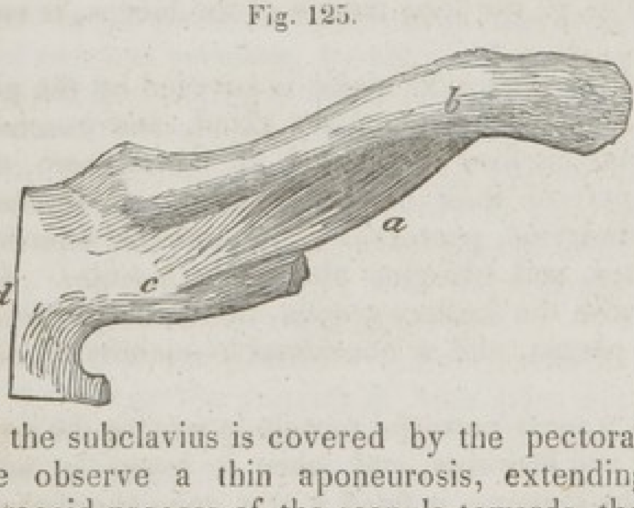
This muscle, *a*, *b*, *c*, *d*, is situated behind the preceding muscle ; its shape and the direction of its fibres are obvious in the figure. Superiorly it is attached by a strong flat tendon to *d*, the coracoid process of the scapula ; inferiorly by three divisions at *a*, *b*, *c*, to the third, fourth, and fifth ribs.

The *anterior surface* is covered by the preceding muscle ; between them we find some of the thoracic vessels and nerves. The *posterior surface* is connected with the ribs, the external intercostals, the serratus magnus, the axillary vessels, and the brachial plexus of nerves.

The pectoralis minor draws the shoulder bone forwards and downwards, and when that bone is fixed, it elevates the ribs.

SUBCLAVIUS.

Fig. 125.



This muscle, *a*, is placed obliquely under the clavicle. It is attached by its external extremity to the inferior surface of *b*, the clavicle ; by its internal extremity it is fixed by a flat tendon, at *c*, to the cartilage of the first rib.*

The *anterior surface* of the subclavius is covered by the pectoralis major ; between them we observe a thin aponeurosis, extending from the clavicle and coracoid process of the scapula towards the first rib. The *posterior surface* is placed upon the axillary vessels and the nerves of the brachial plexus ; indeed, these separate it from the first rib.

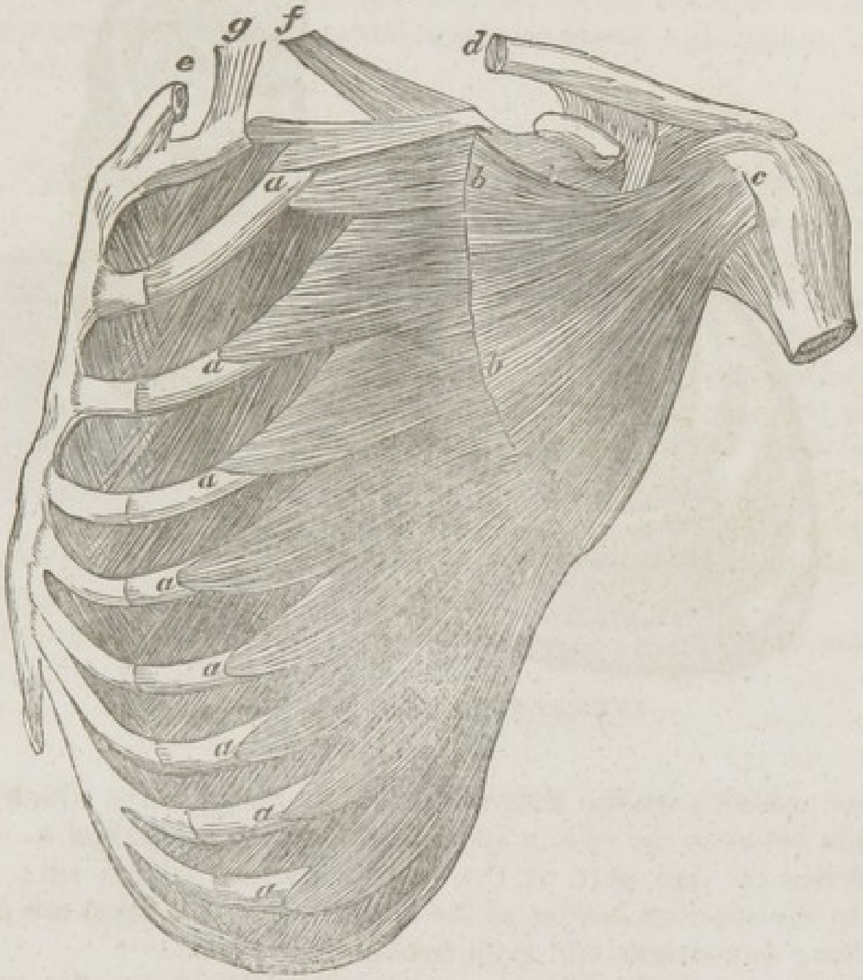
This muscle brings forward and downward the clavicle, and consequently the shoulder.

* *d* the sternum.

LATERAL THORACIC REGION

SERRATUS MAGNUS.

Fig. 126.



The serratus magnus is situated on the side of the chest. The form of this muscle and the direction of its fibres are represented in the figure; but as part of it lies between the blade bone and the ribs, the collar bone is here divided at *d*, *e*, and the blade bone thrown back from the trunk. The serratus magnus is anteriorly attached to eight or nine of the first ribs, *a*, *a*, *a*, *a*, *a*, *a*, *a*, *a*, by as many digitations; posteriorly to *b*, *b*, *b*, the whole length of the base of the scapula.*

The *outer surface* of this muscle is covered by the two pectoral muscles, the latissimus dorsi, and subscapularis, the axillary vessels, and the brachial plexus; the *inner surface* is placed over seven or eight of the first ribs, the corresponding external intercostal muscles, and a portion of the serratus posticus.

The office of this muscle is to bring the scapula forward; when that bone is fixed, it becomes a muscle of inspiration; the obliquity of its fibres contributes to raise the ribs.

* *f*, the inferior portion of the levator scapulæ, *g*, the inferior portion of the scalenus anticus, *b*, *b*, *b*, *c*, the subscapularis.

INTERCOSTAL REGION.

Fig. 127.

INTERCOSTALES EXTERNI.

Fig. 127.

These muscles are the external layers of fleshy fibres which fill up the space between the ribs, a specimen of which is marked *a*. They are attached on one part to the inferior border of the rib; on the other, to the superior border of the rib beneath; the fibres are oblique from above downwards and from behind forwards.

The *outer surface* of these muscles is covered by the pectoral muscle, serratus magnus, obliquus externus abdominis, serratus posticus superior and inferior, and sacro-lumbalis. The *inner surface* is in contact with the pleura, from the tuberosity as far as the angle of the ribs; in the rest of their extent they are in contact with the internal intercostal muscles.

INTERCOSTALES INTERNI.

These muscles, a specimen of which is marked *b*, are similar in number and in situation to the preceding. They extend from the inferior margin of one rib to the superior margin of the rib below, and from the spine to the breast bone. They differ only in having the fibres pass obliquely from above downwards and from before backwards.

The *outer surface* of this set of muscles is covered by the preceding muscles, and is in contact with the intercostal vessels and nerves. The inner surface is lined by the pleura.

The intercostal muscles are two sets of muscular fibres, the one external, *a*, the other internal, *b*, passing in contrary directions, as the old anatomists describe them, like St. Andrew's cross ; excepting that between the cartilages of the ribs, see Fig. 126, there is merely the internal layer, and at a small space from the spine the external layer only.

The offices of both the external and internal intercostals are the same ; they elevate or depress the ribs, in the motions of inspiration or expiration, according as the upper or lower attachment is the line from which they act.

LEVATORES COSTARUM.

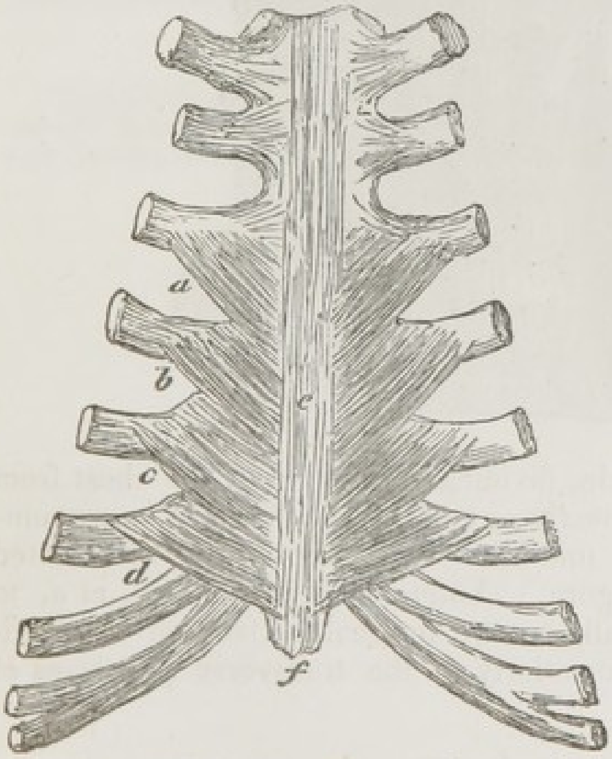
Fig. 128.

These are twelve very small thin triangular muscles on either side of the dorsal vertebræ ; they appear as if they were portions of the external intercostals. Each muscle is attached superiorly to the transverse process of the lowest cervical and the eleven uppermost dorsal vertebræ ; inferiorly to a part of the upper border of the rib next below.* Three or four of the inferior elevators, however, are longer than the others, and run down over one rib, to be attached to the alternate rib ; hence ALBINUS denominated this set of muscles *levatores costarum breviores et longiores.*

The action of these muscles assists in raising the ribs and in supporting the spinal column.

TRIANGULARIS STERNI.

Fig. 129.



This muscle is situated within the thorax, behind the cartilages of the ribs. It is attached on the outer side at *a*, *b*, *c*, *d*, by four triangular tendinous and fleshy portions, to the cartilages of the third, fourth, fifth, and sixth ribs ; on the inner side to the posterior and inferior part of *e*, the sternum, and at *f*, to the ensiform cartilage.

We have here a posterior view of the triangularis sterni, and *this surface* is covered by the pleura, and a small part by the diaphragm. The *anterior surface* is covered by the cartilages of the ribs, the inner intercostal muscles, and internal mammary vessels

* A specimen of these muscles is given in the figure ; *b*, the transverse process *a*, the rib. The whole are represented in Fig. 143, *b*, *b*, *b*, *b*, *b*, *b*, *b*.

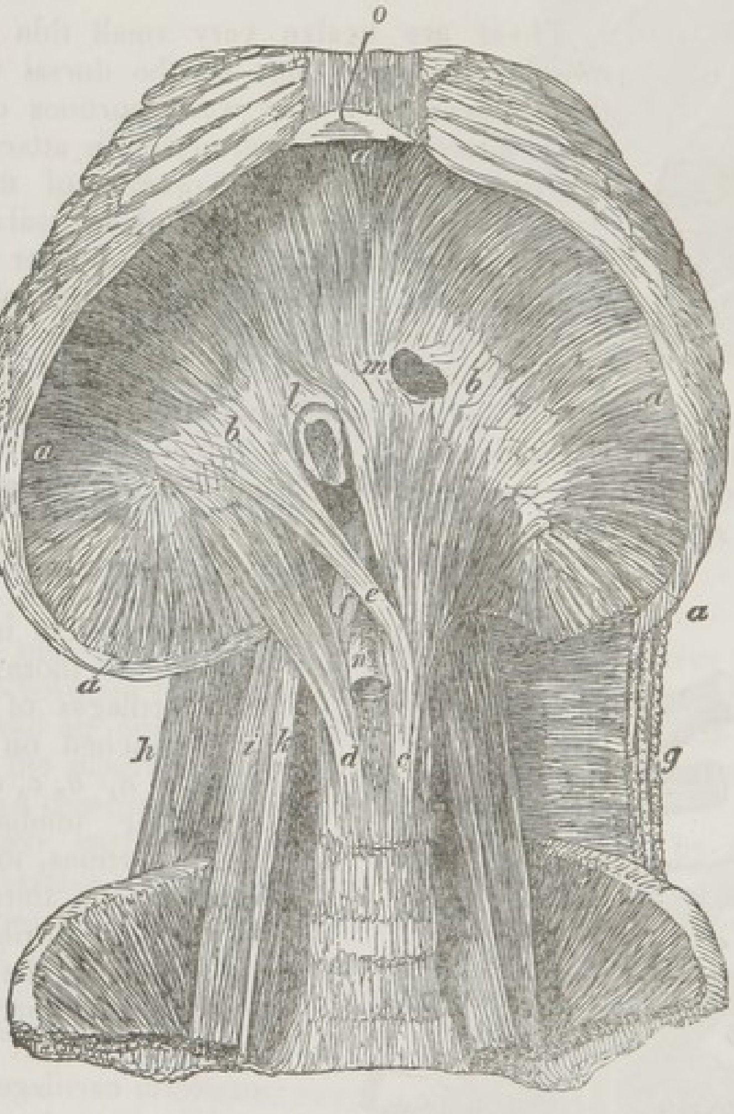
16

This muscle depresses the cartilages and lowers the extremities of the ribs, and is consequently subservient to expiration.

REGION OF THE DIAPHRAGM.

DIAPHRAGMA.

Fig. 130.



This is a broad, thin muscle, dividing the cavity of the chest from the abdomen. Its form is nearly circular, it is fleshy at its circumference, aponeurotic in the middle. The direction of its radiated fibres is represented in this figure. Anteriorly it is attached, at *o*, to the ensiform cartilage; laterally to the internal surface of the cartilages of the six last ribs; posteriorly to the transverse processes of the first lumbar vertebra; by its left pillar at *c*,* to the bodies of the three first vertebræ of the same region; by its right pillar at *d*, to the bodies of the first four. The structure of the diaphragm consists in part of a three-lobed aponeurosis, *b*, *b*, termed the *phrenic centre*, having an opening for the vena cava, *l*; it is fleshy at *a*, *a*, *a*, in the rest of its extent, and presenting posteriorly two openings, one at *m*, for the œsophagus and pneumo-gastric nerves, the other traversed by *n*, the aorta; the vena azygos and thoracic duct also pass through it.

The *upper surface* of the diaphragm is connected with the pericardium, the mediastinum, and the pleura; it supports the heart and the base of the lungs. The *lower surface* posteriorly is in contact with the kidneys, the surrenal capsules, the pancreas, and the duodenum; on the right side with the liver; on the left side with the spleen and stomach; in its whole extent it is covered by the peritoneum.

The diaphragm performs a most important office in the phenomena of respiration; every time we draw in our breath it contracts, and changing its vaulted form to that of a plane, it enlarges the capacity of the chest so as to admit of the dilatation of the lungs; it may therefore be called the principal muscle of inspiration. On the other hand, when it relaxes, the abdominal muscles press their viscera upwards, and the diaphragm ascends in the thorax and compresses the lungs, and thus contributes to expiration. It also acts in coughing, vomiting, laughing, and speaking, and assists in various other functions, as in the expulsion of the contents of the uterus, bladder, and intestines.

The motion of the diaphragm is moreover subservient to snuffing odors, to sighing, yawning, coughing, sneezing, hiccup, and all those actions connected with inspiration and expiration.

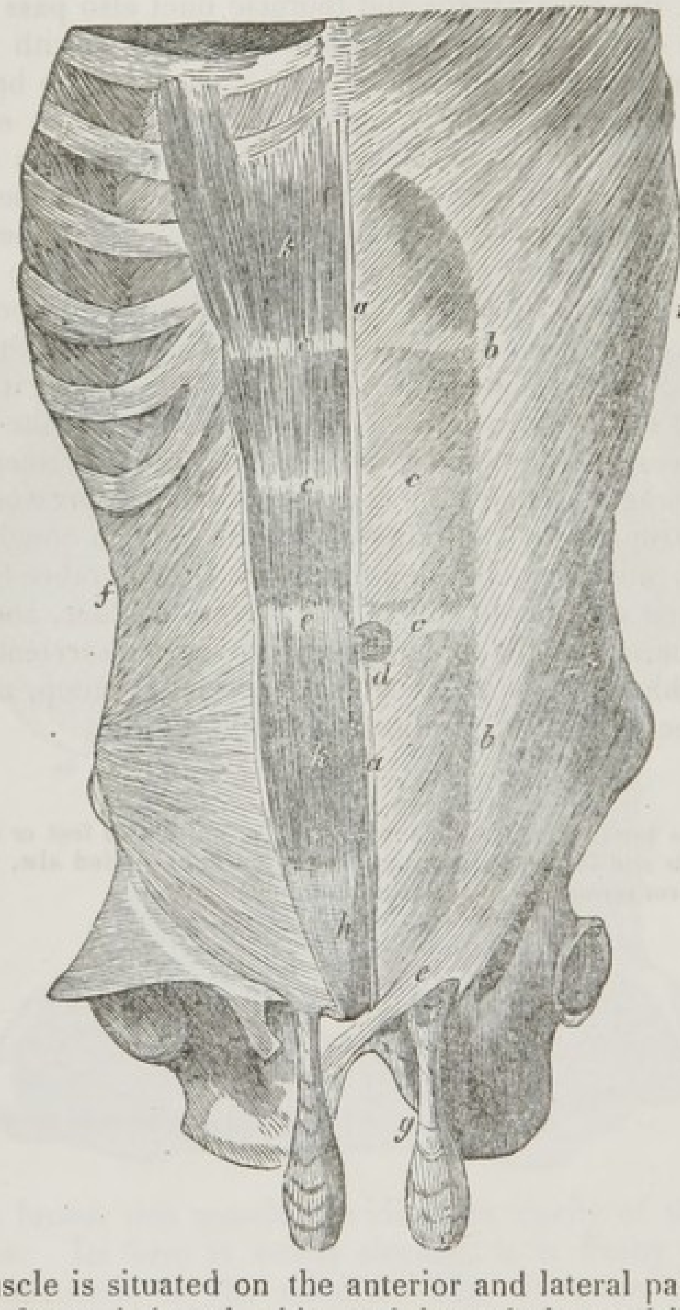
* Termed also tendinous feet, or crura, *c*, *d*, *e*, *f*. These feet or crura run obliquely upwards and forwards into two fleshy portions called alæ, which mixing and crossing fibres terminate in *b*, *b*, the tendinous centre.

MUSCLES OF THE ABDOMEN.

ABDOMINAL REGION.

OBLIQUUS ABDOMINIS EXTERNUS.

Fig. 131.



This muscle is situated on the anterior and lateral part of the abdomen; its figure is broad, thin, and irregularly quadrilateral. It is attached superiorly by fleshy triangular slips, called digitations, to the external surface and inferior margin of the seven or eight last ribs; inferiorly to the two anterior thirds of the edge of the hip bone. The muscular fibres, *i*, are directed obliquely from above downwards and from behind forwards, and about the middle terminate abruptly at *b*, *b*, the semicircular line (*linea semicircularis*,) which runs from the pubis to the ribs. A flat tendinous expansion or aponeurosis is then continued to meet with that on the opposite side, where it forms a central tendinous cord, *a*, *a*, termed the white line (*linea alba*,) which extends from the ensiform cartilage to the pubis. This line appears to be the result of the reunion of the aponeuroses of the two oblique and transverse muscles upon the median line of the abdomen; and it is composed of inextricable fibres of a very strong texture, forming a kind of ligament to unite the sternum to the pelvis. There are lines of a similar nature, passing from the linea semicircularis to the linea alba, marked with the letters *c*, *c*, and termed *lineæ transversales*. The letter *d*, marks the umbilicus or navel, consisting of condensed cellular membrane: in the fœtus it was a foramen which gave passage to the nutrient vessels, which connected the fœtus with the placenta. Inferiorly the external oblique muscle is fixed to *Poupart's ligament*, which appears like a strong resistant fold stretched from the anterior superior spine of the ilium to the pubis. Near this insertion there is a small oblique opening at *e*, formed as it were by the splitting of the aponeurosis; it is named the *abdominal ring:* it allows the spermatic cord in the male, and the round ligament of the uterus in the female, to pass through it. The fibres being again united, cross each other, and are inserted into the pubes. This opening is likewise strengthened by tendinous fibres, which pass transversely, and in various directions, forming it into an elliptical aperture.

The *outer surface* of this muscle is covered by the common integuments, and at the back part of the latissimus dorsi: the *inner surface* is placed on the anterior part of the last eight ribs and their cartilages, the corresponding intercostal muscles, and the obliquus internus.

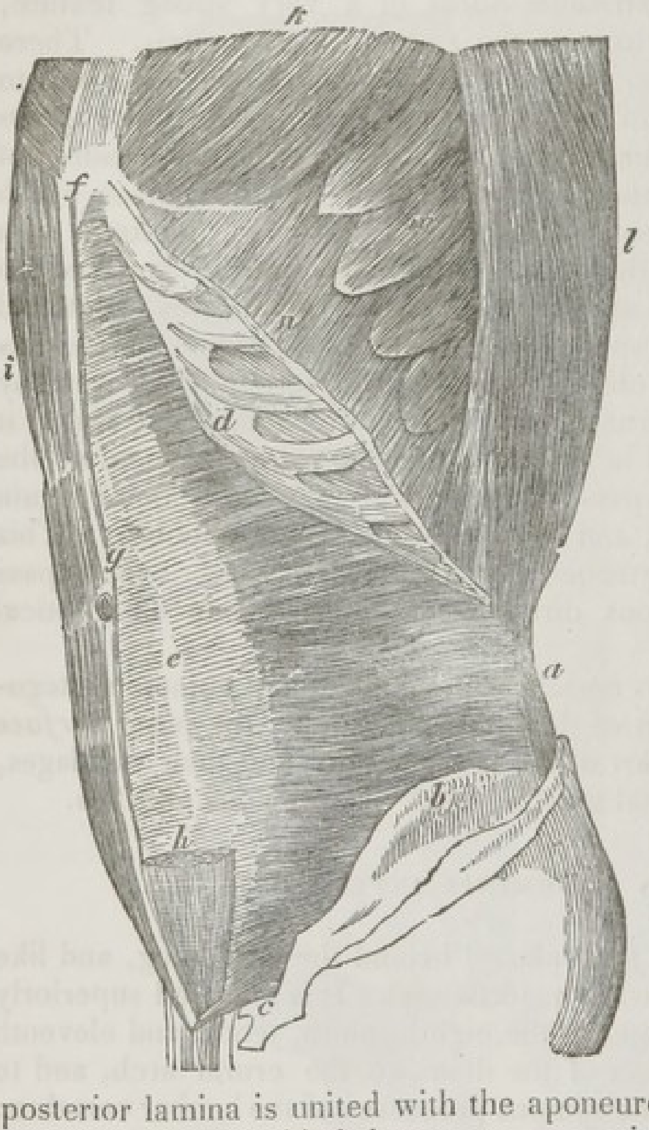
OBLIQUUS ABDOMINIS INTERNUS.

This muscle, Fig. 131, *f*, is placed behind the preceding, and like it is broad, thin, and somewhat quadrilateral. It is attached superiorly to the border of the cartilages of the eighth, ninth, tenth, and eleventh ribs: inferiorly, to the spine of the ilium, to the crural arch, and to the pubis; posteriorly, to the spinous processes of the lumbar vertebræ, and to the sacrum; anteriorly, to the linea alba. The figure expresses by its lines the direction of the fibres; viz., the superior fibres are oblique from below upwards, and from behind forwards; the middle, horizontal; the inferior, a little oblique from above downwards. The muscle becomes aponeurotic at the linea semicircularis, and adheres firmly to it, then divides into two layers. The anterior layer unites with the tendon of the external oblique, the internal adheres to the muscle behind it; they inclose a long muscle, *k*, *k*, and are finally reunited at *a*, *a*, the central linea alba. The anterior tendon is here removed to show the rectus muscle.

The *outer surface* is covered by the preceding muscle and by the latissimus dorsi; the *inner surface* is in contact with the transversalis abdominis and sacro-lumbalis.

TRANSVERSALIS ABDOMINIS.

Fig. 132.



This muscle is situated behind the oblique muscles; its form is similar, and it is attached superiorly to *d*, the cartilages of the seven lower ribs; inferiorly, to the crest of *b*, the ilium, and at *c*, to the two internal thirds of the crural arch; posteriorly, to the summit of the transverse and spinous processes of the four first lumbar vertebræ. The fleshy fibres proceed transversely, and end in *e*, a flat sheet of tendon or aponeurosis, which, after being connected to the tendons of the two oblique muscles at the semicircular line, it then divides into two laminæ to form a sheath for the rectus abdominis; the anterior lamina is united with the aponeurosis of the external oblique muscle, and is extended over the front of the rectus; the posterior lamina is united with the aponeurosis of the internal oblique, and is extended behind the rectus, excepting at its lower part; for at the middle distance between the umbilicus and pubes, a slit or fissure is formed at *h*, in the aponeurosis of the transversalis, through which the rectus passes, so that the remainder of the aponeurosis passes before the rectus, and is anteriorly inserted into *f*, the ensiform cartilage, and *g*, the linea alba. The *external surface* of this muscle is covered by the obliquus internus, the *internal* by the peritoneum.

RECTUS ABDOMINIS.

This muscle, Fig. 131, *k*, *k*, Fig. 132, *i*, is situated immediately in front of the abdomen, on each side of the linea alba, under the anterior laminæ of the tendons of the oblique muscles. The rectus abdominis is long and flat, and is attached superiorly to the cartilages of the fifth, sixth, and seventh ribs, and to the ensiform cartilage; inferiorly to the pubes. It is divided by three or four tendinous intersections, marked in Fig. 131, *c*, *c*, denominated the transverse lines; by these divisions the muscle is connected firmly to the anterior part of the sheath, while it adheres very slightly by loose cellular substance to the posterior layer.

The *anterior surface* of this muscle is covered by the aponeurosis of the pectoralis major, and by a lamina of the abdominal aponeurosis, except at the lower part, where we commonly find the pyramidalis. The *posterior surface* is extended over the cartilages of the last three true ribs, a portion of the cartilages of the last two false ribs, the ensiform cartilage, the posterior fold of the abdominal aponeurosis, the internal mammary and the epigastric arteries, and the peritoneum.

The office of the last-mentioned muscles, viz., the external and internal oblique, the transversalis, and rectus, is to draw down the ribs in expiration; to bend the body obliquely, or to one side when one set acts singly, but when they act together they bend the thorax directly forwards. They have the power, when the ribs are fixed, of raising the pelvis; they also compress the abdominal viscera, so as to raise the diaphragm and expel the air from the lungs; lastly, they assist in the expulsion of the fœtus, urine, and fæces.

PYRAMIDALIS.

This is a very small muscle, Fig. 131, *h*, placed over the pubes. It is attached superiorly, near half-way between the pubes and umbilicus, to the linea alba; inferiorly to the pubes.

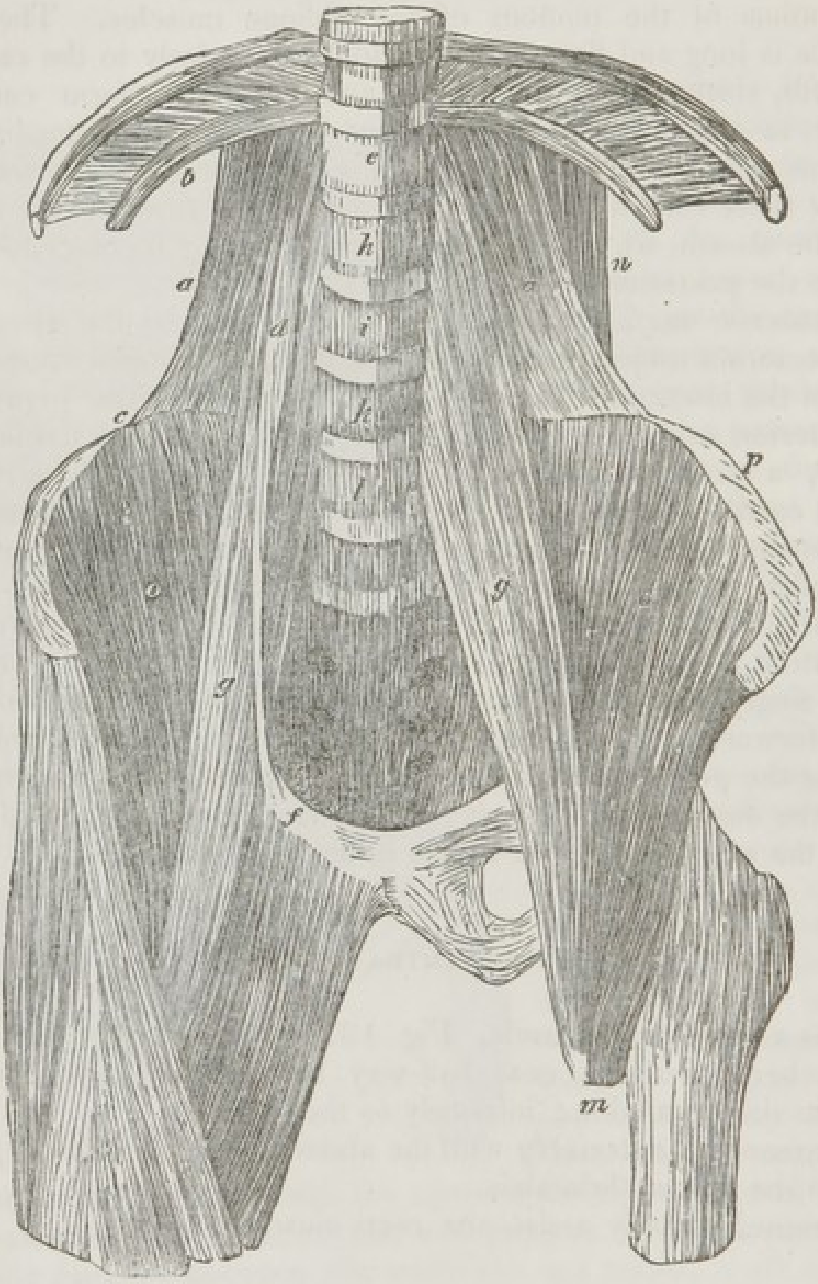
It is connected *anteriorly* with the abdominal aponeurosis; *posteriorly* with the rectus abdominis.

This muscle merely assists the recti muscles.

LUMBAR REGION.

PSOAS MAGNUS.

Fig. 133.



This muscle, *g*, *g*, is situated on the side and lower part of the vertebral column. It is attached superiorly, at *e*, to the last vertebra of the back, and at *h*, *i*, *k*, *l*, to the four superior vertebræ of the loins; inferiorly, at *m*, to the smaller trochanter of the os femoris.

The *anterior surface* of the psoas magnus is connected with the diaphragm, peritoneum, kidney, psoas parvus, external iliac artery, crural artery and vein; the inner side with the bodies of the lumbar vertebræ and the fibro-cartilages which separate them, and with the external iliac vein and the pectineus; the *posterior surface* with the quadratus lumborum, lumbar nerves, and the anterior lamina of the aponeurosis of the transversalis abdominis. Lower down it is connected with the os ilii and the capsular ligament of the hip joint.

This muscle is a flexor of the thigh on the pelvis, bending the thigh forwards, and rolling it outwards ; or, if the inferior extremities are fixed, it will assist in bending the body.

PSOAS PARVUS.

This muscle, *d*, does not exist in every subject ; it is small and thin, and placed before the preceding muscle. It is attached superiorly, at *e*, to the last dorsal vertebra and fibro-cartilage, which separates it from *h*, the first lumbar vertebra ; inferiorly, at *f*, to the brim of the pelvis.*

The *anterior surface* of the psoas parvus has the diaphragm, renal vessels and nerves, the peritoneum, and the external iliac artery, extending over it ; the *posterior surface* is united in its whole extent by the cellular tissue to the psoas magnus.

The contraction of this muscle will assist the great muscle in bending the body forwards on the pelvis.

ILIACUS INTERNUS.

This muscle, *o*, is placed in the cavity of the ilium, from which it is named ; it is large, thick, and radiated. It is attached superiorly, at *p*, to the two anterior thirds of the crest of the ilium, and to the principal part of the concave surface of that bone ; its converging fibres join *g*, the psoas magnus, and are inserted inferiorly with it by one common tendon into (*m*) the small trochanter of the thigh bone.

The *anterior surface* of this muscle is covered above by the peritoneum on the right, and by the cæcum ; on the left, by the sigmoid flexure of the colon ; more inferiorly, that is, below the crural arch, by the sartorius, the pectineus, and by the crural vessels and nerves. The *posterior surface* is extended over the iliac fossa, the superior part of the rectus femoris, and the hip joint.

This muscle powerfully assists in bending the thigh on the pelvis, or the latter on the thigh ; it acts strongly in progression, and in maintaining the body in the erect position.

QUADRATUS LUMBORUM.

The name of this muscle, *a*, *a*, is expressive of its figure and situation. It is attached superiorly, at *b*, to the last rib ; inferiorly, at *c*, to the posterior part of the crest of the ilium, and to the ilio-lumbar ligament ; and on the inner side, by tendons, to the transverse processes of the four first lumbar vertebræ.

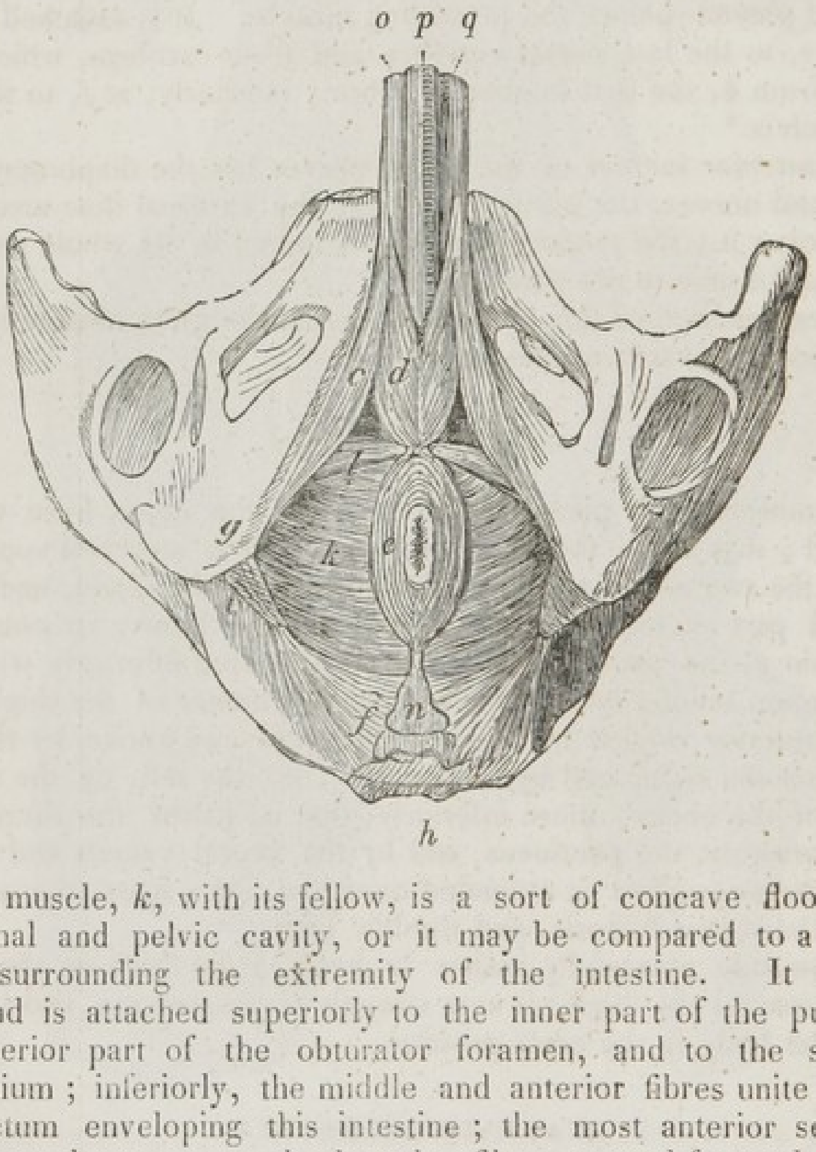
* This edge is also named the linea ilio-pectinea.

This muscle has the power of inclining the body to one side; if both muscles act, they are flexors of the chest upon the hips, and reciprocally the pelvis upon the trunk.

ANAL REGION.

LEVATOR ANI.

Fig. 135.



This muscle, *k*, with its fellow, is a sort of concave floor to the abdominal and pelvic cavity, or it may be compared to a shallow funnel surrounding the extremity of the intestine. It is very thin, and is attached superiorly to the inner part of the pubes, to the superior part of the obturator foramen, and to the spine of the ischium; inferiorly, the middle and anterior fibres unite beneath the rectum enveloping this intestine; the most anterior seem attached to the prostate gland; other fibres spread forwards on the commencement of the urethra, and backwards to *n*, the os coccygis, forming a tendinous line.

The *outer surface* of this muscle is connected by a layer of cellular tissue to the gluteus maximus, the obturator internus, and transversus perinæi. The *inner surface* is connected with the bladder, prostate gland, and lower part of the rectum.

The use of this muscle, as its name implies, is to draw up the rectum after its contents have been expelled.

COCCYGEUS.

This is a thin, flat, triangular muscle, *f*, attached on the one part to *g*, the spinous process of the ischium; its fibres diverge, and are inserted on the other part into *n*, the border of the os coccygis, and into *h*, the extremity of the sacrum.

The *posterior surface* of this muscle, which inclines downwards, is covered by the sacro-sciatic ligaments; the *anterior* is connected to the rectum by cellular tissue.

This muscle moves the coccyx, and secures it in its situation.

SPHINCTER ANI.

This muscle, *e*, is of an oval figure, open in its centre; its fibres surrounding the extremity of the rectum or anus are accurately expressed in the figure. It is attached, at *n*, to the os coccygis, by a species of cellular tendon, from whence two fleshy fasciculi proceed, uniting together in front of the anus.

The *upper surface* is connected with the levator ani by cellular tissue; the *lower surface* is covered by the common integuments.

This muscle closes the anus, and in the male draws down the bulb of the urethra.

GENITAL REGION.

I. IN THE MALE.

CREMASTER.

This muscle consists of a few scattered fibres, sent off by the obliquus internus abdominis, over the spermatic cord, and expanded upon the tunica vaginalis testis. For a view of this muscle we must refer back to Fig. 131, *g*.

This muscle draws up the testis.

ISCHIO-CAVERNOSUS, OR ERECTOR PENIS.

This is a small, elongated muscle, Fig. 135, *c*, placed along the ramus of the ischium, and root of *o*, the corpus cavernosum. It is attached on the one part to the tuber ischii, and on the other part to the fibrous membrane of the corpus cavernosum.

The *outer surface* corresponds with the ramus of the ischium; the *inner* is connected with the transversus perinæi and bulbo-cavernosus.

This muscle draws the root of the penis downwards and backwards. It is also called *ischio-cavernosus* from its origin and insertion.

BULBO-CAVERNOSUS, OR ACCELERATOR URINÆ.

This muscle, *d*, is situated beneath the bulb of the urethra, and covers part of *p*, the corpus spongiosum. It is attached to these parts, and its fibres are confounded with the muscles of the anal region ; but it is separated from its fellow muscle by a tendinous line.

The *superior surface* covers the bulb and commencement of the spongy portion of the urethra and corpus covernosum ; the *inferior surface* is connected with the preceding muscle and common integuments.

This muscle compresses the posterior part of the urethra, and urges forward any fluid which that canal may contain ; hence it has been sometimes denominated accelerator urinæ, vel ejaculator seminis.

TRANSVERSUS PERINEI.*

This is a flat thin muscle, *l* ; the name indicates its situation. It is attached on its outer part to the ramus and tuberosity of the ischium; on the inner part to the middle line, with its fellow on the opposite side.

The *exterior surface* is covered by the common integuments ; its other relations may be seen in the figure.

This muscle is supposed to dilate the urethra ; it certainly supports the lower part of the bladder and rectum.

There is frequently another slip of muscular fibres, taking the same course, termed *transversus perinei alter*.

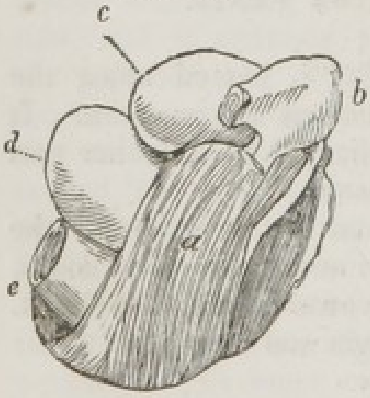
II. IN THE FEMALE.

ERECTOR CLITORIDIS.

This muscle is similar to that just described in the other sex, but is much smaller. It is attached on the outer side to the tuber ischii ; on the inner it terminates by embracing the cavernous body of the clitoris.

CONSTRICTOR VAGINÆ.

Fig. 136.



This muscle, *a*, consists of a number of muscular fibres, forming a sort of broad fleshy ring surrounding the vagina.†

This muscle contracts the part which it embraces.

* The perineum is that space which is between the genitals and the anus.

† *b*, the pubis, *c*, the bladder, *d*, the uterus, *e*, the rectum.

MUSCLES OF THE POSTERIOR PART OF THE TRUNK.

LUMBO-DORSAL REGION.

TRAPEZIUS.

Fig. 137.

The trapezius is a broad, flat muscle, *a*, *b*, *d*, and Fig. 138, *a*, *e*, *d*, situated at the posterior part of the neck, shoulder, and upper part of the back. It is attached superiorly, at *a*, the superior transverse line of the occipital bone, and to the cervical ligament, and to the spinous process of the seventh cervical vertebra ; inferiorly to the spinous processes of all the dorsal vertebræ ; on the outer side to *d*, the spine of the scapula, and the edge of this muscle slides over *e*, a triangular space at the extremity of that bone, to the acromion, and to *c*, the external third of the clavicle. The direction of the fibres is shown by the lines of the engraving.

The *posterior surface* of the trapezius is entirely covered by the common integuments; the *anterior surface* is connected at its upper and inner part with the complexus major; further down with the splenius, levator anguli scapulæ, and serratus posticus superior; at its lower part it covers the supra-spinatus, infra-spinatus, rhomboideus, latissimus dorsi, and sacro-lumbalis muscles.

When all the fibres of this muscle act simultaneously, they draw back the scapula and clavicle; the upper fibres will elevate the tip of the shoulder, the lower will move it backwards and obliquely downwards. If the shoulder is fixed, the trapezius has the power of inclining the head to one side.

LATISSIMUS DORSI.

This is a large, thin, flat muscle, placed on the back and side of the lower part of the trunk. It is attached superiorly, at *f*, to the inner edge of the groove in the os humeri, which receives the long tendon of the biceps; inferiorly, to the posterior half of *g*, the external border of the crest of the ilium, and at *l*, to the back and upper part of the sacrum; on the inner side it is fixed to the spinous processes (from *b* to *l*) of all the lumbar vertebræ, and to those of the six or seven lower dorsal; on the outer side to the four last ribs, at *n*, *n*, *n*, *n*, by as many digitations. The direction of the fibres is expressed in the figure; they are aponeurotic at the internal and inferior part of the muscle, tendinous at its insertion into the humerus, and fleshy in other parts. The superior edge passes over the inferior angle of the scapula at *m*, and sometimes has a slip attached to it, and the margin, at *f*, forms the fold of the back part of the arm-pit. This muscle is also represented in Fig. 138, at *b*.

The *posterior surface* of this muscle is covered by the integuments, excepting at its upper and inner part, which is covered by *a*, *d*, *b*, the trapezius. The *anterior surface* is connected with the obliquus abdominis, serratus posticus inferior, sacro-lumbalis, levatores costarum, external intercostal muscles, the serratus magnus, rhomboideus, teres major, infra-spinatus, the lower ribs, and the inferior angle of the scapula.

The office of the latissimus dorsi is to carry the arm backwards and downwards; or when the hand is fixed, to bring forward the body.

DORSO-CERVICAL REGION.

RHOMBOIDEUS.

Fig. 138.

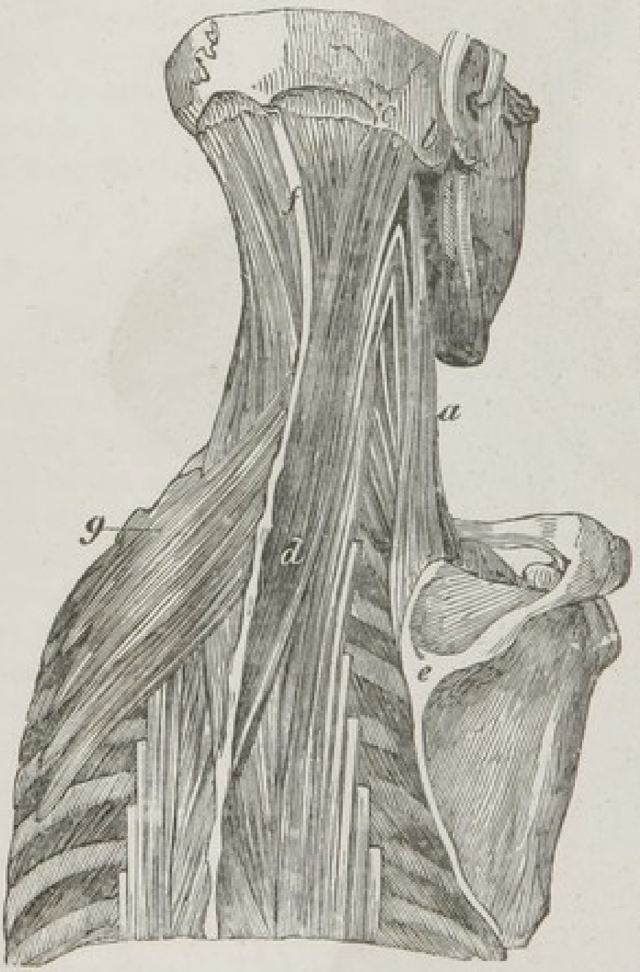
The situation and form of this muscle, *i*, *f*, is clearly exhibited in the figure. It is attached by its internal margin to the posterior cervical ligament, to the spinous process of the seventh cervical vertebra, and to those of the four or five first dorsal ; by its internal margin, at *n*, to all the base of the scapula below *o*, the spine of the bone. This muscle is divided by a cellular line into two portions : therefore frequently denominated, *f*, the *rhomboideus major*, *i*, the *rhomboideus minor*.

The *posterior surface* of the rhomboideus is covered by the trapezius and latissimus dorsi ; the *anterior surface* covers the serratus posticus superior, the splenius, the sacro-lumbalis, the ribs, and external intercostal muscles.

The action of this muscle is to bring the scapula obliquely upwards and directly backwards.

LEVATOR SCAPULÆ.

Fig. 139.



This is a long, thick muscle, *a*, placed at the side and back of the neck. It is attached superiorly to the transverse processes of four or five of the superior vertebræ of the neck, by distinct tendons; these unite and form a strong muscle, which is fixed inferiorly into the base of the scapula above *e*, the spine. See also Fig. 138, *h*.

The *outer surface* of this muscle is covered on the upper part by the sterno-cleido-mastoideus, in the middle by the skin, and below by the trapezius. The *inner surface* is connected with the serratus posticus superior, the sacro-lumbalis and splenius.

This muscle raises the posterior angle of the scapula, and consequently depresses the tip of the shoulder; it has the power also of inclining the neck to one side, or maintaining it in an erect position, when it acts in conjnnction with its fellow.

SERRATUS POSTICUS SUPERIOR.

This muscle, *g*, is very thin; its situation and form are delineated in the figure. It is attached by its internal border to the posterior cervical ligament, to the spinous process of the last cervical vertebra, and to those of the three upper dorsal; outwardly, by distinct fleshy portions, or digitations, into the second, third, fourth, and sometimes the fifth ribs, a little beyond the angle.

The *posterior surface* is connected with the rhomboideus, the levator anguli scapulæ, serratus magnus, and trapezius ; the *anterior surface* with the splenius, longissimus dorsi, transversalis colli, sacrolumbalis, ribs, and the external intercostals.

The action of this muscle dilates the thorax, by elevating the ribs.

SERRATUS POSTICUS INFERIOR.

For the form of this muscle, the reader is referred back to the preceding engraving, Fig. 138, *l*. It is situated at the inferior part of the back, and, like the serratus superior, is broad and thin. It is attached by its inner border to the spinous processes of the two lower dorsal vertebræ, and to those of the three upper lumbar ; at its outer border, by distinct slips, into the four inferior ribs.

The *posterior surface* is connected with the latissimus dorsi ; the *anterior surface* with the three lower ribs, the corresponding intercostal muscles, and the posterior lamina of the aponeurosis of the transversalis abdominis.

This muscle depresses the ribs, and draws them backwards.

SPLENIUS.

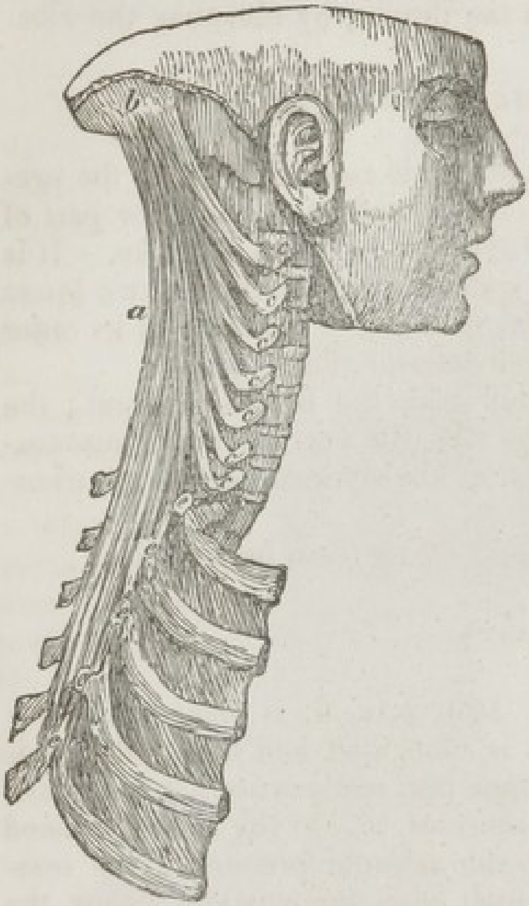
This muscle, Fig. 138, *k*, Fig. 139, *b*, *c*, *d*, is placed obliquely at the back of the neck ; its form is elongated and flattened. It is divided by a line of cellular membrane into two portions, which have sometimes been considered as two muscles, and in the last-mentioned figure is attached superiorly at *b*, to the mastoid process of the temporal bone, and at *c*, to the occipital bone immediately below the superior transverse ridge ; inferiorly, at *d*, to the last cervical and six upper dorsal vertebræ.

The *external surface* of the splenius is connected with the sterno-cleido-mastoideus, the trapezius, levator anguli scapulæ, serratus posticus superior, and rhomboideus ; the *internal surface* with the great and little complexus.

The contraction of this muscle will turn the head, or incline the head and neck completely backwards ; when both muscles act together, they bend the head directly backwards.

COMPLEXUS.

Fig. 140.



The situation and form of this muscle, *a*, is obvious in the figure before us. It is attached superiorly, at *b*, between the transverse ridges of the occipital bone; inferiorly, by isolated fasciculi of tendinous and fleshy fibres, at *c*, *c*, *c*, *c*, *c*, *c*, to the transverse and articular processes of the last six cervical vertebræ, and at *e*, *e*, *e*, *e*, to the transverse processes of the four or five first dorsal vertebræ. These attachments are frequently confounded with those of the transversus colli.

The *external surface* is connected with the trapezius, splenius, and trachelo-mastoideus; the *internal* with the semi-spinalis colli, the arteria cervicalis profunda, the posterior branches of the cervical nerves, the rectus capitis posticus minor, and the obliquus capitis inferior.

This muscle draws the head backwards and to one side. When the two act together, the face is turned upwards.

TRACHELO*-MASTOIDEUS.

Fig. 141.

This muscle is much smaller than the preceding, and is placed on its outer edge. It is attached superiorly, at *a*, to the posterior part of the mastoid process of the temporal bone; inferiorly, at *b*, to the transverse processes of the four last cervical vertebræ, and sometimes, at *c*, to the first dorsal, by distinct tendinous and fleshy fasciculi. The trachelo-mastoideus is also connected at its inner edge by a fleshy band to the longissimus dorsi. Both this and the preceding muscles are traversed by aponeurotic intersections or bands, varying in direction and position.

The *outer surface* of this muscle is connected with the splenius and transversalis colli; the *inner* with the complexus and obliquus capitis, the posterior extremity of the digastricus, and the occipital artery.

The action of this muscle keeps the head erect, or inclines it a little backwards or to one side, without rotation.

POSTERIOR OCCIPITO-CERVICAL REGION.

RECTUS CAPITIS POSTICUS MAJOR.

Fig. 142.

This is a small muscle, *a*, situated on the upper part of the back of the neck. It is attached superiorly to the lower transverse ridge of the occ pital bone, and to part of the depression above that ridge, between the rectus capitis posticus minor and obliquus capitis superior. Inferiorly it is fixed to the spinous process of the dentata or second cervical vertebra.

The *posterior surface* of this muscle is connected with the complexus and obliquus capitis superior, *the anterior surface* with the occipital bone, the atlas, the rectus capitis posticus minor and the vertebral artery.

* So called from a Greek word for the neck. This and the former muscles are as frequently denominated complexus major et minor, and their resemblance may be seen by comparing the figures before us.

RECTUS CAPITIS POSTICUS MINOR.

This is a very small muscle, *b*, attached superiorly to the occipital bone behind the foramen magnum, and a little to the side of the inferior curved line ; inferiorly to the tubercle at the posterior arch of the atlas.

The *posterior surface* of this muscle, which is inclined downwards, is connected with the great complexus and with the preceding muscle ; the *anterior surface* with the occipital bone, the atloido-occipital ligament, and the vertebral artery.

OBLIQUUS CAPITIS SUPERIOR.

The relative size and situation of the obliquus capitis superior, *c*, is expressed in the figure ; it is attached superiorly to the outer part of the curved line of the occipital bone ; inferiorly to the transverse process of the first cervical vertebra, in front of *b*, the preceding muscle.

The *posterior surface* is connected with the complexus, the trachelo-mastoideus, and the splenius ; the *anterior* with the occipital bone, the vertebral artery, and the attachment of the rectus capitis posticus major.

OBLIQUUS CAPITIS INFERIOR.

This muscle, *d*, will be found to resemble very much the superior oblique ; it is attached superiorly to the transverse process of the atlas, and inferiorly to the spinous process of the dentata.

The *posterior surface* is connected with the complexus and trachelo-mastoideus ; the *anterior* with the second vertebra, and with the posterior ligament uniting the axis and atlas, and with the vertebral artery.

The office of the four muscles just described, according to their several directions and obliquity, is to rotate the head, incline it backwards or to one side, and to maintain the head in the erect position.

INTERSPINALES CERVICIS.

There are six very small muscles, at *e*, *e*, *e*, *e*, *e*, *e*, on either side of the intervals of the spinous processes of the neck. Each of them is attached superiorly to the lower surface of the spinous process, and inferiorly to the upper surface of the next spinous process below it.

These muscles draw the spinous processes nearer to each other, and consequently incline the head backwards. Similar sets of muscles occupy the spaces between the spinous processes of the vertebræ of the back and loins ; in the neck, however, they are double, corresponding to the bifurcations of the spinous processes. In the back and loins they are indistinct, and are rather like tendons than muscles.

VERTEBRAL REGION.

LONGISSIMUS DORSI.

Fig. 143.

The longissimus dorsi, *d*, *d*, constitutes part of the thick muscular mass which occupied the space between the spinous processes of the vertebræ and the angle of the ribs. On the inner side it is attached by small double tendons to all the transverse processes of the back, and to the last transverse process of the neck; from its outer side it sends forth fleshy and tendinous filaments, which are inserted into the eight lower ribs. Inferiorly, it is attached in common with the sacro-lumbalis.

The *internal surface* of the longissimus dorsi is connected with the multifidus spinæ, complexus, and transversalis colli; the *external* is contiguous to the sacro-lumbalis; the *anterior* is placed upon the levatores costarum, the ribs, the transverse processes of the vertebræ, the posterior costo-transverse ligaments, the dorsal vessels and nerves, and a portion of the external intercostal muscles. The *posterior surface* is connected with the aponeurosis of the obliquus internus and transversalis abdominis, serratus posticus superior, latissimus dorsi, trapezius, rhomboideus, and splenius.

SACRO-LUMBALIS.

Fig. 144.

This muscle, *a*, *a*, is situated on the outer side of *b*, the longissimus dorsi, extending from the sacrum to the neck. On the right side of the figure we see it attached on the outer part of the lower edge of all the ribs, by as many distinct tendons; on the inner part we find it is attached to the upper border of nine or ten of the lower ribs by as many tendons. The muscle on the left side is drawn back with the hook *f*, to show these tendons. There are some portions of this muscle marked, *g*, *g*, which are inserted into the transverse procssses of five or six of the lower cervical vertebræ by as many distinct tendons. These fasciculi are frequently described under the name of the *cervicalis descendens.* The sacro-lumbalis is inferiorly fleshy within and aponeurotic without; and, as I before observed, forms one inseparable muscle with the longissimus dorsi, which is attached, at *e*, to the sacrum, he posterior spine of the lium, all the spinous processes, and near the roots of the transverse processes of the lumbar vertebræ; not separating from *b*, *b*, its companion, just mentioned, till it reaches the ribs.

The *anterior surface* of the sacro-lumbalis is connected with the aponeurosis of the transversalis abdominis, the ribs, and external intercostal muscles, the longissimus dorsi, and transversalis colli. The *inner side* with the longissimus dorsi; the *outer side* with the line of union of the posterior laminæ of the aponeurosis of the transversalis abdominis.

The longissimus dorsi and sacro-lumbalis preserve the vertebral column from yielding to the weight placed on it and before it; in a word, they are the most powerful muscles that are employed in keeping the body erect.

TRANSVERSALIS COLLI.

This muscle, Fig. 143, *a*, lies on the inner side of the longissimus dorsi, and is indeed sometimes considered as an appendage to it. It is attached superiorly, by small tendons, to the transverse processes of the second, third, fourth, fifth, and sixth cervical verterbræ; inferiorly it is fixed by tendinous and fleshy slips to the transverse processes of the third, fourth, fifth, sixth, and seventh dorsal vertebræ.

The *posterior edge* of this muscle is blended with the trachelo-mastoideus muscle; in the middle it is connected with the levator anguli scapulæ and the serratus posticus superior, and below with the longissimus dorsi. The *anterior edge* is connected with the transverse processes of the second cervical to the eight dorsal vertebra. The *outer surface* corresponds with the splenius, levator anguli scapulæ, and sacro-lumbalis; the *inner* with the complexi and part of the multifidus spinæ.

This muscle turns the neck obliquely backwards and to one side.

MULTIFIDUS SPINÆ.

The fasciculi, *c*, *c*, Fig. 143, composing this mass of muscles, are placed obliquely from the transverse processes to the spinous processes. They are attached by distinct tendons to all the spinous, transverse, and articular processes of the six last cervical vertebræ, the twelve dorsal, and the five lumbar, and to the posterior surface of the sacrum.*

The *postarior surface* of these muscles is connected with the trachelo-mastoideus, arteria cervicalis profunda, posterior cervical nerves, and longissimus dorsi; the anterior surface with the plates of the vertebræ, their transverse and oblique processes, and the ligamenta subflava; on the *inner side* with the spinous processes of the vertebræ, the inter-spinalis cervicis, and the dorsal and lumbar interspinous ligaments.

The office of these muscles is to incline the vertebral column to one side; but when the muscular fibres on each side act, they keep the body erect.

INTER-TRANSVERSALES COLLI.

These are small muscles which fill up the spaces between the transverse processes of the vertebræ of the neck. They are distinguished into anterior, six in number on either side, and into posterior, five in number. The two muscles of each interval are sepa-

* These have been described by some anatomists as three distinct sets of muscles, viz., *transverso-spinalis colli*, *transverso-spinalis dorsi*, *transverso-spinalis lumborum*.

rately attached, and extend from the inferior border of the transverse process of the vertebra above, to the superior border of the transverse process of the vertebra below.

The *anterior set* are connected in front with the rectus capitis anticus major; the *posterior* behind, with the splenius, transversalis colli, and sacro-lumbalis.

These muscles contribute to the lateral motions of the neck.

INTER-TRANSVERSALES LUMBORUM.

Between the transverse processes of the lumbar vertebræ are fleshy fasciculi, similar to those just described. There are five on each side; they are stronger and more distinct than the preceding muscles.

Their *posterior surface* is connected with the sacro-lumbalis; the *anterior* with the quadratus lumborum. Their *lower* and *upper* edges are connected with the corresponding adjacent transverse processes by means of short aponeurotic fibres.

These muscles are supposed to bend the lumbar region of the vertebral column laterally; the short muscles of the spine certainly strengthen the back during muscular exertions.

CHAP. V.

MUSCLES OF THE EXTREMITIES.

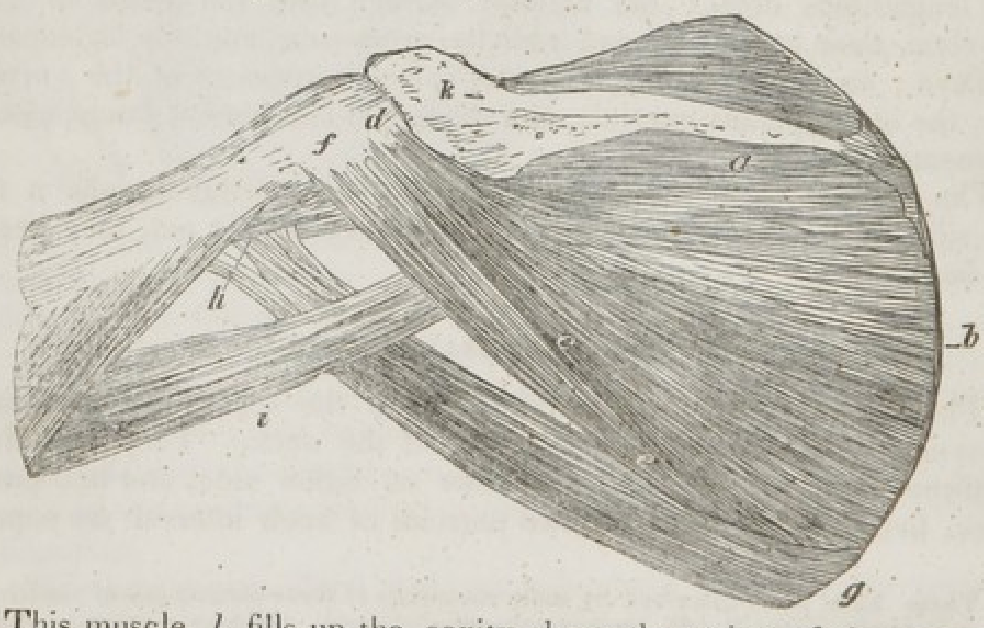
MUSCLES OF THE SUPERIOR EXTREMITY.

MUSCLES OF THE SHOULDER.

POSTERIOR SCAPULAR REGION.

SUPRA-SPINATUS.

Fig. 145.



This muscle, *l*, fills up the cavity above the spine of the scapula.

Its attachment on the inner side is fleshy, from the whole concave surface above *k*, the spine of the scapula, from the spine, and from the superior border of that bone passing under the acromion and adhering to the capsular ligament of the joint ; on the outer part it forms a strong tendon, which is inserted into the greater tuberosity of the humerus.

The *posterior surface* of this muscle is connected with the trapezius, deltoides, and coraco-acromial ligament ; the *anterior* with the fossa supra-spinata, the superior scapular vessels and nerves, and with the capsule of the shoulder joint.

This muscle raises the arm, and if the arm is fixed, it acts upon the shoulder.

INFRA-SPINATUS.

The infra-spinatus, *a*, *b*, *c*, *d*, occupies that space on the back of the scapula which is below the spine. It is attached, on the inner side, to the two internal thirds of the infra-spinata fossa ; the fibres converge towards a central tendon which runs over the neck of the bone, adheres to the capsular ligament, and is inserted into *d*, the greater tuberosity of the humerus.

The *posterior surface* of the infra-spinatus is connected with the deltoides, trapezius, latissimus dorsi, and integuments ; the *anterior surface* with the infra-spinata fossa, from which it is separated, in its outer third, by cellular tissue, and by the superior scapular nerve and vessels. It is also applied upon the capsule of the shoulder joint. The *lower edge* is confounded with *e*, *f*, the teres minor.

This muscle turns the arm outwards, and assists in raising it.

TERES MINOR.

This muscle, *e*, *f*, is placed along the inferior border of the scapula. A strong aponeurosis covers this and the infra-spinatus ; indeed, the two muscles in some subjects are so closely united, as to be with difficulty separated. On the inner part, it is attached to the inferior angle of the scapula, and to the third of the inferior border of that bone ; on the outer part it extends to *f*, the lower and back part of the tuberosity of the humerus, where it is fixed by a strong tendon.

The *posterior surface* is connected with the deltoides and integuments ; the *anterior* with the external scapular artery, the long portion of the triceps, and the capsule of the articulation of the shoulder. *Superiorly*, it is connected with *c*, *d*, the lower edge of the infra-spinatus muscle ; *inferiorly*, with *g*, *h*, the teres major, from which at one part it is separated by *i*, the long portion or the triceps.

The office of the teres minor is similar to that of the preceeding muscle.

TERES MAJOR.

This muscle, *g*, *h*, is situated beneath the teres minor. On the inner side it is attached to the quadrilateral surface of the inferior border of the infra-spinata fossa, and to the lower third of the base of the scapula. On the outer side it is inserted by a broad tendon into the inner side of the bicipital groove of the humerus.

The *posterior surface* is connected with the latissimus dorsi, the integuments, the humerus, and the long portion of the triceps ; the *anterior* with the subscapularis, latissimus dorsi, coraco-brachialis and biceps, the axillary vessels and brachial plexus of nerves. The *lower edge* is covered by the integuments, and with the latissimus dorsi, forms the posterior edge of the axilla. The *upper edge* is united to the teres minor, from which at one part it is separated by the long portion of the triceps.

The teres major turns the arm inwards and draws it backwards.

ANTERIOR SCAPULAR REGION.

SUBSCAPULARIS.

Fig. 146.

This is a very thick triangular muscle, *a*, occupying the whole of the subscapular fossa. It is attached on the inner side to the internal three fourths of the subscapular fossa ; the fibres are disposed in fleshy bundles with aponeurotic septa, which, converging, slide over the inner surface of the neck of the scapula, and pass under *i*, the coracoid process ; it then forms a broad and flat tendon which adheres to the capsule of the joint, and is finally fixed at *c*, to the small tuberosity of the humerus.

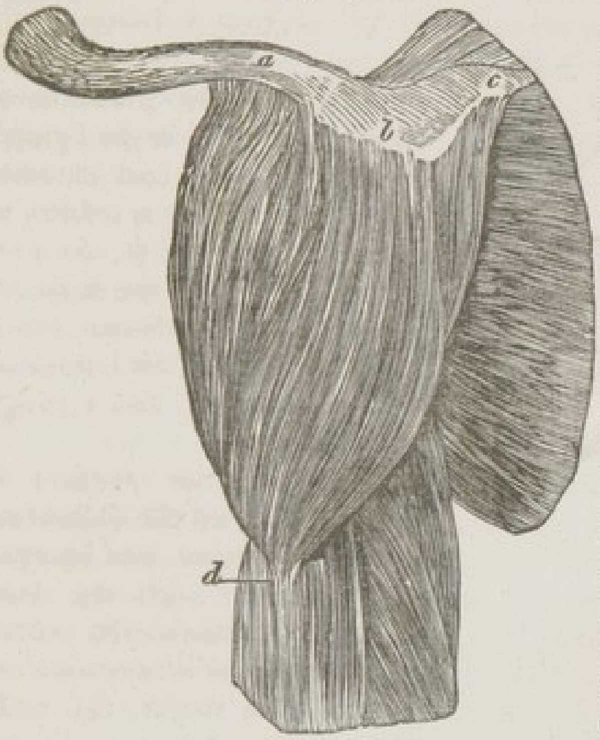
The *anterior surface* of the subscapularis is connected by a thick layer of cellular tissue with the serratus magnus, the brachial plexus of nerves, the axillary artery, and the coraco-brachialis, the biceps and the deltoid muscles ; the *posterior surface* with the subscapular fossa, and with the teres major, the long portion of the triceps extensor cubiti, and with the capsule of the articulation of the shoulder.

When the arm is distant from the body it draws it near ; or it turns the arm inwards ; or when raised depresses it.

EXTERNAL SCAPULAR REGION.

DELTOIDES.*

Fig. 147.



The deltoides forms the fleshy part of the shoulder; its shape and the direction of its fibres are exhibited in the figure. Superiorly it is attached by aponeurotic fibres at *a*, to the external third of the clavicle; at *b*, to the acromion process; and at *c*, to the lower margin of the spine of the scapula; inferiorly the fibres concentrate to a tendon which is inserted at *d*, into the deltoid impression in the middle part of the external surface of the humerus. This muscle is composed of large fasciculi of fibres separated by grooves more or less deep. The inner surface is aponeurotic; and where it lies over the greater tuberosity of the os humeri, there is a bursa of considerable size.

The *external surface* of the deltoides is connected with the platysma myoides, and the integuments; the *internal* with the infra-spinatus, teres minor, and triceps extensor muscles, the tendon of the supraspinatus, the acromio-coracoid ligament, the subscapularis, pectoralis minor, biceps and coraco-brachialis muscles, the coracoid process, the capsule of articulation, the superior third of the external surface of the humerus, and tendon of the pectoralis major. The anterior part, which is parallel to the external border of the biceps, is separated from the pectoralis major by the cephalic vein.

The principal office of this muscle is to raise the arm; but it is also capable of moving it forwards or backwards, according as the anterior or posterior fibres are brought into action.

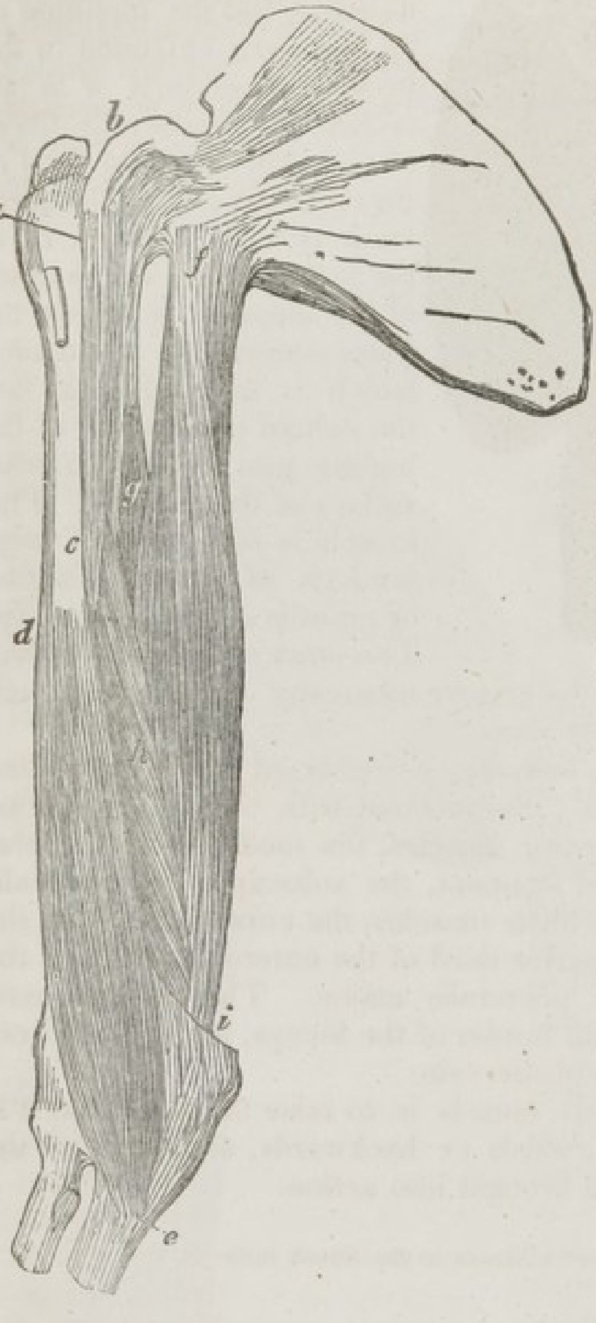
*So named from its resemblance to the Greek letter *Δ*.

MUSCLES OF THE ARM.

ANTERIOR BRACHIAL REGION.

CORACO-BRACHIALIS.

Fig. 148.



We see the situation of this muscle, *a*, in the figure; it is long, flat, and narrow. It is attached by a tendon at *a*, to the apex of *b*, the coracoid process of the scapula; it terminates tendinous about *c*, the middle of the humerus, and is inserted into a rough elevated line.

The *anterior surface* is connected with the deltoides, pectoralis major, and biceps; the *posterior* with the subscapularis muscle, the united tendons of the latissimus dorsi and teres major, the axillary artery, the musculo-cutaneous and median nerves, and the brachial artery.

This muscle moves the arm forwards, upwards, and inwards.

The coraco-brachialis is perforated by a nerve called *musculo-cutaneous*. The intermuscular aponeurosis is seen extending from the lower part of this muscle along a ridge to the internal condyle, separating the brachialis internus from the third head of the triceps.

BICEPS FLEXOR CUBITI.

This muscle, Fig. 146, *k*, is situated at the front and inner part of the arm; it is thick at its middle portion, thin at its extremities, the superior of which is divided into two portions. Its short portion is attached at *h*, to the coracoid process of the scapula, along with *m*, the preceding muscle, and by *g*, its long portion, to the superior part of the glenoid cavity ; at *k*, the two portions or heads form a thick mass, and about the middle of the arm become inseparably united ; it is finally inserted at its inferior extremity to *l*, the tubercle at the upper end of the radius, and by a tendinous expansion into the aponeurosis of the fore-arm.

The *anterior surface* of this muscle is connected with the deltoid and great pectoral muscles, the brachial aponeurosis, and the integuments ; the *posterior* with the humerus *a*, Fig. 148, the coraco-brachialis *d*, *e*, the brachialis internus, and the musculo-cutaneous nerve ; on the *inner side* with the coraco-brachialis above, and in the middle and below with the brachial artery.

The biceps flexor cubiti bends the fore-arm on the arm, and the arm on the shoulder.

BRACHIALIS INTERNUS.

This muscle, *d*, *e*, is situated at the anterior and inferior part of the arm. At its upper extremity, *d*, it is attached on each side of the insertion of the deltoides, to the external and internal surface of *c*, the humerus, and to most of the lower and fore part of the bone, as far as the articulation of the elbow joint ; it has also an attachment to the external and internal aponeurosis, and inferiorly, by a strong tendon at *e*, to the rough surface immediately below the coronoid process of the ulna. The fibres pass over the joint, and adhere to the capsular ligament.

The *anterior surface* of this muscle is connected with the brachial aponeurosis and the integuments, the supinator radii longus, the biceps, the musculo-cutaneous nerve, the brachial artery, the median nerve, and the pronator teres ; the *posterior surface* with the inferior part of the humerus and the articulation of the elbow.

The brachialis internus bends the fore-arm.

TRICEPS EXTENSOR CUBITI.

The triceps, *f*, *g*, *h*, *i*, occupies all the posterior part of the arm. It is very thick and fleshy, and is divided at the upper part into three portions, whence it derives its name. Of these, the *first* or middle, which is longer and larger than the others, is attached by a broad tendon *f*, to the inferior border of the scapula, near its neck ; it then forms a large fleshy mass, which covers the back of the os humeri. The *second* or outer portion, *g*, is attached by a pointed extremity to the outer and back part of the os humeri, below the great tuberosity, and to a ridge which runs from that eminence to the outer condyle, and to the intermuscular aponeurosis, which is common to it and the brachialis internus. The *third* or inner portion, *h*, which is the shortest, commences by an acute form from the inner edge of the os humeri near its middle, and receives an addition of fibres from the intermuscular partition ; its fleshy fasciculi descend backwards and outwards. The three portions of this muscle unite about the middle of the humerus, invest the whole back part of the bone, and terminate by a very strong, broad, and thick tendon, which is inserted into the upper part of the olecranon.

The *posterior surface* of the triceps extensor is connected above with the deltoides and teres minor, the brachial aponeurosis and integuments. The *anterior surface* is connected with the subscapularis, teres major, and latissimus dorsi, the capsule of the articulation of the shoulder, and the posterior part of the elbow joint.

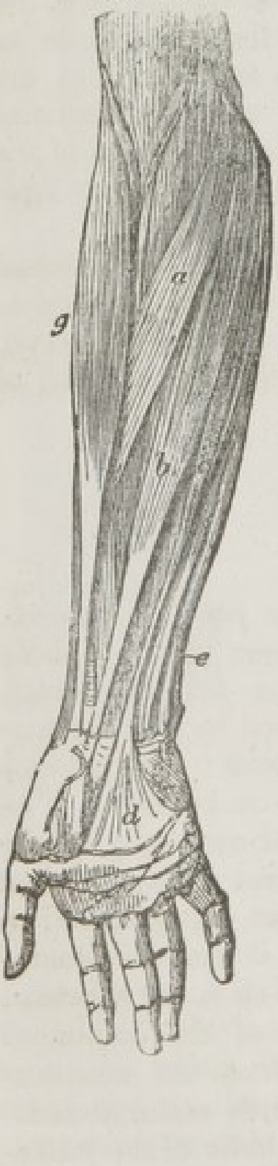
The triceps extensor, by extending the fore-arm, acts in opposition to the biceps flexor. The long portion has the power of carrying the arm backwards.

MUSCLES OF THE FORE-ARM.

ANTERIOR REGION OF THE FORE-ARM.

PRONATOR RADII TERES.

Fig. 149.



This muscle, *a*, is extended obliquely across the upper and anterior part of the fore-arm. See also Fig. 150, *a*, *b*, *c*, and Fig. 153, *a*, *b*. Superiorly it is attached to the anterior part of the inner condyle of the humerus, and to the inner side of the coronoid process of the ulna; between these two parts the median nerve passes. Inferiorly it is fixed to the middle part of the external surface of the radius.

The *anterior surface* of this muscle is connected with the aponeurosis of the fore-arm and integuments, the supinator radii longus, the radial vessels and nerves, and the external radial muscles; the *posterior surface* with the brachialis internus, the flexor sublimis, the median nerve, and the ulnar artery; on the *inner side* with the triangular space for the tendon of the biceps, the brachial artery, the median nerve, and the supinator radii brevis.

The pronator teres turns the radius and hand inwards, or it may assist as a flexor of the fore-arm.

FLEXOR CARPI RADIALIS.

This muscle, *b*, is situated on the inner side of the preceding. It has a tendinous attachment to the fore part of the inner condyle of the humerus, fleshy to the fascia and intermuscular aponeurosis, and to the upper end of the ulna. The extent of its muscular fibres is marked in the figure. The tendon of this muscle passes under the annular ligament of the wrist, through a groove in the trapezium, and is fixed to the base of the metacarpal bone which sustains the fore-finger.

The *anterior surface* of the flexor carpi radialis is connected externally with *a*, the pronator teres, and with the aponeurosis of the fore-arm ; the *posterior surface* with the flexor digitorum perforatus, the flexor longus pollicis muscles, and the wrist.

This muscle bends the wrist, turning it a little inwards. It also serves as a flexor of the fore-arm.

PALMARIS LONGUS.

This muscle, *c*, *d*, is not always to be found in the arm. It has a slender form, and is attached superiorly by tendinous fibres to the inner condyle of the os humeri ; it then forms, at *c*, a thin fleshy mass, which, about the middle of the arm, sends off a small tendon which is inferiorly adherent to the annular ligament, and is spread out into a very strong tendinous membrane, *d*, named the *palmar aponeurosis*, which is finally fixed to the roots of all the fingers.

The *anterior surface* is connected with the aponeurosis of the fore-arm ; the *posterior surface* with the superficial flexor of the fingers.

The palmaris binds down the muscles of the palm of the hand, and its aponeurosis protects the blood-vessels and nerves in their course to the fingers.

FLEXOR CARPI ULNARIS.

The flexor carpi ulnaris, *e*, is situated internally to the preceding muscles of the fore-arm. It is half-penniform, and is attached by means of a common tendon to the inner side of the olecranon, and to the posterior border of the ulna ; a number of its fibres are also united to the aponeurosis of the fore-arm. Inferiorly it becomes tendinous, and is inserted into the pisiform bone, and some fibres are detached from it to the annular ligament of the wrist.

The *anterior surface* of this muscle is connected with the aponeurosis of the fore-arm ; the *posterior surface* with the deep flexor of the fingers, the ulnar artery and nerve, and the pronator quadratus, and on the outer edge with the flexor sublimis.

This muscle bends the wrist, inclining it a little towards the ulna. When it contracts at the same time with the flexor carpi radialis, it draws the hand directly upwards.

FLEXOR DIGITORUM SUBLIMIS VEL PERFORATUS.

Fig. 150.

This muscle, *d*, *e*, is situated immediately beneath the preceding muscles. It is attached superiorly at *d*, to the inner condyle of the humerus; at *b*, to the coronoid process of the ulna; and at *c*, to the upper part of the anterior border of the radius; these several attachments as they descend form a strong fleshy mass, which sends off four tendons; the tendons are connected by cellular tissue, and pass under the annular ligament of the wrist; from thence diverging as they proceed towards their respective fingers, each tendon, as it were, splits at the extremity of the first phalanx for the passage of the flexor profundus, and is attached to the second phalanx.

In this figure the fibrous sheaths of the fingers are pinned open; and in the fore finger, at *g*, we observe the splitting of the tendon just mentioned.

The *anterior surface* of this muscle is connected with the pronator teres, the flexor carpi radialis, the palmaris longus, the aponeurosis of the fore-arm, the annular ligament, the palmar aponeurosis, the fibrous sheaths of the fingers, and with the tendons of the deep flexor. The *posterior surface* is connected with the flexor profundus, the flexor longus pollicis, the median nerve the ulnar artery, the lumbricales muscles, and the phalanges.

This muscle bends the second joint or phalanx upon the first, and the hand upon the fore-arm.

Fig. 151.

a, Tendon of the flexor sublimis; *b*, the division or slit in the tendon for the passage of *c*, the tendon of the flexor profundus, to be attached at *e*, the extremity of the finger.

SUPINATOR RADII LONGUS.

This muscle, Fig. 149, *g*, is attached superiorly by short tendinous fibres to the external condyle of the humerus, whence it passes downwards fleshy, until it arrives at about the middle of the radius, where it becomes tendinous, and is at length inserted by a long narrow tendon, near the base of the styloid process of the radius.

Its action is to roll the radius outwards, and, consequently, the palm of the hand upwards.

ANTERIOR DEEP REGION OF THE FORE-ARM.

FLEXOR DIGITORUM PROFUNDUS VEL PERFORANS.

Fig. 152.

This muscle is situated beneath the preceding; superiorly it is attached, at *a*, to the three superior fourths of the anterior and internal surfaces of the ulna, and at *b*, to the interosseous ligament; the muscular fibres then form a thick mass upon the fore part of the ulna, and divide into four portions, each of which is terminated by a tendon. These tendons pass under the annular ligament of the wrist, and perforate the slits or fissures in the flexor sublimis, as in Fig. 150, and at length are inserted into the anterior part of the third phalanx of the fingers. Figure 151 best explains the mode in which the tendon of the flexor sublimis, *a*, divides at *b*, to transmit the tendon of the flexor profundus, *c*, *e*.

The *anterior surface* of the flexor profundus is connected with the flexor sublimis and flexor carpi ulnaris muscles, the median and ulnar nerves, and the ulnar artery; the *posterior surface* with the fore and inner surfaces of the ulna, the interosseous ligament, the pronator quadratus, the anterior radio-carpal ligaments, the fore part of the metacarpus, the flexor brevis and adductor pollicis, and the two last palmar interosseous muscles.

This muscle bends the third, or extreme joint of the fingers, and assists generally in the flexion of the fingers, hand, and wrist.

FLEXOR LONGUS POLLICIS MANUS.

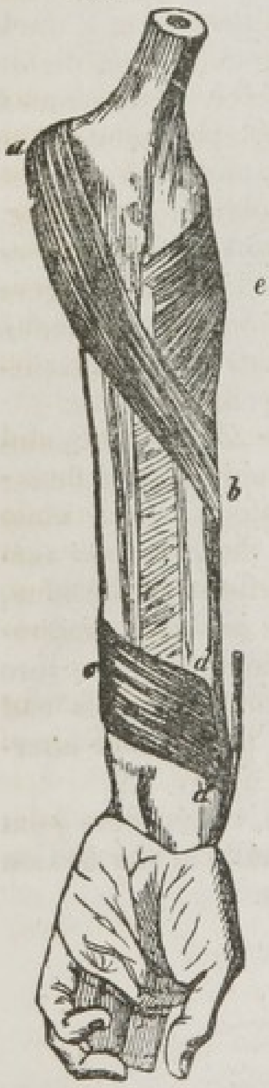
This muscle, Fig. 150, *f*, *h*, Fig. 152, *c*, lies on the outer side of the flexor profundus; superiorly it is attached by fleshy fibres to the fore part of the radius and interosseous ligament, and has frequently a tendon from the inner condyle of the humerus. The fibres, *f*, pass obliquely into a tendon on the anterior part of the muscle; this tendon passes under the annular ligament of the wrist, runs between the two portions of the short flexors of the thumb, and is attached inferiorly at *h*, the last joint.

The *anterior surface* of the long flexor of the thumb is connected with the flexor digitorum sublimis, flexor carpi radialis, and supinator longus muscles, the radial artery, and the anterior annular ligament of the wrist ; the *posterior surface* with the radius, part of the interosseous ligament, the pronator quadratus, the fore part of the carpus, and the flexor brevis pollicis. The inner edge lies upon the flexor digitorum profundus.

The action of this muscle bends the last joint of the thumb upon the first, the first upon the corresponding metacarpal bone, and the latter upon the carpus ; it likewise assists in the flexion of the fore-arm.

PRONATOR RADII QUADRATUS.

Fig. 153.



This muscle, *c*, *d*, *d*, as its name implies, is of a quadrilateral form, and lies close to the bone on the lower part of the fore-arm. It is attached broad, by tendinous and fleshy fibres, on the inner side at *c*, to the anterior surface of the ulna, extending from the lower extremity of that bone two inches up its edge. The fibres passing nearly transversely, adhere to the interosseous ligament, and on the outer side at *d*, *d*, are attached to the anterior surface of the radius.

The *anterior surface* of this muscle is connected with the flexor profundus, flexor longus pollicis manus, flexor carpi radialis, flexor carpi ulnaris, and with the radial and ulnar arteries ; *posteriorly*, with the two bones of the fore-arm and the lower part of the interosseous ligament.

This muscle turns the radius together with the hand inwards.

EXTENSOR CARPI RADIALIS LONGIOR.

This muscle, Fig. 154, *b*, arises just below the supinator radii longus from the lower part of the external condyle of the humerus, and is inserted into the root of the metacarpal bone of the fore-finger at *d*. Use ; to extend and bring the hand backwards.

EXTENSOR CARPI RADIALIS BREVIOR.

This muscle, Fig. 154, *c*, arises from the external condyle, and is inserted by a round tendon, *e*, into the upper and back part of the metacarpal bone of the middle finger, and it assists the last named muscle.

POSTERIOR SUPERFICIAL REGION OF THE FORE-ARM.

EXTENSOR DIGITORUM COMMUNIS.

Fig. 154.

This muscle, *f*, is situated at the posterior part of the arm. It is attached superiorly to the lower part of the outer condyle of the humerus, to the aponeurosis of the fore-arm, and to the aponeurotic septa of the different muscles in that region. From these several attachments it descends vertically, and at the middle of the fore-arm the fleshy mass forms four tendons, which pass under *g*, the annular ligament of the wrist. Below the ligament the tendons diverge, become broader, and proceed to the lower extremities of the metacarpal bones; they sometimes send aponeurotic bands, more or less oblique, to each other, as in the figure before us. These tendons terminate on the back of the fingers by an aponeurotic expansion, reaching to the last phalanx.

The *posterior surface* of the common extensor of the fingers is connected with the aponeurosis of the fore-arm; the *anterior surface* with the supinator brevis, extensores pollicis, extensor indicis, the wrist, the metacarpus, the fingers, and the interossei dorsales.

This muscle opens the hand, and bends it back upon the fore-arm.

EXTENSOR PROPRIUS MINIMI DIGITI.

This muscle, *h*, which is placed on the inner side of the preceding, is of a very slender form. It is attached superiorly to the external condyle of the humerus, and to the aponeurotic septa which separate it from the extensor communis and extensor ulnaris; and its muscular fibres, at *f*, constitute one mass with these muscles. Within a short distance of the wrist its fibres pass into a tendon, which is transmitted through a distinct ring at *g*, in the annular ligament, and arrives at the posterior surface of the little finger, to which it is attached in the same manner as the tendons of the extensor communis.

The *posterior surface* of this muscle is connected with the aponeurosis of the fore-arm, and at the back of the hand with the integuments. The *anterior surface* with the supinator brevis, extensores pollicis, and extensor indicis. The *outer edge* is united to the extensor digitorum communis; the *inner edge* to the extensor carpi ulnaris.

This muscle extends the little finger, and assists in bending back the hand.

EXTENSOR CARPI ULNARIS.

This muscle, *i*, is situated on the posterior part of the arm; its shape is exhibited in the figure. It is attached superiorly to the lower part of the outer condyle of the humerus, to the intermuscular septa and aponeurosis of the fore-arm, and nearly the middle third of the posterior border of the ulna. It terminates in a strong tendon, which is inserted into the upper part of the metacarpal bone of the little finger.

The *posterior surface* of this muscle is connected with the aponeurosis of the fore-arm, to which it adheres above; the *anterior surface* with the supinator brevis, the extensor ossis metacarpi and extensor secundi internodii pollicis, and extensor proprius indicis muscles, and upon the ulna. Its *outer edge* with the former muscle; the *inner edge* with the anconeus.

SUPINATOR RADII BREVIS

Arises tendinous from the external condyle of the os humeri, tendinous and fleshy, from the external and upper part of the ulna, and adheres firmly to the ligament that unites these bones, and is inserted into the ridge of the radius.

Its use is to rotate the radius outwards.

ANCONEUS.

This muscle, Fig. 154, *l*, which is situated at the outer side of the olecranon, consists of a triangular fleshy mass adhering to the capsular ligament. It is attached superiorly to the external condyle of the humerus by a distinct tendon; inferiorly to the superior third of the external border and surface of the ulna.

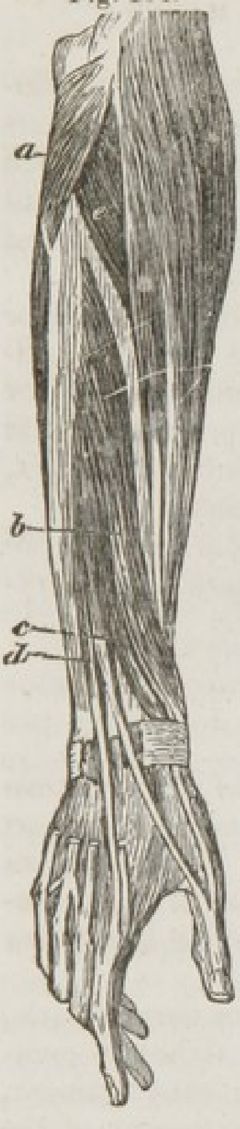
The *posterior surface* of the anconeus is connected with the aponeurosis of the fore-arm; the *anterior surface* with the orbicular ligament of the radius, the supinator radii brevis, and with the ulna.

The office of this muscle is to assist in extending the fore-arm.

POSTERIOR DEEP REGION OF THE FORE-ARM.

EXTENSOR OSSIS METACARPI POLLICIS.

Fig. 154.*



This muscle, *b*, is placed obliquely at the back and outer part of the fore-arm. It is attached superiorly, by a pointed extremity to the posterior surface of the ulna, to the interosseous ligament, and to the posterior surface of the radius below the attachment of the supinator radii brevis. The fleshy fibres terminate in a tendon, passing along a groove on the outer edge of the lower extremity of the radius, and is attached inferiorly to the superior part of the metacarpal bone of the thumb.

The *posterior surface* of this muscle is connected with the supinator radii brevis, extensor carpi ulnaris, extensor minimi digiti, extensor digitorum communis, and extensor secundi internodii pollicis ; at the lowest part it is in apposition with the aponeurosis of the fore-arm. The *anterior surface* is connected with a portion of the ulna above ; crossing the interosseous ligament and the posterior surface of the radius in the middle, and lying upon the outer surface of the radius, the tendons of the radial extensors, the radial artery, and the wrist below.

This muscle extends the metacarpal bone of the thumb outwardly. It is therefore called by some anatomists *abductor longus pollicis manus.*

EXTENSOR PRIMI INTERNODII POLLICIS MANUS.

This muscle, *c*, is much shorter than the preceding, but of a similar form, and is situated immediately below it. It is attached superiorly by fleshy fibres to the back part of the ulna below its middle, to the interosseous ligament and radius. Its tendon follows the same direction as that of the extensor ossis metacarpi pollicis ; inferiorly it is attached to the back of the first bone of the thumb, and its tendon is also continued into the second or extreme joint.

The *posterior surface* of this muscle is connected with the extensor secundi internodii pollicis, extensor minimi digiti, and extensor digitorum communis ; at its lowest part with the aponeurosis of the fore-arm. The *anterior surface* has the same connexions as the preceding muscle, excepting at its inferior extremity, where it is placed upon the first articulation of the thumb.

This muscle extends the first joint of the thumb obliquely outwards.

EXTENSOR SECUNDI INTERNODII POLLICIS MANUS.

This muscle is situated below the two last. It is attached, tendinous and fleshy, to the posterior surface of the ulna, and to the interosseous ligament; its muscular fibres terminate in a tendon which passes in a distinct groove at the back of the radius. It is seen to join the tendon of the extensor primi internodii pollicis, and is inserted into the back part of the last, or extreme joint of the thumb.*

The *posterior surface* of this muscle is connected with the extensor carpi ulnaris, the extensor digitorum communis and the extensor indicis, and at its lowest part with the integuments: the *anterior surface* with the extensor ossis metacarpi pollicis and extensor primi internodii pollicis, the bones of the fore-arm, the tendons of the radial extensors, the first metacarpal bone, and the phalanges of the thumb.

This muscle extends the last joint of the thumb, and it may be observed that the extensors just described have also the power of carrying the hand outwards and backwards.

INDICATOR.

This muscle, *d*, is placed nearer to the inner edge of the arm than the extensors of the thumb. It is attached superiorly to the back part of the ulna, and to the interosseous ligament. Its tendon passes through the same sheath of the annular ligament as those of the extensor digitorum communis; and terminates at the back of the fore finger with the tendon of the common extensor.

The *posterior surface* is connected with the extensor carpi ulnaris, the extensor proprius minimi digiti, and the extensor digitorum communis; the *anterior surface* with the ulna, the interosseous ligament, the extensor secundi internodii pollicis, the inferior extremity of the radius, and the back of the hand.

The office of this muscle is to point the fore finger, from which it takes its name.

RADIAL REGION.

SUPINATOR RADII LONGUS.

This muscle, Fig. 149, *g*, is attached by short tendinous fibres to the external condyle of the humerus, whence it passes downwards fleshy as far as the middle of the radius where it terminates in a ten-

* No letter happens to mark this muscle, although it is distinctly drawn in Fig. 154*, and placed between the points of *c*, and *d*.

don, which runs along the outer edge of the radius and is inserted near the base of the styloid process of that bone.

Its action is to roll the radius outwards, and consequently the palm of the hand upwards.

SUPINATOR RADII BREVIS.

This muscle, which is seen in Fig. 153, *e*, arises tendinous from the external condyle of the humerus, both tendinous and fleshy from the external and upper part of the ulna, and adheres firmly to the ligaments that join these two bones, and is inserted into the head, neck, and tubercle of the radius.

Its use is to roll the radius outwards and thus to supinate the hand.

EXTENSOR CARPI RADIALIS LONGIOR, OR RADIALIS EXTERNUS LONGIOR.

This muscle, Fig. 154, *b*, arises from the inferior part of the external edge of the humerus and superior part of its external condyle, and is inserted into the posterior part of the upper extremity of the second metacarpal bone.

It extends the wrist and hand, and abducts them a little. Acting with the extensor carpi ulnaris, it extends the hand directly. Acting with the flexor carpi radialis, it produces the direct abduction of the hand. If the hand be fixed, it extends the fore-arm upon the wrist.

EXTENSOR CARPI RADIALIS BREVIOR, OR RADIALIS EXTERNUS BREVIOR.

This muscle is precisely similar to the preceding, behind which it is placed. It arises from the external condyle of the humerus, and is inserted in the posterior part of the upper extremity of the third metacarpal bone.

It assists the former.

MUSCLES OF THE HAND.

EXTERNAL PALMAR REGION.

ABDUCTOR BREVIS POLLICIS MANUS.

Fig. 155.

This muscle, *b*, *c*, constitutes the outermost portion of the ball of the thumb. It is attached at *b*, to the anterior surface of the annular ligament of the wrist, and to the os scaphoides and os trepezium ; from thence it descends a little obliquely outwards. Its fibres converge towards each other, and are attached by a tendon at *c*, to the outer side of the extremity of the first phalanx of the thumb. In this figure the muscle is divided and turned back.*

The *anterior surface* is connected with the palmar aponeurosis and the integuments ; the *posterior surface* with the opponens and flexor brevis pollicis manus.

The office of the abductor pollicis is to carry the thumb from the fingers.

OPPONENS POLLICIS.

This muscle, *d*, lies under the preceding. It is attached superiorly by aponeurotic fibre, to the annular ligament of the wrist, to the os naviculare and the os trapezium. Inferiorly to the anterior and lower part of the metacarpal bone of the thumb.

The *anterior surface* of this muscle is covered by the preceding and by the integuments ; the *posterior surface* is connected with the anterior annular ligament of the carpus, the articulation of the trapezium at the first metacarpal bone, part of the anterior surface of that bone, aud the flexor brevis pollicis manus.

The office of this muscle is to bring the thumb inwards, so as to oppose the fingers, from which circumstance it has derived its name.

FLEXOR BREVIS POLLICIS MANUS.

This muscle, Fig. 156, *e*, is of a short, thick, triangular form, and is placed beneath the two preceding. It is attached superiorly to the under part of the annular ligament of the carpus, to the os magnum, and to the third metacarpal bone ; inferiorly it is inserted into the ses-

* Sometimes this forms two muscles, designated *abductores breves pollicis manus, interior et exterior*.

amoid bone, which is connected by a ligament to the fore part of the upper extremity of the first joint of the thumb.

The *anterior surface* of this muscle is connected with the tendon of the flexor longus pollicis manus, the tendons of the flexor profundus digitorum, the two first lumbricales, with an aponeurosis, the integuments, and the adductor minimi digiti ; the *posterior surface* with the first metacarpal bone, the first two dorsal and the first palmar interosseous muscles, and the tendon of the flexor carpi radialis.

This muscle bends the first phalanx of the thumb, and the whole thumb towards the wrist.

ADDUCTOR POLLICIS MANUS.

Fig. 156.

This muscle, *c*, which is broad, thin, and triangular, is still more deeply seated than the flexor brevis. On the inner side it is attached to nearly the whole length of the metacarpal bone of the middle finger, and crossing the metacarpal bone of the fore finger, its fibres converge, and are outwardly inserted by a tendon with *e*, the preceding muscle, into the inner and upper part of the first bone of the thumb.

The *anterior surface* is connected with the tendons of the flexor profundus, the two first lumbricales, and with the integuments ; the *posterior* with the interossei and the bones of the metacarpus.

This muscle draws the thumb towards the fingers.

INTERNAL PALMAR REGION.

PALMARIS BREVIS.

The palmaris brevis is not easily demonstrated in every subject, for it consists merely of several small fasciculi of muscular fibres, situated immediately under the skin of the palm of the hand. On the outer side it is attached to the annular ligament of the wrist, and to the palmar aponeurosis ; on the inner side to the chorion of the skin which covers the little finger and inner edge of the hand.

The *anterior surface* of this muscle is connected with the integuments ; the *posterior surface* with the abductor and flexor muscles of the little finger, the ulnar artery and the nerve.

The office of these fibres is to contract the skin of the palm of the hand.

ADDUCTOR MINIMI DIGITI.

This muscle, Fig. 155, *f*, is placed on the inner edge of the palm of the hand. It is attached superiorly to the os pisiforme, and to the adjacent annular ligament of the carpus; its fibres extend along the metacarpal bone of the little finger, terminating in a tendinous attachment to the inner side of the first phalanx of that finger, and in the aponeurotic expansion which covers the back part of the same finger.

The *anterior surface* of the abductor of the little finger is connected with the preceding muscle, a very thin aponeurosis, and with the integuments; the *posterior surface* with the adductor ossis metacarpi minimi digiti.

The action of this muscle draws the little finger inwards and forwards, and separates it from the other fingers.

FLEXOR PROPRIUS MINIMI DIGITI.

This muscle, Fig. 155, *g*, is situated by the side of the preceding. It extends from the os cuneiforme, and from the annular ligament of the carpus to the upper portion of the first phalanx of the little finger, to which it is attached with the preceding muscle by a round tendon; its connexions are the same as the preceding muscle.

This muscle bends the first joint of the little finger, and assists the adductor.

ADDUCTOR OSSIS METACARPI MINIMI DIGITI.*

This muscle, Fig. 156, *a*, is almost concealed by the two muscles last described. It is attached superiorly, by fleshy fibres, to the os unciforme and annular ligament of the carpus; it forms a thick mass, which is attached inferiorly by a tendon to the fore part of the metacarpal bone of the little finger.

The *posterior surface* is connected with the last interosseous muscle, the fourth metacarpal bone, and the tendon of the flexor sublimis, which passes to the little finger.

This muscle carries the metacarpal bone of the little finger outwards, and assists the flexor.

MIDDLE PALMAR REGION.

LUMBRICALES.†

The lumbricales are four small muscles, Fig. 155, *a*, *a*, *a*, *a*, situated in the palm of the hand. They are attached superiorly to the tendons of the flexor digitorum profundus perforans; each muscle has a tendon, which passes along the side of the finger, and is attached inferiorly to the back part of the first joint.

* This muscle is frequently designated *opponens minimi digiti*.

† These derive their name from their resemblance to the *lumbricus* or earth-worm.

The *anterior surface* is connected with the tendons of the flexor digitorum profundus, the palmar aponeurosis, and the collateral vessels and nerves of the fingers ; the *posterior surface* with the interosseous muscles, the inferior transverse metacarpal ligament, and the phalanges.

These muscles bend the first phalanx : they are small and appear insignificant as flexors, when compared with the powerful muscles already described, but they are indispensably necessary in the performance of the rapid movements of the fingers, as in playing on musical instruments, etc. Hence COWPER gave them the name of *musculi fidicinales.*

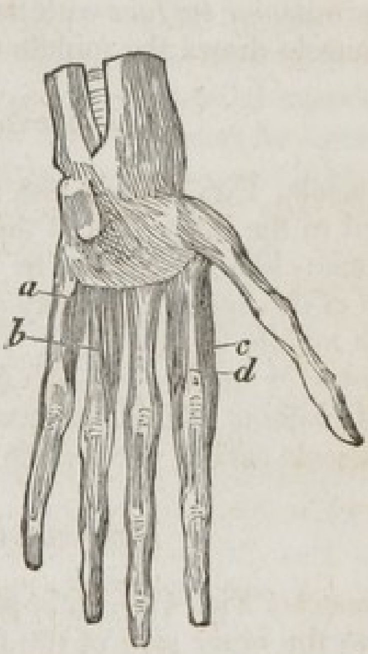
INTEROSSEI.

These are seven little muscles named interossei, situated in the intervals of the metacarpal bones; four, Fig. 157, *a, a, a, a,* on the back of the hand, and three, Fig. 158, *a, b, d,* in the palm : the latter are not seen till the other muscles of the thumb and fingers are removed ; they are designated adductors, and abductors, according to their uses.

1. ABDUCTOR INDICIS.

Fig. 157.

Fig. 158.



This muscle, *c*, Figs. 157 and 158, is of a triangular form ; it is attached to the outer edge of the metacarpal bone of the fore finger, and to the upper part of the inner edge of the metacarpal bone of the thumb. The two fasciculi unite into a tendon, which terminates on the outer side of the upper extremity of the first phalanx, and the extensor tendon of the fore-finger.

The *posterior surface* of this muscle is connected with the integuments ; the *anterior* with the first lumbricalis, the flexor brevis, *b*, the abductor pollicis, and the integuments.

This muscle approximates the fore-finger to the thumb, and inclines the metacarpal bone inwards.

2. ADDUCTOR INDICIS.

This muscle, Fig. 158, *d*, is placed in the palm of the hand ; it is attached superiorly to the inner side of the metacarpal bone of the fore-finger ; inferiorly by a tendon in the same manner as the preceding.

The *anterior surface* of the adductor indicis is connected with the flexor brevis and adductor pollicis ; the *inner surface* corresponds with the next muscle.

The action of this muscle carries the fore-finger inwards.

3. ABDUCTOR DIGITI MEDII.

This muscle, Fig. 157, is seen at the back of the hand. It is attached to the inner side of the second and third metacarpal bones, and terminates by a tendon, like the preceding, which is attached to the outer side of the first phalanx of the middle finger, and its extensor tendon.

The *posterior surface* of this muscle is connected with the integuments, the tendons of the extensor muscles of the fore-finger, and with an aponeurosis which passes from the second to the third metacarpal bone ; the *anterior surface* with the flexor brevis and adductor pollicis.

This muscle draws the middle finger outwards.

4. ADDUCTOR DIGITI MEDII.

This muscle, Fig. 157, is also situated at the back of the hand. It is attached to the inner side of the third and fourth metacarpal bones, and terminates like the others in a tendon, which is inserted into the inner side of the upper extremity of the first phalanx and extensor tendon of the middle finger.

The *posterior surface* of this muscle is connected with the integuments and tendons of the common extensors of the fingers.

This muscle carries the middle finger towards the ring finger.

5. ABDUCTOR DIGITI ANNULARIS.

This muscle, Fig. 158, *b*, is placed in the palm of the hand ; it is attached to the outer side of the fourth metacarpal bone ; and its tendon is inserted into the outer side of the first phalanx and extensor tendon of the ring finger.

The *anterior surface* is connected with the lumbricales muscles and tendons of the flexor profundus.

This muscle draws the ring finger towards the middle finger.

6. ADDUCTOR DIGITI ANNULARIS.

This muscle, Fig. 157, is situated on the back of the hand. It is attached to the inner side of the fourth metacarpal bone, terminating in a tendon, which is inserted into the inner side of the ring finger.

The *posterior surface* of this muscle is connected with an aponeurosis, which passes from the fourth to the fifth metacarpal bone, the extensor tendons of the little finger, and the integuments; the *anterior surface* is concealed above by the interosseous muscle of the little finger, but below appears between it and the preceding muscle.

This muscle brings the ring finger towards the little finger.

7. ABDUCTOR MINIMI DIGITI.

This muscle, Fig. 158, *a*, is seen in the palm of the hand. It is attached to the outer surface of the fifth metacarpal bone; its tendon is inserted into the outside of the first phalanx and the extensor tendon of the little finger.

The *anterior surface* of this muscle is connected with the adductor ossis minimi digiti; the *outer surface* corresponds with the preceding muscle.

The action of this muscle carries the little finger outwards.

THE ENVELOPING APONEUROSIS OF THE UPPER EXTREMITY.

The muscles of the arm are covered by a delicate cellular tissue, very different from aponeurosis, and therefore is usually, in dissections, taken off with the integuments. But on the fore-arm we find a strong fascia or aponeurosis, investing all the superficial muscles. This external aponeurosis is continued from the intermuscular aponeurosis, which passes down to the condyles of the humerus. It is attached to the condyles and to the olecranon, and on the back part receives a great addition of fibres from the tendon of the triceps. On the fore part of the arm it appears to be a continuation of the aponeurotic insertion of the biceps, and is attached to all the muscles by septa, or fibrous partitions. The sheath descends along the fore-arm, adhering to the whole inner edge of the ulna, and arriving at the wrist, is continued into the annular ligament. The outer surface is covered by skin, cellular tissue, adipose substance, and by the superficial veins, nerves, and lymphatics of the arm. It appears to form thin sheaths for these different organs; it sends also between them, and especially above them, areolæ and arches, through which the branches of superficial veins and nerves pass. The fibres have no constant direction, but cross each other in all directions, and leave between them small openings, which are traversed by blood-vessels.

CHAP. VI.

MUSCLES OF THE INFERIOR EXTREMITY.

REGION OF THE HIP.

MUSCLES OF THE HAUNCH AND THIGH.

GLUTEUS MAXIMUS.

Fig. 159.

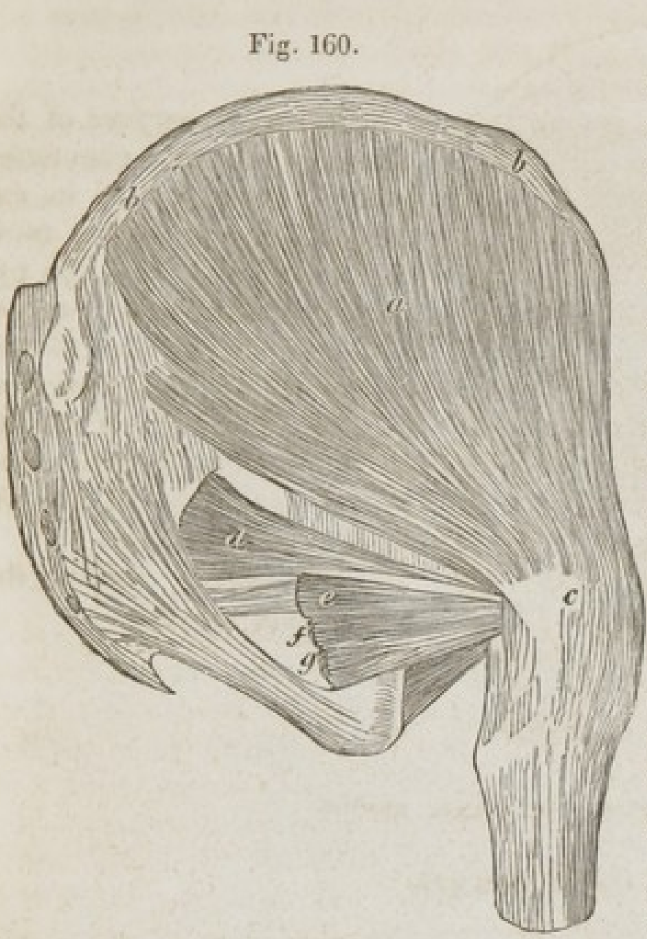
This muscle is placed at the back part of the hip, covering all the muscles situated on that part. A correct idea of its form may be had from the annexed representation. It is attached superiorly, at *a*, to the posterior crest of the ilium ; at *b*, to the posterior surface of the sacrum ; at *c*, to the border of the os coccygis, and to the posterior surface of the sacro-sciatic ligament ; the fleshy fibres pass obliquely downwards and forwards, forming a very broad, thick, coarse muscle ; its fasciculi, gradually con verging, terminate in a strong flat tendon, which is attached inferiorly at *d*, *e*, the upper and outer part of the linea aspera of the femur. A great portion of tendinous fibres also unite it to the aponeurosis of the thigh.

The *posterior surface* of this muscle is covered by an extremely thin lamina of the fascia lata, adipose tissue, and skin. The *anterior surface* is applied to the ilium, sacrum, and the os coccygis ; the attachments of the sacro-spinalis, the gluteus medius, pyriformis, gemelli, obturator internus, and quadratus femoris muscles ; to the sciatic nerve, the tuber ischii, the posterior sacro-sciatic ligament, the upper extremity of the biceps, semimembranosus and semitendinosus, the great trochanter, and to the triceps adductor muscle.

The office of the gluteus maximus is to extend the thigh by drawing it backwards and somewhat outwards. It extends likewise the pelvis on the thigh in standing ; and assisted by the other glutei in progression, it maintains the equilibrium of the body on the lower extremity, which rests on the ground.

GLUTEUS MEDIUS.

Fig. 160.



This muscle, *a*, is broad, strong, and radiated; it is situated under the preceding, except at its anterior part, where it is covered only by aponeurosis. Superiorly it is attached by fleshy fibres to *b*, *b*, the whole of the outer edge of the crista of the ilium, and to the dorsum of that bone; its converging fibres, *a*, are collected, and terminate ina broad aponeurosis, which is somewhat concealed in its substance, but is converted into a tendon, and is inferiorly inserted into the upper part of *c*, the great trochanter.

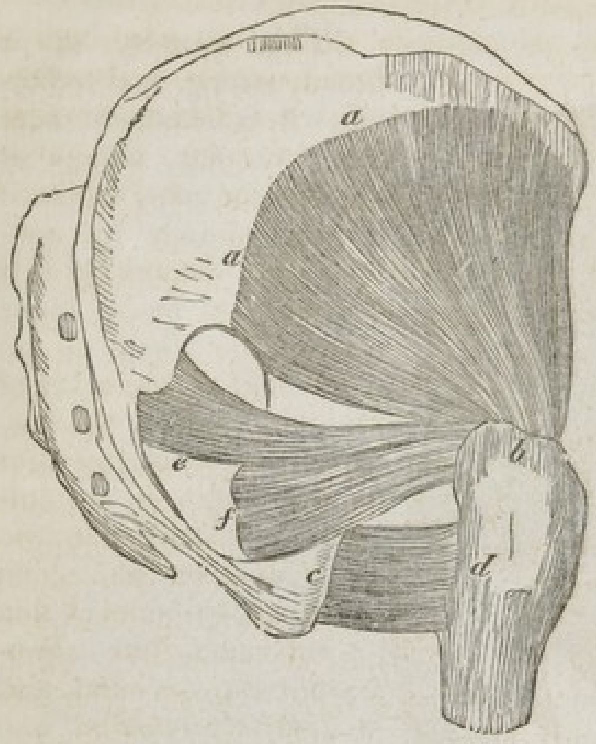
The *outer surface* of this muscle is connected with the posterior half of the gluteus maximus, and its anterior with the fascia lata; the *inner surface* with the iliac bone, the gluteus minimus, pyramidalis, triceps extensor muscles, and the gluteal artery. The *anterior edge* is connected above with the tensor vaginæ femoris, but is separated below by an interval occupied by a great quantity of cellular tissue and branches of the external circumflex artery. The *posterior edge*, at its upper part, is parallel to the pyriformis muscle.

The gluteus medius draws the thigh outwards and a little backwards. It also acts in standing and in progression.

GLUTEUS MINIMUS.

This muscle, *a*,*a*, *b*, is smaller than the gluteus medius, and is entirely concealed until that muscle is raised from its connexions. A synovial bursa is found between their tendons. The gluteus minimus is attached superiorly by fleshy radiating fibres at *a*, *a*, to the semicircular ridge of the ilium, and to the dorsum of that bone below the ridge. Its fasciculi descend and are collected together, terminating inferiorly in a strong tendon, which is attached, at *b*, to the anterior and superior part of the trochanter major.

Fig. 161.



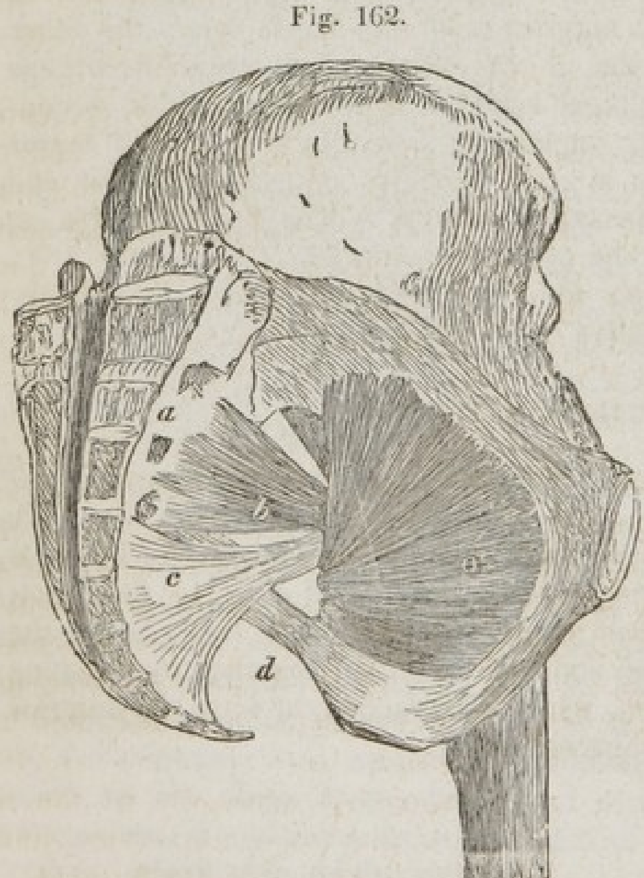
The *outer surface* of the gluteus minimus is connected in the greater part of its extent with the preceding muscle; posteriorly with the pyriformis; the *inner surface* with the ilium, the fibrous capsule of the articulation of the hip, the curved tendon of the rectus femoris, and with a small part of the triceps extensor cruris.

This muscle assists the two former muscles.

PELVI-TROCHANTERIC REGION.

PYRIFORMIS.

Fig. 162.



This, like the other small muscles of the hip, cannot be demonstrated till the gluteus maximus is removed. It lies behind and below the gluteus medius, but it is not at all covered by it. On the one part it is attached at *a*, by three fleshy portions, to the concave surface of the sacrum, and becoming round and tapering, it passes out of the pelvis below the notch of the posterior part of the ilium, and above *c*, the superior sacro-sciatic ligament; that part which passes out of the pelvis is seen in Fig. 161, at *e*, terminating in a round tendon, and is inserted into the cavity at the root of *b*, the trochanter major.

In the pelvis, the *anterior surface* is connected with the rectum, the sciatic plexus, and the hypogastric vessels. After leaving that cavity, it is in contact with the ilium, the capsule of the hip joint, and the gluteus minimus. The *posterior surface* is connected with the sacrum and the gluteus maximus ; the *upper edge* with the gluteal artery, gluteus medius, and gluteus minimus ; the *lower edge* with the anterior sacro-sciatic ligament, and is separated from the superior gemellus by the sciatic nerve.

This muscle turns the thigh outwards : in some degree it has the power of turning the pelvis on the thigh.

OBTURATOR INTERNUS.

The superior part of this muscle, Fig. 162, *o*, is situated within the pelvis ; it is attached by radiated fibres to more than one-half of the margin of the obturator foramen, and to the inner surface of the aponeurosis which fills up that hole. Its fibres concentrate into a round tendon, *f*, Fig. 161, which passing over the ischium between the spine and tuber of that bone, leaves the cavity of the pelvis, is inclosed in the sheath of the gemelli, *e*, *g*, (as seen in Fig. 160 ;) finally it is attached with them at the root of *c*, the great trochanter. Where the obturator bends there is a *synovial capsule*, lining the cartilaginous layer of the lesser sciatic notch, and reflected over the tendon.

The *outer surface* of the obturator internus is connected with the ilium, pelvis, obturator ligament, sciatic nerve, and gluteus maximus ; the *inner surface* with the aponeurosis to which the levator ani is attached, and with the capsule of the articulation of the hip.

The office of this muscle is to rotate the thigh and leg outwards, and to draw it in the same direction.

OBTURATOR EXTERNUS.

Fig. 163.

This muscle covers the external obturator foramen. It is not distinctly seen until all the muscles, which run from the pelvis to the upper part of the thigh, are removed. Inwardly, it has a fleshy attachment, at *a*, to the circumference of the obturator foramen, and to the external surface of the obturator aponeurosis ; its fibres are directed outwards through the notch placed between the inferior margin of the acetabulum and the tuberosity of the ischium, pass round the cervix of the femur, adhering to *e*, the capsular ligament, and terminate in a tendon, which is attached outwardly, at the root of the trochanter major, immediately below the gemelli, as seen in Fig. 160, below the letter *g*.

The *anterior surface* of the obturator externus is connected with the pectineus, the adductors, and the quadratus femoris ; the *posterior surface* with the ilium, the obdurator ligament, and the capsule of the articulation of the hip.

The office of this muscle is to rotate the thigh obliquely outwards.

GEMELLUS SUPERIOR.*

This muscle, Fig. 160, *e*, is placed below the preceding. It is short, flat, and broad, thicker in the middle than at the extremities. It is attached on the inner side to the external border of the sciatic spine, then proceeds transversely outwards, and embraces the tendon of *f*, the obturator internus, and becomes attached outwardly to the upper part of the inner surface of the great trochanter.

The *posterior surface* of the gemellus superior is connected with the sciatic nerve and gluteus maximus ; the *anterior surface* with the ilium and the capsule of the articulation of the hip.

GEMELLUS INFERIOR.

This muscle, Fig. 160, *g*, has the same form, attachments, and connections, as the gemellus superior. The two tendons of the gemelli unite behind that of the obturator internus, so as to form a kind of channel.

These muscles roll the thigh outwards, and draw the one from the other.

QUADRATUS FEMORIS.

This muscle, Fig. 161, is situated below the inferior gemellus. On the inner side, it is attached, at *c*, to the ischium, between its tuberosity and the obturator foramen ; on the outer side, its fibres run transversely, and are attached at the back part of the femur to a rough line, which extends from the root of the great to that of *d*, the small trochanter.†

The *posterior surface* of the quadratus femoris is connected with the sciatic nerve, the gluteus maximus, the semimembranosus, and the adductor magnus muscles ; the *anterior surface* with the obturator externus, the extremity of the tendon of the psoas magnus, and the posterior part of the small trochanter.

The office of this muscle is to turn the lower extremity outwards.

* This muscle, and the following, are frequently designated under the general name of *musculi gemini.*

† This muscle is also shown in Fig. 163, at *b*.

ANTERIOR FEMORAL REGION.

SARTORIUS.

Fig. 164.

This muscle, *b*, which is the longest of the human body, is situated on the front and inner part of the thigh, before the other muscles. Superiorly it is attached at *h*, to the anterior superior spinous process of the ilium ; crosses the thigh obliquely, passes behind the inner condyle of the femur, at *e*, and is inserted inferiorly by a broad tendon, at *i*, to the inner side of the head of the tibia, near the inferior part of its tubercle.

The *anterior surface* of the sartorius is connected with the fascia lata ; the *posterior surface* from above downwards with the psoas magnus and iliacus internus, the rectus femoris, triceps extensor cruris, adductor longus, adductor magnus, and gracilis muscles ; with the crural artery about the middle of the thigh ; and at its lower part with the internal lateral ligament of the articulation of the knee. The *inner edge* of the superior part of this muscle forms with the adductor longus a triangular space, in which the crural artery, vein, and nerve, are situated.

The action of this muscle brings the leg obliquely inwards, as when tailors cross their legs at work ; and from this circumstance the muscle obtains its name. Its continued contraction will also bend the thigh on the pelvis.

RECTUS FEMORIS.

The rectus femoris, Fig. 164, *c*, is situated immediately in front of the thigh ; its fibres are penniform. Superiorly it is attached by a tendon to the anterior inferior spinous process of the ilium, and by another strong tendon to the dorsum of that bone a little above the edge of the acetabulum, and is also adherent to the capsular ligament of the hip joint. These two tendons unite and form a fleshy mass, which terminates inferiorly in a flat tendon at *f*, and is inserted into the upper part of the patella *g*, where a thin aponeurosis is continued over that bone, and becomes ligamentous at *h*, connecting the lower part of the patella to the tibia. Thus, virtually the rectus is attached to the large bone of the leg.

The *anterior surface* of the rectus femoris is connected with the fascia lata, iliacus externus, and sartorius muscles ; the *posterior surface* with the articulation of the hip, the external circumflex vessels, and the triceps extensor cruris.

The office of this muscle is to extend the leg on the thigh, and the thigh on the pelvis : when standing, it assists in fixing the body.

TRICEPS EXTENSOR CRURIS { *Vestus externus* / *Vestus internus* / *Cruræus.*

Fig. 165.

This muscle embraces the femur from the base of the trochanters to the patella. The older writers described it as three distinct muscles ; and as its upper part is divided into three fasciculi, the distinction is here retained.

1st. The *external fasciculus* or *vastus externus*. This portion forms the fleshy mass which occupies the outer side of the thigh bone ; it is attached superiorly, by tendinous and fleshy fibres, at *a*, to the anterior surface of the great trochanter, to the outer border of the linea aspera, and to the oblique line running to the external condyle. The fleshy fibres pass forwards, and are connected, at *b*, to the tendon of the cruræus, and inferiorly, at *c*, to the side of the patella ; part of it also ends, at *d*, in an aponeurosis, which passes over the side of the knee, is fixed to the head of the tibia, and continued to the leg.

2d. The *internal fasciculus*, or *vastus internus*, covers the inner part of the femur, in the same manner as the preceding portion does the outer side. It is attached by aponeurotic and fleshy fibres, at *f*, to the fore part of the minor trochanter ; its fibres are continued along the inner border of the linea aspera, and the oblique line running to the inner condyle, taking a direction downwards and forwards ; they are then connected, at *b*, to the tendon of the cruræus, and inferiorly, to the side of the patella, *c*, and to the aponeurosis of the leg.

3d. The *middle fasciculus*, *b*, is called the *cruræus vel cruralis*, the principal part of which is concealed by the fleshy masses of the vasti, and is connected intimately with them. It is attached superiorly between the trochanters of the femur and to the fore part of that bone almost to its inferior extremity. As before stated, the sides are united to the vasti fasciculi. The front is covered by the rectus, the tendon of which, at g, joins it near the lower part of the thigh, terminating with it in c, the patella.*

The *anterior surface* of this muscle is connected externally and above with the tendons of the gluteus maximus and minimus, farther down with the fascia lata and its tensor muscles, and at its lowest part with the short portion of the biceps. In the middle it is in connexion with the external circumflex vessels; internally, the fascia lata, the crural artery, and the sartorius, are in contact with it. The *posterior surface* is connected with the whole surface of the shaft of the thigh bone, but it is separated below from it by a mass of cellular and adipose tissue.

The office of the triceps extensor muscle is to extend the leg on the thigh, and the latter on the former.

INTERNAL FEMORAL REGION.

PECTINEUS.

Fig. 166.

This muscle, d, is situated at the superior part of the thigh, and is of a flat, long, and triangular figure. It is attached superiorly by aponeurotic adhesions to the brim of the pelvis; inferiorly by means of a tendon to the linea aspera, immediately below the trochanter minor.

The *anterior surface* of the pectineus is connected with the fascia lata and the crural vessels and nerves; the *posterior* with the pubis, the articulation of the hip, the obturator externus, the adductor brevis muscles, and the obturator vessels and nerves. The *inner border* is a little covered by the adductor longus; the *outer* is parallel to the psoas magnus.

The office of this muscle is to bend the thigh, and to rotate it, as when we turn out our toes. It also bends the pelvis upon the thigh, or preserves it in its upright position.

* There are frequently found some fasciculi of muscular fibres under the middle portion, and attached to the capsule of the knee joint, which have been considered by some anatomists as a separate muscle, under the name of *subcruræus*.

GRACILIS.

The gracilis, which is situated on the inner side of the thigh, is a long, thin, flat muscle. Superiorly it is attached at *a*, by aponeurosis or flat, thin tendon, to *b*, the ramus of the os pubis, near the symphysis ; descending in a direct course by the inside of the thigh, it terminates at *h*, in a tendon, which passes behind the inner condyle of the femur, and is attached inferiorly to the inside of the tibia below the tendon of *i*, the sartorius, and above that of *k*, the semitendinosus.

The *inner surface* is connected with the fascia lata and the sartorius ; the *outer* with the adductors, and the semimembranosus muscles, and the internal lateral ligament of the knee joint.

This muscle, like the sartorius, brings the thigh inwards and forwards ; it acts also as a flexor of the leg and thigh.

ADDUCTORS OF THE THIGH.

The adductor muscles of the thigh consist of three distinct muscles, though they are frequently described as one under the name of *triceps adductor femoris.*

ADDUCTOR LONGUS.

This muscle, Fig. 167, is placed between the pectineus and gracilis. It is attached superiorly, by a short and strong tendon at *b*, to the upper and inner part of the os pubis, near its symphysis ; the fibres, *a*, descend obliquely, and are inferiorly attached by an aponeurosis, at *c*, to the middle of the linea aspera, occupying rather more than one third of its length.

The *anterior surface* of the adductor longus is connected with the fascia lata, the sartorius, and the the femoral artery ; the *posterior surface* with the two other adductor muscles, and is almost inseparably united to them below. The *outer border* is parallel to the pectineus muscle ; the *inner* is concealed by the gracilis.

ADDUCTOR BREVIS.

This muscle is situated behind the preceding ; it is of a triangular, flat figure, and is attached superiorly, by tendinous and fleshy fibres, to the pubes between the symphysis and obturator foramen ; inferiorly, to the upper third of the linea aspera, where its insertion is blended with the adductor longus, the adductor magnus, and the pectineus.

The *anterior surface* of the adductor brevis is connected with the preceding muscle and the pectineus ; the *posterior* with the adductor magnus. Inferiorly it is united to the gracilis ; and externally to the tendon of the psoas magnus, the iliacus internus, and to the obturator externus.

ADDUCTOR MAGNUS.

Fig. 167.

The adductor magnus occupies nearly the whole inner part of the thigh ; it is situated behind and below the other two adductors, and separates the anterior and posterior parts of the thigh. It is attached superiorly, at *e*, to the inferior part of the anterior surface of the ramus of the pubes ; at *b*, to the anterior surface of that of the ischium, and to the external border of its tuberosity ; the fibres run inwards and downwards, having various degrees of obliquity, and are attached inferiorly to the whole length of the linea aspera, to the oblique ridge above the internal condyle of the os femoris, and by a long round tendon to the upper part of the condyle, where the tendon is united to the adductor longus. There is a perforation in the tendon of this muscle at *i*, near the bone, through which the femoral artery passes in its course towards the ham.

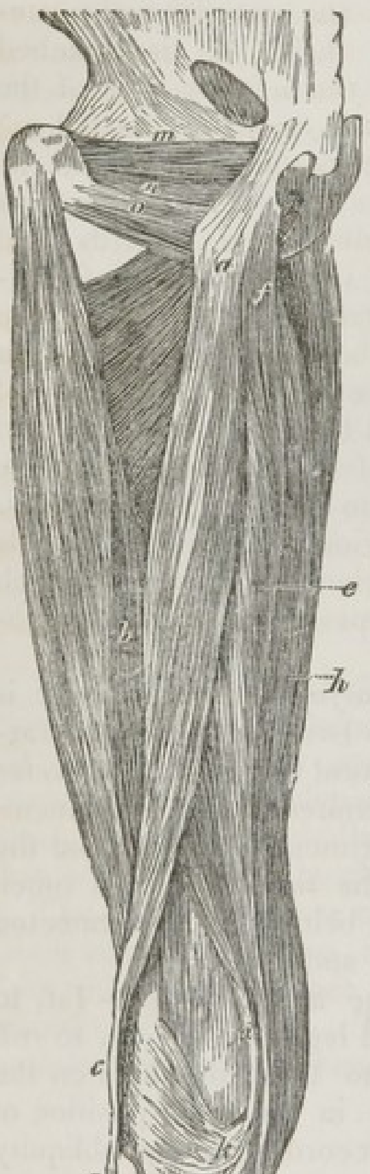
The *anterior surface* of this muscle is connected with the two preceding, the sartorius, and the femoral artery ; the *posterior surface* with the semitendinosus, semimembranosus, biceps, gluteus maximus, and the sciatic nerve. The *inner border* is much thicker above than below, and is connected with the fascia lata and gracilis.

The office of the adductors is — 1st, to move the thigh and leg inwards ; 2d, to roll it outwards ; 3d, to bend the thigh on the pelvis ; and lastly, to keep the pelvis firm in the erect position of the trunk. The action of the fibres varies according to the obliquity of their attachments.

POSTERIOR FEMORAL REGION.

BICEPS FEMORIS.

Fig. 168



The biceps femoris is situated at the back part of the thigh, and forms the outer ham-string. It is divided into two portions, one long and the other short. The long portion is attached superiorly at *a*, by a tendon, to the outer part of the tuberosity of the ischium, and descending, forms a thick fleshy mass ; its short portion, *b*, is fixed by tendinous and fleshy fibres to the linea aspera immediately below the gluteus maximus, and to the oblique ridge passing from the condyle, where it is connected with the fibres of the vastus externus. The two heads are united at an acute angle a little above the external condyle of the femur, and terminate in a strong tendon, *c*, which is attached at *d*, to the outside of the head of the fibula.

The *posterior surface* of this muscle is connected with the gluteus maximus and the fascia lata ; the *anterior surface* with the semitendinosus, triceps, and adductor magnus muscles, the sciatic nerve, the femur, and the external lateral ligament of the knee. The long portion is placed over the short portion, which is connected with the external superior articular artery and the external head of the gastrocnemius. The *inner border* unites with the preceding muscle to form the ham.

The biceps is a powerful flexor of the leg upon the thigh, or the latter upon the leg ; its long portion is capable of extending the thigh upon the pelvis, or of keeping the pelvis erect. It also assists in turning the leg outwards.

SEMITENDINOSUS.

This muscle, *e*, is placed between the biceps femoris and gracilis : we may also see it in Fig. 166, *c*, *k* ; it is attached superiorly, in common with the biceps, by aponeurotic fibres to the tuberosity of the ischium ; it has also some fleshy fibres fixed to that projection more outwardly, and is connected for several inches at *f*, with the commencement of the biceps. The fleshy mass runs down the back of the thigh, forms a long round tendon, *g*, which passing round the inner side of the knee, becomes flattened, and is reflected forward to be inserted into the inner side of the ridge of the tibia, a little below the tubercle, and is connected with the under edge of the tendon of the gracilis, marked in this figure, *h*.

The *posterior surface* of the semitendinosus is connected with the fascia lata, and a little at its upper part with the gluteus maximus ; the *anterior surface* with the semimembranosus and adductor magnus.

The office of this muscle is to bend the leg backwards and a little inwards, and to assist in keeping the pelvis erect.

SEMIMEMBRANOSUS.

This muscle, *i*, is situated behind the preceding muscle, and with it properly forms the inner hamstring. The tendons of the sartorius and gracilis are sometimes enumerated as part of the inner hamstring, but they lie more anteriorly. The upper portion is best displayed in Fig. 166, and is superiorly attached, at *d*, to the outer part of the tuberosity of the ischium. It forms a fleshy mass in the middle and back part of the thigh ; and inferiorly terminates obliquely in a flat tendon, Fig. 168, *i*, which passing behind the inner condyle is spread out at *k*, in an aponeurotic expansion, which covers and strengthens the capsule of the knee joint, and is attached, at *l*, to the inner and back part of the head of the tibia.

The offices of this muscle are the same as those of the preceding muscle.

The *posterior surface* of the semimembranosus is connected with the biceps, semitendinosus, and fascia lata ; the *anterior surface* with the quadratus femoris, adductor magnus, and internal head of the gastrocnemius, popliteal artery, and the knee joint. Its *outer border* is connected with the sciatic nerve, and concurs with the biceps to form the cavity of the ham ; the *inner border* is covered by the gracilis and the cavity of the fascia lata.

TENSOR VAGINÆ FEMORIS.

This muscle, Fig. 164, *a*, is situated at the upper and outer part of the thigh ; it is attached externally to the anterior and superior iliac spine, between the sartorius and gluteus medius, by a very short tendon ; the fleshy fibres descend nearly vertically, diverging as they proceed, and about three inches above the great trochanter terminate in the laminæ of the femoral aponeurosis.

The *outer surface* is connected to a thin lamina of the aponeurosis of the thigh ; the *inner* to another aponeurotic plate, which separates the rectus femoris from the triceps extensor cruris. It also covers a portion of the gluteus medius and gluteus minimus muscles. The principal action of this muscle is to stretch the aponeurosis which envelopes the muscles of the thigh. It also carries the limb outwards, separating it from the other.

APONEUROSIS OF THE THIGH.

The inferior extremities, like the superior, are enveloped by a strong tendinous web. In the thigh it is frequently termed the *fascia lata femoris* ; and is composed of strong tendinous and ligamentous fibres, which cover all the muscles, and indeed send septa or partitions between them. On the outer part, it is very strong and tendinous ; but in front, and on the inner part, it is thin, and composed of a mere condensed cellular membrane.

Superiorly and anteriorly the aponeurosis of the thigh is continuous with the fibres of the crural arch, and is fixed posteriorly to the sacrum and os coccygis ; on the outer side, it is inserted into the crest of the ilium ; on the inner side, it is continuous with the ligaments of the pubis. Inferiorly, this aponeurosis is blended round the knee with that of the leg.

There is a considerable opening beneath the crural arch, through which the crural vein passes. This opening is formed in the following manner :—The aponeurosis being composed of two portions, the *iliac* and *pubic*, the former is folded in the shape of a sickle at that part where it ceases to be united to the crural arch. The concavity of this fold looks downwards and inwards, and is termed the *falciform process* ; the latter, or pubic portion, coming from the pubes, passes over the pectineus and adductors, and unites with the iliac portion beneath the point where the saphena vein joins the femoral.

MUSCLES OF THE LEG.

ANTERIOR REGION OF THE LEG.

TIBIALIS ANTICUS.

Fig. 169.

This muscle, Fig. 169, *a*, *b*, is situated quite superficially on the fibular side of the tibia. It is attached superiorly to the external tuberosity and outer surface of that bone, and to nearly half of the interosseous ligament, *g* ; from these surfaces it continues to adhere down two-thirds of the length of the leg. Its fibres also are attached to the inner surface of the aponeurosis of the leg, and to the intermuscular septa. The fleshy mass descends obliquely, and forming a strong tendon, crosses from the outside to the fore part of the tibia, and passing through a distinct ring of (*b*) the annular ligament, near the inner ankle, and running over the astragalus and os naviculare, it is inferiorly inserted, at *c*, into the os cuneiforme internum, and the posterior extremity of the metatarsal bone of the great toe.

The *anterior surface* of this muscle, at its superior part, firmly adheres to the aponeurosis of the tibia ; it is also connected with the annular ligament of the tarsus, and the dorsal aponeurosis of the foot ; on the *inner side* with the tibia ; on the *outer* with the extensor communis digitorum pedis, extensor proprius pollicis pedis, the anterior tibial vessels and nerves. The *posterior border* is placed upon the interosseous ligament, the tibia, the articulation of the ankle, and the upper and inner part of the tarsus.

The office of the tibialis anticus is to bend the foot upwards and inwards. It is also a flexor of the leg on the foot, and it prevents the limb from falling backwards in the standing posture.

PERONEUS TERTIUS.

The fleshy fibres of this muscle, *d*, *e*, and Fig. 171, *e*, *f*, are almost inseparably connected with the long extensor of the toes, and indeed it may be said to be the outer portion of it. It is attached superiorly to the inferior third of the anterior border of the fibula, and to the neighboring part of the internal surface. It sends its fleshy fibres forwards to a tendon, which passes under the annular ligament of the tarsus in the same groove as those of *d*, Fig. 171, and is attached inferiorly, at *e*, to the posterior part of the metatarsal bone of the little toe.

The *outer surface* of the peroneus tertius is connected with the aponeurosis of the leg; the *inner surface* with the extensor brevis communis digitorum pedis. In the foot it passes over the extensor digitorum pedis and the first metatarsal bone: its posterior border is placed upon the fibula and interosseous ligament.

The office of this muscle is to bend the foot upon the leg, raising its outer edge; it also bends the leg on the foot.

EXTENSOR LONGUS DIGITORUM PEDIS.

Fig. 170.

This muscle, *a*, is placed entirely superficially between *a*, the tibialis anticus, Fig. 169, and *d*, *e*, the peroneus tertius, being firmly connected to them by the intermuscular membranes. In the figure before us it is represented drawn aside by a hook at *a*; superiorly it is attached by aponeurotic and fleshy fibres, at *b*, to the external tuberosity of the tibia; to the head, and to almost the whole anterior part of the internal surface of the fibula, to the interosseous ligament, and to the aponeurosis of the leg, and the intermuscular septa. The fleshy fibres, proceeding from these different directions, pass obliquely into a tendon marked *d*, Fig. 171, which below the middle of the leg is divided into four continuous portions, and pass under *c*, Fig. 170, the annular ligament, then over the upper part of the foot, and are distributed to the posterior extremity of the first phalanx of the four small toes, by flat tendons, which afterwards expand upon the upper surface of the toes.

The *anterior border* of this long extensor of the toes is connected with the aponeurosis of the tibia, the annular ligament of the tarsus, and the integuments; the *posterior border* with the fibula, the interosseous ligament, the tibia, the ankle joint, and the extensor brevis digitorum, and the toes. The *inner* corresponds to the tibialis anticus and extensor proprius pollicis pedis. The *outer* is intimately united above with the peroneus longus, at the middle with the peroneus brevis, and below with the peroneus tertius : see Fig. 171.

The office of this muscle is to extend all the joints of the small toes, and to assist in raising the foot.

EXTENSOR PROPRIUS POLLICIS PEDIS.

The fleshy fibres of this muscle, *d*, are situated between the long extensor of the toes and the anterior tibial muscle, and cannot be exhibited until those muscles are separated from each other ; but the tendon is superficial, passing between the tendons of those two muscles. It is attached superiorly to the anterior part of the middle third of the inner surface of the fibula, and to the adjacent part of the interosseous ligament; the muscular fibres terminate in a tendon, which passes in a particular groove under *c*, the annular ligament ; runs along the inner edge of the foot, and is inserted, at *e*, into the upper surface of the posterior extremity of the last phalanx of the great toe.

The *inner surface* of this muscle is connected with the tibialis anticus, and anterior tibial vessels and nerves ; the *outer surface* with the extensor communis digitorum ; the *anterior border* is concealed above between the tibialis anticus and extensor digitorum, and is covered by the aponeurosis of the tibia and the integuments. The *posterior border* is placed on the fibula, the interosseous ligament, the tibia, the anterior tibial artery, the articulation of the tibia and tarsus, and upon the back of the foot and great toe.

The office of this muscle is to extend the great toe ; it also bends the leg on the foot and the foot on the leg.

PERONEAL REGION.

PERONEUS LONGUS.

Fig. 171.

This muscle, *g*, and Fig. 174, *d*, is situated at the external part of the leg. Its fleshy fibres are quite superficial. It is attached superiorly to the outer side of the upper extremity of the fibula, at *g*, and to one-third of its length downwards, to the crural aponeurosis and to the aponeurotic septa placed between the soleus and flexor longus pollicis pedis on one side, and the extensor longus pollicis pedis on the other side; the fibres run obliquely outwards into a tendon, which passes behind the outer ankle through a groove, which is common to it with the peroneus tertius: thus, at the lower end of the fibula, these tendons are bound down by a tendinous bridle. The tendon of the peroneus longus is then conducted through a channel in the os calcis and os cuboides, extends obliquely across the sole of the foot, and is attached to the posterior extremity of the metatarsal bone of the great toe, and to the os cuneiforme internum.*

The *outer surface* of the peroneus longus is connected with the aponeurosis of the tibia; the *inner surface* with the fibula, extensor digitorum communis, and peroneus brevis; the *posterior surface* corresponds to the soleus above and below, to the flexor longus pollicis. The several connexions of the tendon have already been noticed.

The office of this muscle is to turn the foot outward, and to assist in extending it.

PERONEUS BREVIS.

This muscle is situated between the extensor longus digitorum and peroneus longus; its muscular fibres are concealed by those of the latter muscle. It is attached superiorly to the inferior half of the outer surface of the fibula, and to the intermuscular aponeurosis and to the aponeurosis of the leg. The fibres run obliquely towards a tendon, which passes in a groove of the fibula at the outer ankle,

* This insertion is distinctly seen in Fig. 174.

where it is inclosed in the same tendinous ring with the peroneus longus. It is continued through a channel on the outside of the os calcis, and is attached to the superior part of the posterior extremity of the metatarsal bone of the little toe : see Fig. 174, *g*.

The *outer surface* of the peroneus brevis is connected with the aponeurosis of the tibia and peroneus longus : the *inner surface* with the fibula, the extensor digitorum communis, and the peroneus tertius above, and with the flexor longus pollicis below.

The office of this muscle is to turn the foot outwards, and somewhat to extend it. A portion of this muscle is called peroneus tertius, viz., that which arises from the middle of the fibula which terminates in a tendon, which passes under the annular ligament and is inserted into the root of the metatarsal bone that sustains the little toe. It aids in bending the foot.

POSTERIOR REGION OF THE LEG.

GASTROCNEMIUS EXTERNUS ET INTERNUS.

Fig. 172.

These muscles are extremely large and strong, and principally form the calf of the leg. They are separated above into two flat fleshy masses, but are united below, where they present the strongest tendon of the whole body. The internal muscle is attached superiorly, at *a*, to the back part of the inner condyle of the femur ; the external muscle is attached in the same manner, at *b*, to the external condyle. Each of these muscles forms a large fleshy mass, which is united below the ham in a central fibrous line near the middle of the leg : at *c*, they become a broad aponeurosis, which, as it approaches the heel, forms with the two tendons of the subsequent muscles a strong round chord, at *d*, termed the TENDO-ACHILLIS, which is fixed at *e*, the posterior extremity of the os calcis.

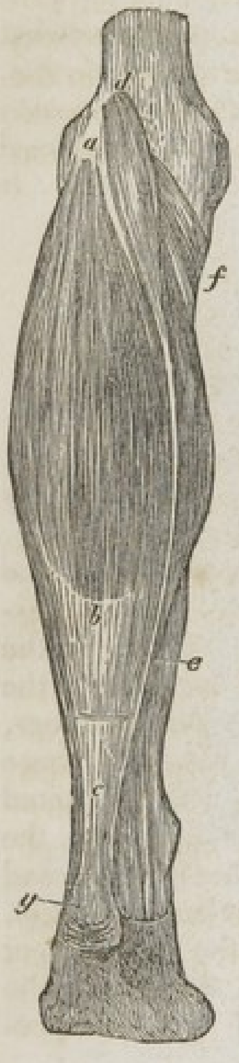
The *anterior surface* of the gastrocnemii is connected with the condyles of the femur, and the synovial membrane of the articulation of the knee ; the outer muscle with the popliteus ; the inner with the semimembranosus, the popliteal artery, the plantaris and soleus muscles ; in the remainder of its extent it is in apposition with the soleus. The *posterior surface* is connected with the integuments.

The separation of the two muscles, at *b*, *a*, contributes to form the ham.

The office of these muscles is to extend the foot. They are seen very strongly acting in dancing, running, leaping, and when we are raising ourselves on the toes. From their origin on the femur, they also have the power of bending the leg on the thigh.

SOLEUS.

Fig. 173.



This muscle is placed under the preceding, but part of it appears on each side of those muscles. Superiorly it is attached, by the external portion, at *a*, to the posterior part of the head of the fibula, and to the superior third of the oblique line on the posterior surface of the tibia, and to a portion of the internal border of that bone below *f*, the popliteus, the fleshy fibres terminating, at *b*, in a broad aponeurosis ; inferiorly, this aponeurosis is inseparably united with that of *c*, the gastrocnemii, forming the tendo-Achillis, which is inserted, at *g*, into the os calcis.*

The *poeterior surface* of the soleus is connected with the gastrocnemii and plantaris, and with the aponeurosis of the leg ; the *anterior surface* with the peroneus longus, popliteus, flexor and longus digitorum, flexor longus pollicis, and tibialis posticus muscles, a portion of the back of the fibula, the popliteal, posterior tibial, and fibular vessels.

This muscle assists the gastrocnemii in extending the foot and in raising the heel in progression.

PLANTARIS.

This muscle, which is long, and extremely thin and narrow, is situated under the outer portion of the gastrocnemius. It is attached superiorly, at *d*, to the posterior part of the external condyle of the femur, and adheres to the capsule of the knee joint, and to the tendon of the gastrocnemius externus. It forms behind the joint a small

* From the circumstance of the three muscles being united into one tendon, H. Cloquet has described them as a single muscle, under the name of *triceps extensor pedis*.

fleshy fasciculus, which passes over the popliteus, *f*, and sends a very long and slender tendon, *e*, obliquely inwards, which accompanies *c*, the tendo-Achillis, to be attached with it, at *g*, to the os clcais.

The *posterior surface* of the plantaris is connected with the gastrocnemii and integuments ; the *anterior surface* with the ligaments at the posterior part of the knee joint, the popliteal vessels, and the popliteus and soleus muscles.

The particular use of this muscle has been a question with physiologists ; although it is generally classed with the extensors of the foot, it is so extremely slender, that it can have but little power in the motions of the limb. I am of opinion, that its office is solely to contract the foldings of the capsule, so as to prevent injury in the flexion of the knee joint.

POPLITEUS.

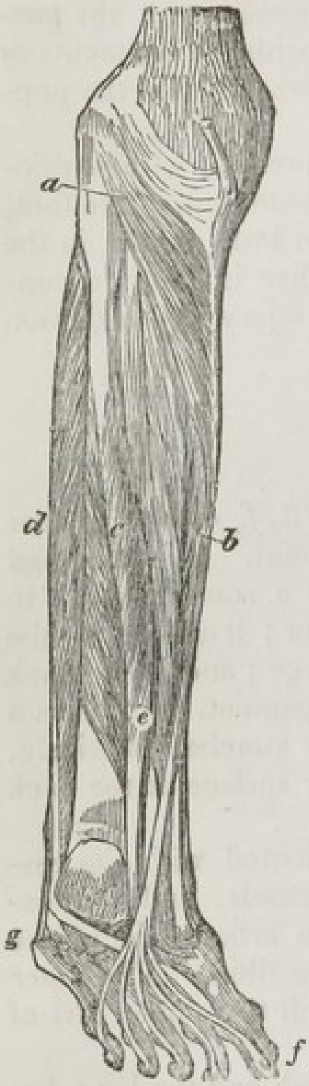
This is a small muscle, Fig. 174, *a*, Fig. 173, *f*, of a triangular figure, situated across the back part of the knee joint. It is attached superiorly within the capsule of the knee joint, by a round tendon, to the depression of the external condyle of the femur ; it adheres to the posterior and outer surface of the semilunar cartilage ; and at the back part of the condyle it perforates the capsular ligament, and forms a fleshy mass, which, passing obliquely inwards, is attached inferiorly, broad, thin, and fleshy, to the superior triangular surface at the back part of the tibia.

The *posterior surface* of the popliteus is connected with the gastrocnemii and plantaris muscles, the popliteal vessels, and the posterior tibial nerve ; the *anterior surface* with the articulation of the tibia and fibula, the tibialis posticus muscle, and the tibia. The *outer margin* is united above by a thin membrane with the upper part of the fibula and soleus.

The office of this muscle is to bend the thigh and the leg ; but chiefly, like the preceding, it prevents the capsule from being compressed in the motions of the knee joint.

FLEXOR LONGUS DIGITORUM PEDIS.

Fig. 174.



This muscle, *b*, is situated beneath the soleus; it is attached superiorly to the posterior surface of the tibia, and to the superior oblique line, until it arrives within three inches of the ankle. The fleshy fibres pass obliquely into a tendon at the posterior edge of the muscle; this tendon runs behind the inner ankle in a groove of the tibia, and is secured in this situation by a strong ligament, which is extended from the ankle to the os calcis, and having received a tendinous slip from the flexor longus pollicis, divides about the middle of the sole of the foot into four tendons, which pass through slips in the tendons of the flexor digitorum brevis, and are finally attached to the posterior part of the inferior surface of the last phalanx of the four small toes.

The *posterior surface* of this muscle is connected with the soleus muscle, the tibial aponeurosis, and the posterior tibial artery; the *anterior surface* with the tibia and the tibialis posticus muscle. The outer border is united with that muscle, and with the flexor proprius pollicis pedis. In the foot, the upper surface is connected with the deep-seated muscles of the sole, and the lower surface of its tendons with the adductor pollicis, flexor brevis digitorum, adductor minimi digiti muscles, and the plantar nerve.

The office of this muscle is to bend the last joint of the toes, to extend the foot; and it is of great use in walking and standing.

FLEXOR LONGUS POLLICIS PEDIS.

This muscle, *c*, *e*, Fig. 174, is placed on the outer side of the preceding, between that muscle and the peroneus longus. It is attached superiorly by fleshy fibres to the middle part of the back of the fibula, to the interosseous ligament, and the aponeurotic septa; the muscular fibres, *c*, terminate in a tendon at *e*, which passes behind the inner ankle; (it is found further back, that is, nearer the os calcis, than the flexor longus digitorum pedis); and in the sole of the foot it crosses the tendon of that muscle to be ultimately attached at *f*, the last joint of the great toe.

The *posterior surface* of this muscle is connected with the soleus and aponeurosis of the tibia ; the *anterior surface* with the fibula, the tibialis posticus, and the flexor longus communis muscles, the tibia, and the interosseous ligament. Its tendon is enveloped by synovial membranes behind the ankle joint, and under the great toe, and by the flexor brevis pollicis under the sole of the foot.

This muscle bends the great toe, and assists in extending the foot on the leg.

TIBIALIS POSTICUS.

Fig. 175.

The flexor longus digitorum pedis, and the flexor longus pollicis pedis, are here removed to show the situation of the tibialis posticus ; the muscles which cover the tendon in the sole of the foot also are separated to exhibit its inferior attachment. Superiorly, the tibialis posticus is attached to the posterior surface of the tibia at *c*, to the fibula at *f*, to the surface of the interosseous ligament, and to the aponeurotic septa ; the fibres pass obliquely, at *b*, towards a central tendon, which passes behind the inner ankle in a channel of the tibia, and is inferiorly inserted into the internal and inferior part of the os naviculare, sending tendinous filaments to the adjacent bones.

The *anterior surface* of the tibialis posticus is connected with the tibia and fibula, a large extent of the interosseous ligament, and the inferior part of the os calcis and scaphoides. The *posterior surface* is covered by the soleus, the flexor longus digitorum, and the flexor proprius pollicis muscles, and by the fibrous sheath of the inner malleolus.

This muscle is an extensor of the foot, and draws it inwards.

MUSCLES OF THE FOOT.

DORSAL REGION.

EXTENSOR BREVIS DIGITORUM PEDIS.

Fig. 176.

This is a broad flat muscle, situated on the upper part of the foot; the tendons of the long extensor pass over it, but in this figure they are cut off near the toes. Posteriorly, the extensor brevis, *a*, is attached, at *c*, to the upper surface of the os calcis, the os cuboides, and the astragalus; its fleshy fibres divide at *b*, *b*, *b*, *b*, into four portions, each of which sends off a slender tendon; one of them is inserted anteriorly into the first phalanx of the great toe, the others into all the small toes except the little one, and uniting with the tendons of the extensor longus, they invest the upper surface of the phalanges of the toes.

The *upper surface* of the short extensor of the toes is connected with a very thin aponeurotic lamina extended over the back of the foot, and with the tendons of the long extensor of the toes; the *inferior surface* with the tarsus, the metatarsus, the interossei dorsales muscles, and the phalanges.

The office of this muscle is to assist in extending the first four toes, and it directs them a little outwards.

INTEROSSEI EXTERNI.

These small muscles are similar in form and arrangement to those of the hand. They are seen on the back of the foot at *b*, *b*, *b*, *b*; being attached posteriorly between the metatarsal bones of all the toes; anteriorly, to the first joint of the smaller toes. They are divided into adductors and abductors of the toes.

The office of these muscles is to separate the toes.

PLANTAR REGION.

FLEXOR BREVIS DIGITORUM PEDIS.

Fig. 177.

This muscle, *a*, is situated in the middle part of the sole of the foot. Posteriorly it is attached to the inferior surface of *d*, the os calcis, to the inner surface of the plantar aponeurosis, and to the tendinous septa interposed between this muscle and the abductors of the toes. It forms a thick fleshy mass, and divides into four tendons, which, having advanced beyond the tarsus, are split for the passage of the long flexor tendons, and are ultimately attached to the inferior surface of the second phalanx of the four lesser toes. The tendon to the little toe, however, is not always found.

The *inferior surface* of the short flexor of the toes is connected with the plantar aponeurosis ; the *superior surface* with the lumbricales and accessory muscle of the flexor longus, with the plantar vessels and nerves, and with the tendons of the long flexor. The inner border is united to the adductor pollicis, posteriorly, but is separated from it anteriorly by the tendon of the flexor longus and a portion of the flexor brevis of the great toe : the *outer border* is contiguous anteriorly to the flexor brevis minimi digiti ; posteriorly it is annexed to the abductor minimi digiti.

This muscle bends the second joint of the toes.

ABDUCTOR POLLICIS PEDIS.

This muscle, *c*, is placed at the inner edge of the foot. It is attached posteriorly to the lower and inner part of *d*, the os calcis, and plantar aponeurosis ; anteriorly to the inner sesamoid bone, and base of the first bone of the great toe.

The *inferior surface* of the adductor of the great toe is connected with the flexor communis digitorum pedis, the flexor accessorius, the lumbricales muscles, and the plantar aponeurosis ; on the *inner border* with the flexor brevis pollicis pedis, the tendon of the peroneus longus, and the outer side of the metatarsal bone ; on the *outer border* with the interosseous muscles and external plantar artery.

The office of this muscle is to carry ths great toe from the others.

ABDUCTOR MINIMI DIGITI PEDIS.

This muscle, *b*, is situated at the outer edge of the sole of the foot. Posteriorly, it is attached to the outer side of *d*, the os calcis, to a ligament which passes from that bone to the metatarsal bone of the little toe, and to the plantar aponeurosis ; anteriorly, to the outside of the first bone of the little toe.

This muscle carries the little toe outwards and downwards.

FLEXOR DIGITORUM ACCESSORIUS.*

Fig. 178.

This muscle, *a*, is situated at the posterior part of the sole of the foot. It is attached on the one part by aponeurotic fibres to the inferior and internal surface of *c*, the os calcis, from which it proceeds in a horizontal direction ; on the other part it is inserted into the external border of *b*, the tendon of the flexor longus digitorum pedis.

The *inferior surface* is connected with the adductor pollicis pedis, flexor brevis digitorum pedis, adductor minimi digiti pedis, and the plantar vessels and nerves ; the *superior surface* with the os calcis, the superficial inferior ligament of the os calcis and os cuboides, and with the abductor minimi digiti pedis.

The office of this muscle is to assist the flexor longus digitorum pedis.

LUMBRICALES PEDIS.

These muscles, Fig. 178, *c*, *c*, *c*, *c*, are similar in form and number to the lumbricales of the hand ; they are an apparatus of moving powers to assist the flexors of the toes. The lumbricales pedis are situated at the anterior part of the foot, and extend from the tendons of the flexor longus digitorum pedis, to the first phalanx of the four lesser toes.

The *inferior surfaces* of the lumbricales are connected with the plantar aponeurosis ; their *superior surfaces* with the abductor pollicis pedis, the transversus pedis, and with the plantar interosseous muscles.

The office of the lumbricales is to bend the toes, and to draw them a little inwards.

* Or *massa carnea Jacobi Sylvii.*

FLEXOR BREVIS POLLICIS PEDIS.

Fig. 179.

The fleshy part of this muscle, *a*, is connected almost inseparably to the adductor and abductor pollicis. It is attached posteriorly to the fore part of the os calcis, and to the two cuneiform bones; extending anteriorly to the inferior and lateral part of the first phalanx of the great toe, and to the sesamoid bones of the articulation.

The *inferior surface* of the short flexor of the great toe is connected with the plantar aponeurosis, flexor proprius, and adductor pollicis pedis; the *superior surface* with the tendon of the peroneus longus, and with the first metatarsal bone: the *inner edge* is united to the abductor pollicis.

The office of this muscle is to bend the first joint of the great toe.

ADDUCTOR POLLICIS PEDIS.

This muscle, *b*, is placed at the internal part of the sole of the foot. Posteriorly, it is attached by aponeurotic and fleshy fibres, at *a*, *b*, in two portions, to a strong ligament, which extends from the os calcis to the os cuboides, and to the plantar aponeurosis; from these different attachments it advances to be inserted into the outer sesamoid bone, and the base of the first phalanx of the great toe.

The *inferior surface* of this muscle is connected with the plantar aponeurosis; the *superior surface* with the flexor accessorius, the flexor brevis pollicis, the tendons of the flexor longus digitorum pedis, the tibialis anticus and posticus, and with the plantar vessels and nerves.

This muscle carries the great toe outwards, and bends it a little.

FLEXOR BREVIS MINIMI DIGITI PEDIS.

This muscle, *d*, is situated at the outer edge of the sole of the foot. It is attached posteriorly to the metatarsal bone of the little toe, and to the ligamentous sheath of the tendon of the peroneus longus; anteriorly, it is inserted into the first joint of the little toe.

The *inferior surface* is connected with the plantar aponeurosis and abductor minimi digiti pedis; the *superior surface* with the fourth metatarsal bone and last plantar interosseous muscle.

The office of this muscle is to assist in the flexion of the little toe.

TRANSVERSUS PEDIS.

This muscle, *e*, is situated at the anterior part of the sole of the foot. It is attached on the outer side to the ligaments of the four last articulations of the phalanges of the toes with the metatarsus ; on the inner side, to the external border of the first joint of the great toe.

The *inferior surface* of the transversus pedis is connected with the tendons of the long and short flexors of the toes, the lumbricales, and the collateral vessels and nerves of the toes ; the *superior surface* with the interosseous muscles.

This muscle carries the great toe outwards, and brings the metatarsal bones nearer to each other.

INTEROSSEI INTERNI.

These muscles, *c*, are three in number, and are situated in the sole of the foot. They are attached posteriorly between the metatarsal bones of the four lesser toes ; anteriorly by tendons to the inside of the first joints of the three smaller toes.

The office of these muscles is to move the three smaller toes towards the great toe.

APONEUROSIS OF THE LEG.

This is continuous superiorly with the femoral aponeurosis ; it adheres strongly to every projecting point of bone, as to the head and spine of the tibia, and to the fibula. At the inferior part of the leg it has very strong adhesions to the outer and inner ankle : it is continuous also with the annular ligament of the instep, and is fixed on the outer side to the sheath of the tendons of the peroneal muscles, and on the inner side to the internal annular ligament.

ANNULAR LIGAMENT OF THE INSTEP.

This is a transverse band of fibres which binds down the tendons of the extensors of the foot and toes ; the anterior part of the annular ligament is attached on the one side to the external part of the os calcis ; on the other side to the anterior part of the inner malleolus. It embraces the tendons of the extensor longus pollicis pedis, the extensor longus digitorum pedis, the peroneus tertius, and the tibialis anticus. The internal annular ligament is broader, extending from the internal malleolus to the os calcis ; it forms with that bone a species of canal, which contains the sheaths of the tendons of the tibialis posticus, the flexor longus digitorum pedis, the flexor longus pollicis pedis, and the plantar vessels and nerves. See Fig. 170, and 171.*

* The plantar aponeurosis so much partakes of the nature of a ligament, that I have thought proper to arrange and describe it with the ligaments. See p. 80.

OBSERVATIONS ON THE MUSCLES.

In describing the offices of muscles I have confined my observations to their simple motions, but there are very few simple motions in the animal economy; almost every kind of contraction is the effect of a combined effort of several of the muscles. One action produces another: for this reason, the two points by which a muscle is attached have an equal tendency to move; if not prevented by the action of other muscles, both extremes would come into motion when the muscle contracted: thus, by the contraction of the extensors of the leg, the limb would be bent on the foot equally with the foot on the leg, if the foot was not fixed; but it can only be so fixed by means of muscles acting in a reverse, or opposition to the extensors; therefore, whenever two points of attachment are movable, the simple motion of the one extreme supposes the contraction of a muscular power to fix the other. No muscles are enabled to move singly without the aid of other muscles, except those which are inserted by one of their extremities into a fixed, and by the other into a movable point, as those of the eye, and the greatest part of the moving powers of the face. We may remark, however, that there is always an immovable line or point from which every ordinary motion originates, and one extremity is always more movable than the other; thus, although the two attachments of the gastrocnemii are movable, yet these muscles act more effectually upon the foot than upon the femur.

To ascertain the office of a muscle, we must examine its direction from the more fixed, up to the more movable point — the reverse of that direction is the line of action. The tibialis anticus directed downwards and inwards raises the foot and brings it outwards; the rectus femoris directed from the pelvis towards the patella, raises the leg without the least deviation. Every other muscle, whatever may be its attachments, has the same disposition; they always act in the reverse of the line of their direction; the coraco-brachialis, which is directed downwards and outwards from the shoulder towards the arm, moves the latter upwards and inwards. By this rule, when we see a muscle we may decide for what uses it was intended.

The whole effort of the contraction in long muscles is usually concentrated on a single point of the tendon: in the greatest part of wide muscles, on the contrary, the insertions being on the sides, and by a number of points, all the fibres have not a uniform action. The different parts of the same muscle may be intended for very different, and even for opposite uses; thus, the anterior fibres of the deltoides advance the arm, the posterior draw it backward, and the lower part of the serratus major does not act like the upper; frequently, even different portions of the same muscle do not contract simultaneously: the upper portion of the trapezius may act independently of the lower; the same may be observed of the muscles of deglutition. In the long muscles, however, every fasciculus concurs to produce the same effect at the same moment.

If a wide muscle is concentrated in one common point, as the temporal and deltoid, which is attached to a multiplicity of points on the one part, and on the other is attached by a single tendon, then the average direction of all its fibres is to be taken to ascertain its office. If a muscle is attached by many points at each extremity, the line of direction of its fasciculi must be examined to judge of its action. It is in this way we understand the action of the rhomboideus, serratus magnus, etc. In those muscles which are reflected, as the obliquus superior of the eye, the circumflexus palati, the peronei, etc., the action of the muscle must be calculated from the point of reflexion only. The orbicular muscles, as those situated around the lips, the eyes, etc., have in general no fixed point; they are intended merely to contract the aperture round which they are situated.

Let it again be observed, that with very few exceptions, the actions of muscles are associated. A number of muscles are required, even to nod the head, to maintain the body erect, to put it in motion, or to continue it in progression; and in very great bodily efforts, all the voluntary muscles appear to be in action.

In early life, the muscular system appears to be penetrated with less blood than at a later period, the muscles of the infant being of a much paler color than those of the adult; as age advances they gradually assume a deeper color, they receive a greater supply of blood-vessels, and consequently are more abundantly nourished than many other organs. During the period of infancy and youth, the conformation of the male and female muscles is analogous. In the former, after growth in stature is completed, the muscles increase in bulk; to the slender and rounded form of adolescence, alternate projections and depressions mark the outline of the more manly form; and we may remark at this period the muscular system appears (if the organs are well exercised) through the integuments, the fleshy masses of muscular fibre forming prominences separated by distinct grooves. Painters and sculptors pay great attention to the development of the muscles, making them characteristic of the figures they represent under different circumstances and modes of life; as we may observe in the statues of the Farnese Hercules and Pancratistæ, contrasted with those of the Antinous and Apollo Belvidere.

As the muscles increase in thickness, they acquire more density. A remarkable difference may be observed in the firmness of the muscles, especially in a state of contraction, in the adult and in the infant, and between persons who are accustomed to take a great deal of robust exercise, and those who are less accustomed to exertion; thus, while the sedentary and indolent are remarkable for the flaccidity of their muscles, the active have them firmly developed. The gymnastic exercises are very much calculated to produce this effect, and to strengthen the moving powers; but such exercises should be taken gradually, and youth should not be urged to exertions beyond those which they can accomplish without subsequent painful sensations.

In the prime of life, the color of the muscles is a deep red; in the subsequent stages of life they gradually fade; but there are other causes besides advanced age which destroy the brilliancy of their hue, such as ill health, and excesses of any kind, which have a depressing influence on the vital powers.

As age advances, the muscles undergo other changes: the fibres become tough and resistant, and their excess of density seems to prevent their contraction; at least, they can no longer perform with such rapidity as formerly, nor can movements be continued so long, for weariness sooner follows. But though in persons advanced in life the fibres are dense, the general feeling of the muscles is loose and flaccid, and the calves of the legs quiver in walking, as if less capable of action. Old age is a period at which motion causes a tremor of the whole muscular system. Why is this? Bichat says, it is because the muscles no longer possess a sufficient degree of contractility, and that they are thus too long for the spaces which they fill. This appears to proceed from the contractility of the tissue being reduced in the last stage of life. We are convinced of this fact by comparing a muscle divided transversely in a young and in an aged person: in the former it contracts much more than in the latter.

By the very great contractility of the muscles of youth, all their fibres are drawn closer together during repose, as well as in action; but in the progress of age this effect is no longer produced: these organs therefore remain lax and flaccid, a phenomenon which indicates the low state of contractile power.

As the blood flows in less quantity to the muscular system of infants, and increases gradually as persons become of an adult age, so the quantity of blood gradually decreases as persons become advanced in years; the vessels in old subjects become partially obliterated, and the parts, being deprived of their former supply of the vital fluid, are left in the state before described, possessed of a reduced state of vital contractility and sensibility.

The condition of the muscular system after death depends upon the causes which produced it; in ordinary cases, after a short time the dead body becomes stiff, and retains the form it is placed in, until decomposition takes place; but in some particular cases, as in poisoning and suffocation from the fumes of charcoal, and in several other instances, the muscles never become firm: all contractility is extinct, and the body continues soft and flexible.

BURSÆ MUCOSÆ, *or Mucous Bags.*

The structures we are about to describe not only enter into the composition of joints, but are placed between the tendons and bones exposed to much friction, and therefore may be considered as auxiliaries to the moving powers. The bursæ mucosæ are intended for the same purpose as the synovial membranes, viz., to produce or secrete a fluid similar to the synovia, which lubricates contiguous surfaces. Their structure and anatomical arrangement are nearly the same, both being shut sacs. Dr. MONROE discovered and described 140 of them, and since which several other bursæ have been described by Dr. ROSENMULLER of Leipsic ; they perform the office of friction-wheels in machinery, and take off too severe pressure or friction from the bone or tendon. Bursæ vary considerably in size, as well as in form, some being oval or circular, others elongated, so as to form sheaths which inclose tendons. Thus, where tendons are retained *in situ* by fibrous sheaths, the contiguous surfaces are invested by a bursal membrane reflected over them, as the different flexor and extensor tendons in both extremities ; and also where a muscle has to slide over a bony prominence, as where the gluteus maximus passes over the great trochanter, a bursa is interposed ; or where processes of bone play on fibrous structures, as between the acromion and the capsule of the shoulder joint. These instances will suffice to point out the operation of the general principle which determines the formation of synovial or mucous bursæ. The following enumeration is from Mr. BELL, and constitute the principal bursæ of the human body.

In connexion with the SHOULDER JOINT :

1st. A very large bursa under the acromion, and betwixt it and the head of the humerus.

2d. Between the head of the clavicle and the coracoid process of the scapula.

3d. Upon the capsule of the shoulder joint and under the tendon of the subscapularis muscle.

4th. Under the deltoid muscle.

5th. Under the tendon of the latissimus dorsi.

The principal bursæ around the ELBOW JOINT are,

1st. Between the tendon of the biceps flexor cubiti and the radius.

2d. Over the round head of the radius and the extensor muscles.

3d. On the olecranon and under the triceps tendo .

About the WRIST,

1st. A large bursa between the flexor tendons and the carpus.

2d. On the trapezium.

3d. On the os pisiforme.

4th. On the back of the carpus and under the extensor carpi radialis.

5th. Between the ligament of the wrist and the tendon of the extensor carpi ulnaris.

Besides these sacs or proper bursæ, sheaths surround the tendons of almost all the muscles of the wrist joint.

On the PELVIS,

1st. A large bursa between the gluteus maximus and the vastus externus.

2d. Between the capsule of the hip joint and the psoas magnus and iliacus internus.

3d. Under the pectinalis.

4th. A large one on the surface of the trochanter major, under the gluteus minimus.

5th. On the os ischii and under the origin of the biceps.

6th. Under the tendons of the rotators of the thigh bone.

In the THIGH, and around the KNEE JOINT,

1st. Under the tendon of the extensors of the leg, and communicating with the knee joint.

2d. Under the ligament of the patella.

3d. Between the insertion of the semimembranosus and the origin of the gastrocnemius.

4th. Over the internal lateral ligament of the knee joint.

5th. Under the popliteus.

Several irregular bursæ are found around those tendons which are inserted into the tibia and fibula.

Around the ANKLE JOINT.

All the principal tendons which cross the ankle joint have bursæ under or around them, as the tendon of the tibialis anticus, the extensor proprius, the extensor digitorum, the peroneus longus and brevis. There is also a proper bursa between the tendo-Achillis and the os calcis; another under the flexor longus pollicis, and also under the flexor longus digitorum and the tibialis posticus.

It is necessary for the surgeon to know these bursæ; because, after a sprain and injuries, effusion takes place in them, and they present a puffy swelling over the joint not easily understood without the recollection of the natural anatomical structure.

ART. V.

VASCULAR SYSTEM.

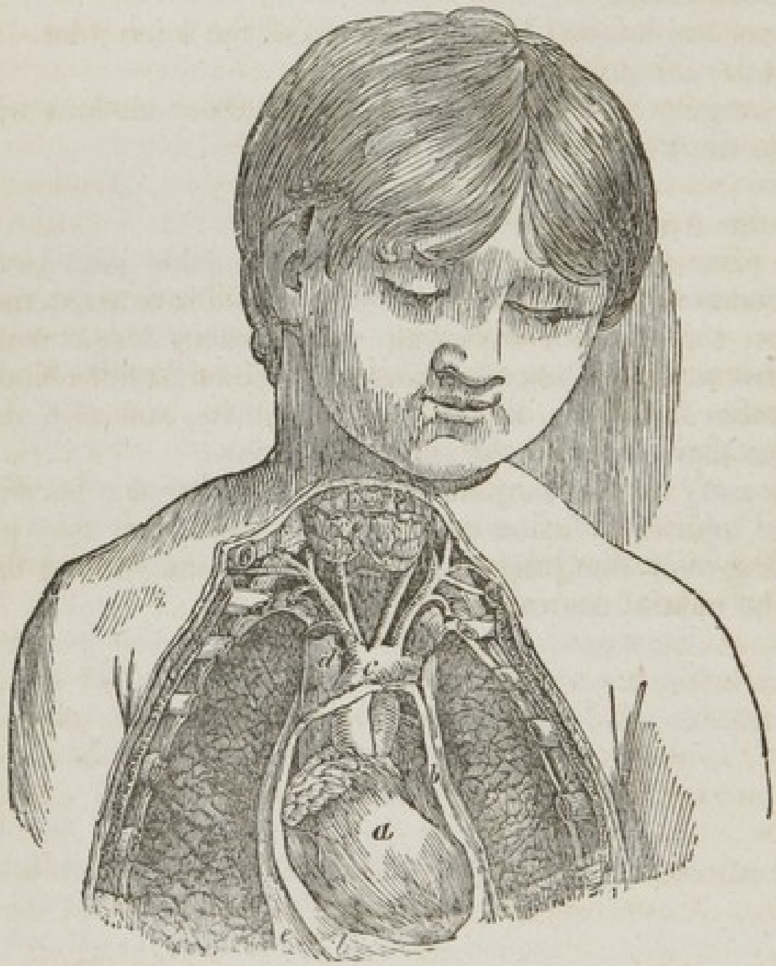
CHAP. I.

ORGANS OF CIRCULATION.

THE HEART AND ITS ENVELOPES.

THE PERICARDIUM.

Fig. 180.



The heart is the central organ of circulation; and the *pericardium*, *b*, *b*, is a membranous bag which encloses the heart, *a*, and the roots of the arterial and venous trunks which issue from it. It is situated in the lower part of the anterior mediastinum, above the aponeurotic centre of the diaphragm. It is connected anteriorly with the pleura, the thymus gland, the sternum, and the cartilages of the sixth and seventh ribs of the left side; posteriorly with the bronchial tubes, the œsophagus, and the descending aorta: laterally with the pleura, *e*, the phrenic nerves, and the inner surface of the lungs.

The pericardium is composed of two membranes, an outer fibrous and an inner serous.

The *fibrous membrane* is intimately united below with the aponeurosis of the diaphragm ; it ascends around the heart, embraces it as far as the base, and is continued to a certain distance upon the trunks of the great vessels. The pericardium, therefore, is not perforated by these vessels, but its fibrous lamina forms sheaths for them.

The *serous membrane* is much more extended than the fibrous membrane ; for after lining the inner surface of the pericardium, it entirely covers the heart, and is continued upon the aorta above its first curve ; to the right, it is reflected upon the superior vena cava ; to the left, upon the pulmonary artery before its bifurcation, and upon the right pulmonary veins immediately after their issuing from the lungs. This serous membrane of the pericardium dips into all the irregularities of the surface of the heart, where it is extremely thin and transparent, and is not easily demonstrated ; it also adheres intimately to the fibrous membrane, but it has very little attachment to the vessels, and can be raised from their surface without difficulty.

The inner surface of this membrane is smooth, glistening, everywhere in contact with itself, and is moistened with a serous fluid to prevent ill effect from the heart's motion.

The arteries of the pericardium are very small, and are derived from larger arteries in the immediate vicinity. The veins correspond to the arteries, and partly terminate in the vena azygos. There have not yet been any nervous filaments traced into its laminæ.

THE BLOOD.

I shall premise a few remarks on the blood, before I proceed to describe the organs which circulate it.

The general appearance of human blood is too well known to render it necessary for me to describe it. The blood circulates in the heart, arteries, and veins ; the estimated quantity is about twenty-eight pounds in an adult. In the veins it is of so deep a color that it is generally termed *black blood ;* in the arteries it is of a *bright vermilion color.*

In order to render the difference between venous and arterial blood more distinct, MAGENDIE has given the following table of them :

	Venous Blood.	*Arterial Blood.*
Color,	Black red,	Vermilion red.
Odor,	Weak,	Strong.
Temperature,	101 ·75° F.	Near 104° F.
Capacity for caloric,	852*	839.
Specific gravity,	1051†	1049.
Coagulation,	Less rapid,	More rapid.
Serum,	More abundant,	Less abundant.

The blood is the most important fluid of the body, and most essential to the support of its functions. Many able anatomists and physiologists have considered it as a living fluid ; and the arguments of those who maintain its vitality are very strong : I consider, stronger

* Water being one thousand.— *Dr. J. Davy. Philosophical Trans.* 1815.
† Water being one thousand.

than those who take an opposite view of the question. While hot and in motion in its vessels, the blood remains constantly fluid; when it cools and is at rest, it coagulates and becomes a gelatinous mass, which gradually separates into two parts; the one, the *crassamentum* or the more solid part, the other, the *serum* or fluid.

The respective relations in the quantity of the serum to the crassamentum, and those of the coloring matter to the fibrin, are variable, according to the circumstances of age and the state of the health.

The crassamentum forms more than half of the blood; it is plastic, thick, and in consistence like a strong glutinous jelly, which soon putrefies in the air; but dried by a gentle heat, becomes a dark brittle mass. The surface of the coagulum, after being exposed in a vessel to atmospheric air, becomes of a florid red color; but the lower surface contiguous to the vessel is of a deep black; the change of color on the surface is supposed to be owing to the oxygen of the atmosphere uniting with the blood. The crassamentum is composed of—1st, *red globules;* 2d, *fibrin*. The red globules are obtained by agitating the crassamentum of the blood in the serum; when the globules, on examination with a powerful microscope, will be found floating in that fluid. According to the observations of Captain KATER and Dr. YOUNG, who measured the red globules of the blood with a micrometer, and thus agree that the size of them is between $\frac{1}{4000}$ and $\frac{1}{6000}$ of an inch in diameter, or, taking the medium, $\frac{1}{5000}$ of an inch.*

The red matter of the blood is soluble in water; when dried and calcined, it yields a charcoal, which furnishes during its combustion ammonial gas, and gives the hundreth part of its weight of ashes, composed of

Oxide of iron, .	55.0	Pure lime, .	17.5
Phosphate of lime, with phosphate of magnesia,	8.5	Carbonic acid, .	19.0

The *fibrin*, separated from the coloring matter, is whitish, insipid, and inodorous; elastic when moist but brittle when dry. In distillation it gives out a great quantity of carbonate of ammonia, and carbon, the ashes of which contain phosphate of lime, a little phosphate of magnesia, carbonate of lime, and carbonate of soda. A hundred parts of fibrin are composed of

Carbon, . .	53.360	Hydrogen, . .	7.021
Oxygen, . .	19.685	Azote . .	19.934

The serum is a transparent liquid, slightly yellow; its odor and taste resemble the odor and taste of the blood. According to Mr. BRAND, the serum is almost pure albumen, united to soda, which holds it in a liquid state. At a temperature of 158° F. it becomes a solid mass, like the white of an egg, and forms on coagulating numerous small cells, which contain a matter very analogus to mucus.

* See also Sir E. Home's paper, Philosophical Transactions, 1819.

According to Dr. MARCET, one thousand grains of the serum of human blood contains,*

Water,	900.00
Albumen,	86.80
Muco-extractive matter,	4.00
Muriate of Soda, with some muriate of Potash,	6.60
Subcarbonate of Soda,	1.65
Sulphate of Potash,	0.35
Phosphates of Lime, Iron, and Magnesia,	0.60
	1000.00

From different analyses of blood, and as the processes of investigation are perfected, we discover in the blood all the principles, all the elements of the various organs of the body. We are able with confidence to point out its fibrin as the same matter with the muscular fibre; the albumen, that which forms cartilages, and so great a number of membranes and tissues; the adipose matter, when combined with the osmazome and albumen, constitutes the nervous mass; the phosphates of lime and magnesia, which constitute a great portion of the bones; the elements of the most remarkable excrementitious substances, as urea and the yellow matter of the bile, the urine, and that which by absorption extends itself into the cellular tissues around contusions.†

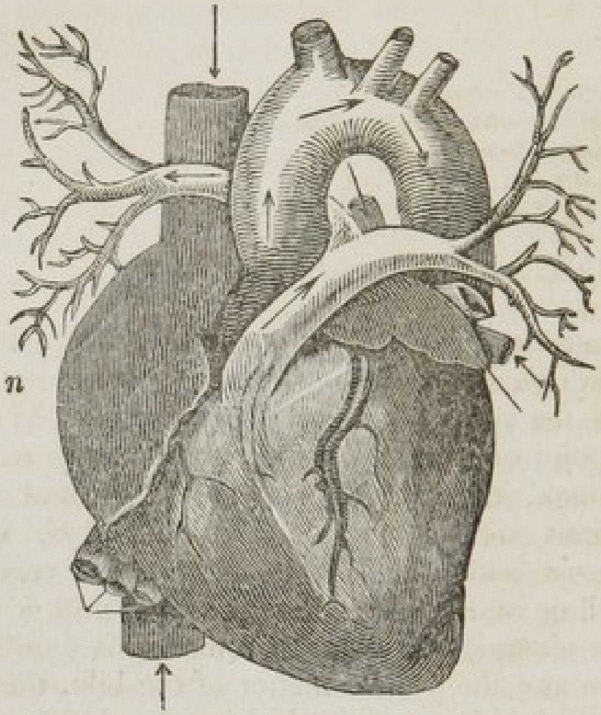
The blood, therefore, is the common source from which every tissue of the body borrows and chooses its materials according to its degree of sensibility, and appropriates them to itself, and subsequently retains or rejects them. The body derives its nourishment from the blood, which supplies the waste that is continually going on in the animal frame; and the reproduction of any part, which may have been destroyed, equally depends upon it. The blood, impelled by the heart, is transmitted by the arteries to the most minute parts of the body, building up the several structures, and keeping them in a state of repair. The superabundant quantity is returned to the heart by the several veins; but as a large portion of it is expended in preserving the healthy state of the body, it is necessary that a constant supply should be provided, and this is formed in abundance from both animal and vegetable food.

* Philosophical Transactions for 1819. These results very nearly coincide with an analysis of BERZELIUS.

† See Magendie's Compendium of Physiology, Art. Blood.

THE HEART.

Fig. 181.



The heart is a hollow muscular organ : its form is annexed. It is inclined forwards, downwards, and outwards, and from right to left ; its general connexions have been pointed out in describing the pericardium. The position of the heart somewhat changes as it follows the motions of the diaphragm in breathing, and its weight draws it in different directions according to the inclination of the body.

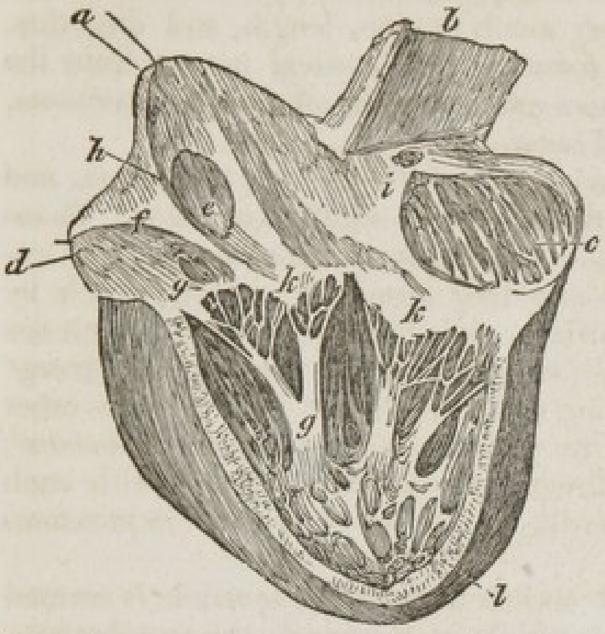
The *anterior surface* is turned a little upwards, and presents in its middle a groove passing from left to right obliquely downwards, and in which is lodged the anterior coronary artery and vein in the midst of a considerable quantity of adipose tissue. The *posterior surface* is nearly horizontal, and rests upon the aponeurotic centre of the diaphragm : it is traversed almost vertically by a channel which receives the posterior coronary artery and vein. The *base* of the heart is situated behind and to the right, and is separated from the vertebral column by the aorta and the œsophagus. There is observed on it an oblique groove, which indicates the junction of the auricles and ventricles. The apex is inclined forwards and to the left, and in the living body is felt beating in the interval of the cartilages of the fifth and sixth ribs.

The heart contains four cavities, which are termed its auricles and ventricles. An auricle and a ventricle is placed to the right, and to the left the same disposition is observed. On each side the auricle communicates with the corresponding ventricle. In the right cavities there is found black blood, which has been received from all parts of the body, and which must be submitted incessantly to the action of the air in the lungs ; in the left cavities we find red blood, which has been received from the lungs, having already undergone a certain change from the atmosphere, for the purpose of again circulating through the whole body.

RIGHT SIDE OF THE HEART.

THE RIGHT AURICLE.

Fig. 182.



The right auricle is also called the anterior auricle; its situation is obvious in the figure before us.* On the right side it has a loose appendage with denticulated borders, which bearing some resemblance to a dog's ear, the whole cavity has obtained the name of *auricle*. The parietes of this cavity, Fig. 181, *n*, are so thin as to be semi-transparent; but in the inner surface at *c*, Fig. 182, its muscular fasciculi are disposed somewhat like the teeth of a comb, therefore have been named *musculi pectinati*. Its posterior part, *b*, presents the *orifice of the superior vena cava*, inclining forwards and downwards; this is separated from *a*, *d*, the *orifice of the inferior vena cava*, by a projection formed by a thickening of the muscular coat, the *tuberculum Loweri*. The septum of the auricle is seen separating the right from the left; it is thin, and presents, at *e*, an oval depression named *fossa ovalis*, at the circumference of which the fibres are thicker, forming an elevated ring, called the *annulus ovalis*. The space, occupied in the adult by the fossa ovalis, is in the fœtus an aperture named the foramen ovale, which sometimes remains open through life, the use of which, before the period of birth, is to transmit the blood of the inferior vena cava directly into the left auricle.

The orifice of the inferior vena cava is furnished with a duplicature of the inner membrane, which advances into the cavity of the auricle, and is named the *Eustachian valve*, marked *h*, *f*; its dimensions are more considerable in children, and it becomes gradually obliterated with age.

The auricle is a reservoir in which the blood is collected during the contraction of the ventricle.

THE RIGHT VENTRICLE.

The ventricles are the most essential parts of the heart; they constitute the forcing machine of the blood, and therefore merit the most particular notice.

The right ventricle has a triangular pyramidical form, the base of which is turned upwards and backwards, being insensibly lost in the corresponding auricle. *Anteriorly* and outwardly, the muscular parietes, marked *l*, are thin and concave; the posterior and inner is

* The venæ cavæ, the auricle, and its opening into the ventricle, are here laid open.

formed by a partition, which equally belongs to the left ventricle. The thickness of the parietes of the right ventricle is unequal in the different parts of their extent : the inner surface presenting a great number of muscular fasciculi, as *g*, commonly designated by the name of *carneæ columnæ*, which vary very much in size, length, and direction. Their disposition is irregular, some taking a vertical course from the apex to the base, while the others cross them in all sorts of directions, and form with them a confused network.

Some of these fleshy columns are much larger than the others, and their number also varies from three or four to eight or nine. These are attached to some points of the parietes of the ventricle, and extending from the apex to the base they terminate abruptly, each by several small white tendinous strings, called *cordæ tendinæ*, which are fixed into the points of *k*, *k*, the tricuspid valve ; on one part diverging from, at another part uniting with, each other. There are other muscular fasciculi attached to the parietes in the manner of pilasters ; they follow every variety of direction, and are interlaced with each other, so as to represent network, leaving between them depressions of different dimensions.

The entrance from the right auricle to the right ventricle is termed the *auriculo-ventricular orifice*, which is furnished with membranous folds, *k*, *k*, termed the *tricuspid valve*, on account of its being divided into three triangular portions, the form of two of which we see in the figure. One of the surfaces of the valve is turned towards the parietes of the ventricle, the other towards the cavity of the auricle. One of its borders is attached to the circumference of the orifice, the other is divided into three floating portions, which are held *in situ* by the cordæ tendinæ, or tendons of the carneæ columnæ. This valve is thin and transparent in its whole extent, but becomes thicker at its free edge, for the attachment of the small tendons which I have before described.

There is another aperture of a smaller size than the preceding, and leads to the pulmonary artery.

COMMENCEMENT OF THE PULMONARY ARTERY.

Fig. 183.

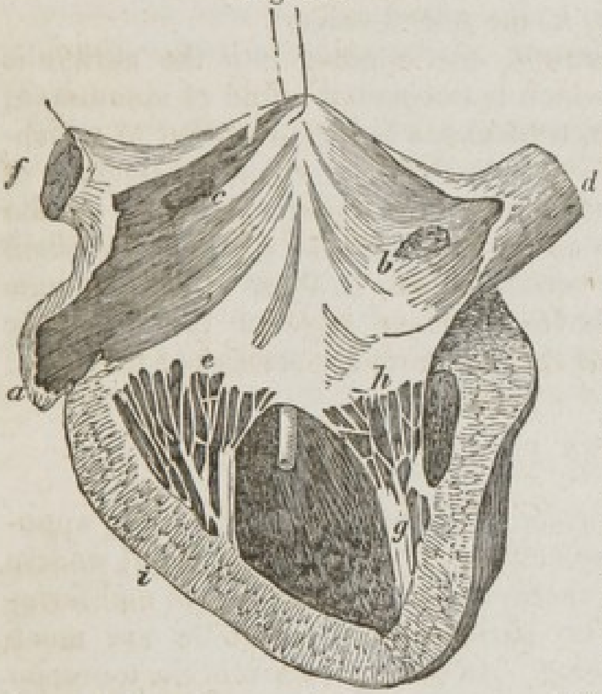
The office of this artery is to carry the blood into the lungs to be submitted to the action of the air in respiration. The pulmonary artery arises from the left part of the right ventricle ; its orifice is surrounded by a callous ring, which indicates the limits of the muscular fibres of the heart ; this orifice is moreover furnished internally with three membranous folds, *c*, *c*, *c*, which are named *sigmoid* or *semilunar valves* : their semicircular form is seen in this figure. They are adherent to the artery by their convex and inferior border, and present in the middle of the loose margin a small tubercle of a fibro-cartilaginous texture, termed the *corpus Arantii.** These are thin and transparent; they are in contact at their extremities, and when let down they completely close the artery, and thus prevent the blood which it contains from again entering the ventricle.

The pulmonary artery passes obliquely upwards and to the left side, crossing the course of the aorta, beneath which it passes, and to which it is united by cellular and adipose tissue. After a course of about two inches, it divides near the second dorsal vertebra into two branches, one for each lung. Between these branches we observe a round ligament passing from the pulmonary artery to the arch of the aorta : this apparent ligament is the remains of a tube which is named the *ductus arteriosus*, and which, in the fœtus, as the lungs were impervious, transmitted the blood to the right ventricle.†

THE LEFT SIDE OF THE HEART.

THE LEFT AURICLE.

Fig. 184.



This figure represents a section of the left auricle and ventricle. The left auricle is situated at the posterior and left side of the heart; its extent is narrower and longer than the right. It presents at its superior and inner part, at *a*, an auricular appendage, similar to that of the right auricle, but smaller. The *interior surface*, or the cavity of this auricular appendix, contains much fewer musculi pectinati than that of the right appendage. Below is the left *auriculo-ventricular orifice*, leading to the left ventricle. The *right side* is smooth, and formed by the auricular septum. We may observe that the *fossa ovalis* is here less distinct than on the right side. The *left side* is perforated at *b*, *d*, by two corresponding pulmonary veins; the orifices are very near each other. Like the right pulmonary at *f*, *c*, they are destitute of valves.

* So named from Arantius, who first described them.

† The distribution of the pulmonary artery will be noticed in a subsequent section.

THE LEFT VENTRICLE.

Fig. 185.

This ventricle is placed at the posterior part of the left side of the heart. Observe at *b*, Fig. 185, and at *i*, Fig. 184, the great thickness of the muscular parietes. The interior is furnished with a great number of fleshy columns, termed *carneæ columnæ*, similar to those of the right ventricle, though less numerous, and more irregularly disposed. There are several larger than others, as at *g*, directed from the apex of the heart to the base, fixed by one of their extremities to the sides of the ventricle, and terminating in a multitude of very slender diverging tendons, which frequently cross each other, and are attached to the loose edge of *e*, *h*, the mitral valve.

At the base of the left ventricle, the opening into the auricle is marked by a whitish zone, to which is connected a fold of membrane, *e*, *h*, called the *mitral valve*, from its shape being compared to a bishop's mitre. It is divided into two portions, to which the tendons of the carneæ columnæ are attached. There is another opening on the right side, which leads into the aorta, Fig. 185, *a*, which is furnished at *c*, *c*, *c*, with three semilunar valves, similar to those at the entrance of the pulmonary artery. Above the loose edge of the semilunar valves we observe the orifices of the two coronary arteries of the heart.

ORGANIZATION OF THE HEART.

The tissue of the heart is formed of muscular fibres in close apposition with each other, taking somewhat of an irregular spiral course from the base to the apex, and there, as it were, dipping in and forming the carneæ columnæ. The parietes of the auricles are much thinner than those of the ventricles. In the *right auricle* the muscular tissue constitutes a stratum of longitudinal fibres towards the point of union of the two venæ cavæ, where it is separated from the serous lamina of the pericardium by a considerable quantity of fat. In the *left auricle* the muscular stratum is much thicker and more uniform than in the right; the muscular fibres extend from the pulmonary veins to the auricle, where they form a transverse plane; but more deeply they cross each other in a very irregular manner.

The exact arrangement of the muscular fibres of the heart is extremely difficult to determine; they intermingle with each other without any apparent cellular tissue being interposed; COWPER, and subsequently J. CLOQUET, represent them as disposed in a spiral direction; but I have frequently examined their fibres, which seem to commence at all points, and extend in all directions; indeed, MAGENDIE confesses that he found it impossible to unravel them.

The *septum auriculorum* forms a thicker and more uniform layer; the muscular fibres of the right ventricle are interwoven at acute angles with those of the left; with a degree of patience, however, they may be separated, so as to divide the heart into two portions, the one the right, the other the left.

The *membrane of the cavities of the heart* is evidently continuous with the membranes which line the vessels destined for the circulation of the blood. On the right side the inner coat of the venæ cavæ is extended to the auricle, upon the muscular fasciculi, and in their intervals upon the serous tissue which covers the heart. Beneath the inferior vena cava it is folded upon itself, to form the Eustachian valve. Again, at the circumference of the auriculo-ventricular orifice, it is separated from the muscular tissue by a thin layer of fat, which constitutes the white circle we have before mentioned. There also it is folded, as it were, on itself, leaving the parietes of the heart to form the tricuspid valve; after which we may trace it through the whole ventricle and into the pulmonary artery, forming by its folding the three semilunar valves, and continued to the most minute ramifications of that vessel.

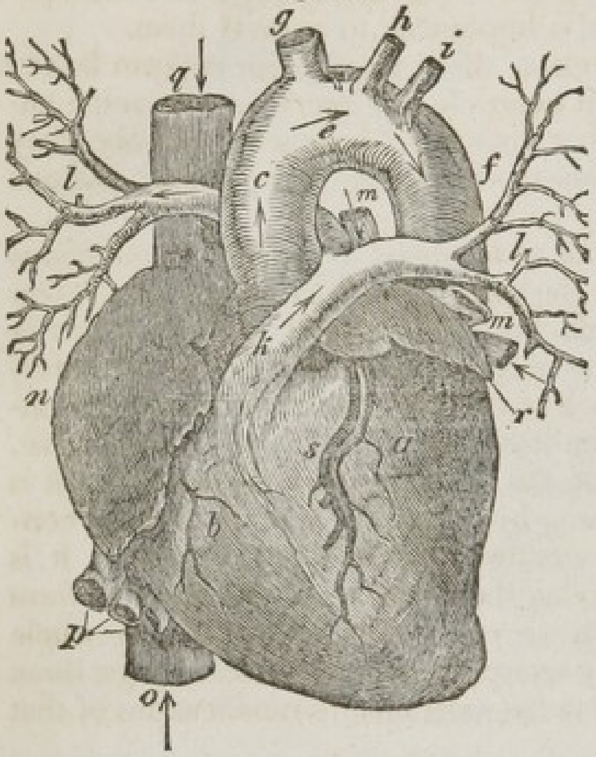
The *membrane of the left cavities of the heart* forms part of the inner tunic of the vessels that carry red blood; it extends from the extremities of the pulmonary veins to the whole cavity of the auricle, and penetrates into the ventricle. At the entrance of the latter its thickness increases, and it is so prolonged and doubled on itself as to form the mitral valve; we may then view this membrane, if we examine the aorta, forming the semilunar valves, and extending itself into it, and constituting a lining to all the vessels of the arterial system.

THE VESSELS OF THE HEART.

There are *two arteries* which rise immediately from the aorta, and are called *coronary;* these terminate in veins which have the same name, discharging themselves into the right auricle; its *lymphatics* are very numerous, and pass before the aorta and left bronchus. The *nerves* also which come from the cardiac ganglion are very thickly distributed upon the heart. We must consider a portion of the pericardium likewise as contributing to the structure of the heart, for its whole exterior is invested with it.

GENERAL OBSERVATIONS ON THE HEART.*

Fig. 186.



The office of the heart is to force the blood through the vessels, which are connected with it, to the remotest parts of the body, and the same force returns it to the heart by means of the veins ; thus the blood is incessantly flowing from the heart, and again proceeding to it, through the whole period of life, in one circuitous, continual, and interminable stream, hence called the circulation. Having studied the heart, we are now prepared to understand its duplex structure and functions, i. e. there is an auricle and a ventricle on the right side, and similar cavities on the left side ; the right performs the *less*, or *pulmonic circulation ;* the left, the *great*, or *systamatic circulation*. But to give a more detailed account of the process : 1st, the *descending vena cava*, *q*, conveys the blood from the head and upper extremities ; the *ascending vena cava*, *o*, collects all the blood from the lower part of the body ; they meet and form the *right auricle*, *n*. We may term this the first cavity of the heart ; its contraction carries the blood into the *right ventricle*, *b*, which stimulated by the quantity and quality of the blood, contracts, and forces the blood through the lungs by means of the *pulmonary artery*, *k*, which divides into right and left, to convey the blood by the branches *l*, *l*, which are distributed through all the cells of the lungs, to render it fit for the general circulation.

2d. The veins of the lungs, *m*, *m*, are sometimes three, at other times four in number : they return the blood, which has been purified in the lungs, to the *left auricle*, *r ;* this cavity contracts and fills the *left ventricle*, *a*, and the muscular action of this ventricle at each beat propels all the blood of the body, comunicating its vibrations to the extremest vessels. The blood thus distributed by the large trunks, namely, the aorta, *c*, *e*, *f*, the arteria innominata, *g*, the subclavian artery, *h*, and the left carotid artery, *i*, to the smaller branches, is brought back by the veins which are continued from their extremities ; this is a fact proved by the veins being filled when a fluid is injected into the arteries. The circulation of the blood also may be seen in the pellucid parts of animals by the aid of a microscope.

* The weight of this organ is about ten ounces in an adult, or, as compared to the body, as 1 to 200.

TABLE OF THE ARTERIES.

I. PULMONARY ARTERY.

II. AORTA.

ARTERIES FURNISHED BY THE AORTA AT ITS ORIGIN.

I. ANTERIOR AND POSTERIOR CORONARY.

II. ARTERIES FURNISHED BY THE ARCH OF THE AORTA.

Primitive carotid. Divided into external and internal carotids.

External carotid.
Furnishes,
1. Superior thyroid.
2. Lingual, which gives the dorsal and two sub-lingual.
3. External maxillary, or facial, furnishes
   1. The inferior palatine.
   2. Submental.
   3. Coronary arteries of the lips.
4. Occipital, which gives the posterior mastoid.
5. Posterior auricular, which furnishes the stylo mastoid.
6. Inferior pharyngeal.

The external carotid terminates in dividing into the temporal and internal maxillary.

7. Temporal artery.
Furnishes,
1. The transverse artery of the face.
2. The anterior auricular.
3. The middle temporal.

8. Internal maxillary artery.
Furnishes thirteen branches,
1. Middle meningeal.
2. Inferior dental.
3. Deep posterior temporal.
4. Masseteric.
5. Pterygoidean.
6. Buccal.
7. Anterior deep temporal.
8. Alveolar.
9. Infra-orbital.
10. Vidian.
11. Superior pharyngeal.
12. Superior palatine.
13. Spheno-palatine.

Internal carotid.
Furnishes,
1. Ophthalmic, which gives
   1. The lachrymal.
   2. Central artery of the retina.
   3. Supra-orbital.
   4. Posterior ciliary.
   5. Long ciliary.
   6. Superior and inferior muscular.
   7. Posterior and anterior ethmoidal.
   8. Superior and inferior palpebral.
   9. Nasal.
   10. Frontal.
2. The communicating artery of Willis.
3. Choroid artery.
4. Anterior cerebral.
5. Middle cerebral.

Subclavian artery.
Furnishes,
1. The vertebral, which gives
   1. The anterior and posterior spinal.
   2. Inferior cerebellic.
   3. The basilar, divided into
      1. The superior cerebellic.
      2. The posterior cerebral.
2. Inferior thyroid, which gives the ascending cervical.
3. Internal mammary, which gives
   1. The anterior mediastinal.
   2. Superior diaphragmatic.
4. Superior intercostal.
5. Transverse cervical.
6. Superior scapular.
7. Deep cervical. Continuing its course, the subclavian takes the name of axillary.

Axillary artery.
Furnishes,
1. Acromial.
2. Superior thoracic.
3. Inferior thoracic, or external mammary.
4. Inferior scapular.
5. Posterior circumflex.
6. Anterior circumflex.

In continuing, it takes the name of brachial.

Brachial artery.
Furnishes,
1. Deep humeral or external collateral.
2. Internal collateral.

It divides afterwards into the radial and ulnar.

1. Radial artery.
Furnishes,
1. The radial recurrent.
2. Dorsal artery of the carpus.
3. Dorsal artery of the metacarpus.
4. Dorsal artery of the thumb, and terminates in forming the deep palmar arch.

2. Ulnar artery.
Furnishes,
1. The anterior and posterior ulnar recurrent.
2. The anterior and posterior interosseous, which furnishes the posterior radial recurrent. It terminates in forming the superficial palmar arch, which gives the collateral arteries of the fingers.

ARTERIES FURNISHED BY THE AORTA IN THE THORAX.

1. The right and left bronchial.
2. Œsophageal (four, five, or six, in number).
3. Posterior mediastinal.
4. Inferior intercostals (eight, nine, or ten, in number).

ARTERIES FURNISHED BY THE AORTA IN THE ABDOMEN.

1. Inferior right and left diaphragmatic arteries.
2. Cœliac artery.
   Divided into three branches.
   1. Coronary of the stomach.
   2. The Hepatic, which gives
      1. The pyloric.
      2. The gastro-epiploica dextra.
      3. The cystic.
   3. The Splenic, which gives
      1. The gastro-epiploica sinistra.
      2. The vasa brevia.
3. Superior mesenteric artery.
   Furnishes from its concavity,
   1. The superior, middle, and inferior right colic.
   2. From fifteen to twenty intestinal branches.
4. Inferior mesenteric artery.
   Furnishes,
   1. The superior,
   2. The middle,
   3. The left colic; and divides into the superior hæmorrhoidal arteries.
5. The middle capsular arteries (two on either side).
6. Renal or emulgent.
7. Spermatic.
8. Lumbar (four or five on either side).

ARTERIES RESULTING FROM THE BIFURCATION OF THE AORTA.

The aorta furnishes a little before its bifurcation,
- 1. The middle sacral, and divides into the primitive iliacs, which are divided into,
  - 1. The internal.
  - 2. The external iliac artery.

Internal iliac artery. Furnishes,
- 1. The ilio-lumbar.
- 2. Lateral sacral.
- 3. Gluteal.
- 4. Umbilical.
- 5. Vesical.
- 6. Obturator.
- 7. Middle hæmorrhoidal.
- 8. Uterine.
- 9. Vaginal.
- 10. Ischiatic.
- 11. Internal pudic, which gives
  - 1. Inferior hæmorrhoidal.
  - 2. Artery of the septum scroti.
  - 3. Transversus perinæi.
  - 4. Artery of the corpus cavernosum.
  - 5. Dorsalis penis.

External iliac artery. Furnishes,
- 1. The epigastric.
- 2. Circumflexa ilii, and continues downwards under the name of the femoral artery.

Femoral artery. Furnishes,
- 1. External epigastric.
- 2. External superficial and deeply seated pudics.
- 3. Profunda, which gives
  - 1. The external and internal circumflex.
  - 2. The superior middle and inferior perforating arteries.
- In continuing its course it takes the name of popliteal.

Popliteal artery. Furnishes,
- 1. The superior middle, external and internal articular arteries.
- 2. The inferior internal and external arteries.
- 3. The anterior tibial; its continuation is called the dorsal artery of the foot, which furnishes,
  - 1. Tarsal.
  - 2. Metatarsal.
  - 3. Interosseous.
  - 4. Dorsal arteries of the great toe.
- The popliteal is divided into the peroneal and posterior tibial arteries.

1. Peroneal artery. Divided into the anterior and posterior fibular.

2. Posterior tibial artery. Divided into internal and external plantar. It forms, in anastomosing with the continuation of the anterior tibial, the plantar arch, from which the superior, posterior, inferior, and anterior branches are given off.

OF THE ARTERIES IN GENERAL.

The arteries are those tubes by which the blood is distributed to every part of the body. During life they may be distinguished by their pulsation, and if wounded, by the florid color of the blood, and by its escaping *per saltum*, or by jets ; after death they may be distinguished by their thick whitish coats, which are elastic, for if cut through, they preserve a circular orifice ; and lastly, by their having no valves except at their union with the heart.

We have taken a review of the heart, which represents a root, the arteries forming, as it were, two highly ramified trees, of which the principal trunk is the aorta, commencing at the left ventricle of the heart, branching out through all parts of the system, and terminating in minute twigs at the circumference of the body, limbs, and internal organs. The other arterial trunk arises from the right ventricle, and is extended through the lungs.

The arteries very frequently communicate with each other, so that the blood can pass from one to the other ; sometimes such communication takes place between trunks of an equal size, as in the vertebral arteries, which unite to form the basilar ; more frequently a small twig joins a more voluminous trunk, or a transverse branch unites two separate trunks, as in the anterior cerebral arteries ; or, lastly, two trunks by their union form an arch, as we observe in the mesenteric arteries.*

As the arteries are further removed from the heart, their communications are more numerous. In the ultimate branches their union is so exceedingly multiplied as to form an intricate network, ramifying *ad infinitum*, and from which the veins and exhalents seem to originate.

STRUCTURE OF ARTERIES.

The arteries are composed of three membranes or coats, embracing each other ; the *inner membrane* is similar and contiguous with that which lines the heart, being very smooth, thin, and transparent, and so fine as to have no traces of fibres. The *outer membrane* is dense and compact, and seems to be continuous with the surrounding cellular tissue, and which is formed of its compressed laminæ ; it is called *cellular coat*. Between these two coats is a *third membrane*, which chiefly forms the artery ; it is of a firm, close texture, and strong in proportion to the calibre of the vessel, of a yellowish or gray color, composed of distinct fibres adherent to each other, and disposed in concentric layers, intimately united to the external or cellular coat, but being very little adherent to the inner membrane. This tissue many anatomists have denominated the *muscular coat ;* but it differs very materially from muscular structure. It is of a peculiar nature, very dense, possessing little extensibility, although it is elastic and contractile.

The arteries receive minute arteries (*vasa vasorum*,) which enter into the coats of the artery, and form very complicated meshes on the

* The communication of arteries with each other is termed *inosculation*, or *anastomosis.*

surface, and which pass into venules, terminating in the trunks of the neighboring veins.* No lymphatics have been traced into them; but their nerves are very apparent, and are supplied chiefly from the system of the ganglia.

THE AORTA.

The aorta commences at the left ventricle; it is connected with the heart by a continuation of the lining membrane of that cavity, prolonged into its interior, and there forming three semilunar valves; see Fig. 185.

At its origin, the aorta is concealed by the pulmonary artery, but which at a short distance leaves it, as the aorta immediately is directed upwards and to the right, and crossing before the vertebral column, forms a curve called the *arch of the aorta*, see Fig. 180, *c*: opposite the third or fourth vertebra it emerges from the pericardium, and occupies the middle of the vertebral column; it is then directed a little backwards and to the left; from this situation the aorta becomes vertical, and descends in the posterior mediastinum upon the anterior and left part of the dorsal vertebræ; it arrives at the diaphragm, see Fig. 130, *n*, and passes along with the thoracic duct between its two pillars, *f*, *e*, *d*, *c*, and terminates in the abdomen by dividing at the fourth or fifth lumbar vertebra.† From its origin to its curve it is termed the *ascending aorta*, and from the arch to its division it is called the *descending aorta*, which is again distinguished into the *thoracic aorta* and the *abdominal aorta*.

The aorta in the pericardium, see Fig. 181, *e*, is embraced by the pulmonary artery, *k*, on the right, and by the vena cava, *q*, on the left; anteriorly, the mediastinum separates it from the sternum. Its arch lies at first on the trachea, a little before the division of the latter, and afterwards on the bodies of the second and third dorsal vertebræ. In the posterior mediastinum it lies on the left of the vertebral column, the œsophagus, the thoracic duct, and the vena azygos.

THE ARTERIES WHICH THE AORTA GIVES OFF AT ITS ORIGIN.

THE RIGHT CORONARY ARTERY.

This artery commences from the aorta immediately above the loose edge of the semilunar valves; and is seen in the groove which separates the right auricle from the corresponding ventricle. It winds round the channel upon the posterior surface of the heart, where it divides into two branches, which are distributed over the heart and extend to the apex.

At its commencement the right coronary artery gives off very small ramifications to the aorta and right auricle; others extend over the venæ cavæ and the interarticular septum; other branches descend upon the right ventricle, and communicate with the left coronary artery.

* The blood which flows through the artery is incapable of supplying nourishment to it; these small vessels support its vitality, and are not supplied by the artery which they nourish, but by others in the vicinity.

† See Fig. 201, *i*.

THE LEFT CORONARY ARTERY.

The left coronary artery is smaller than the right ; it arises like it from the commencement of the aorta, to the left of the pulmonary artery. It then directs itself downwards between the pulmonary artery and the left auricle, and enters the groove of the anterior surface of the heart (see Fig. 181, *s*,) and runs along its whole extent to the apex. It sends branches to the aorta and the pulmonary artery, and to the auricle and ventricle ; and dividing into very numerous twigs it communicates with the branches of the preceding artery.

THE ARTERIES OF THE ARCH OF THE AORTA.

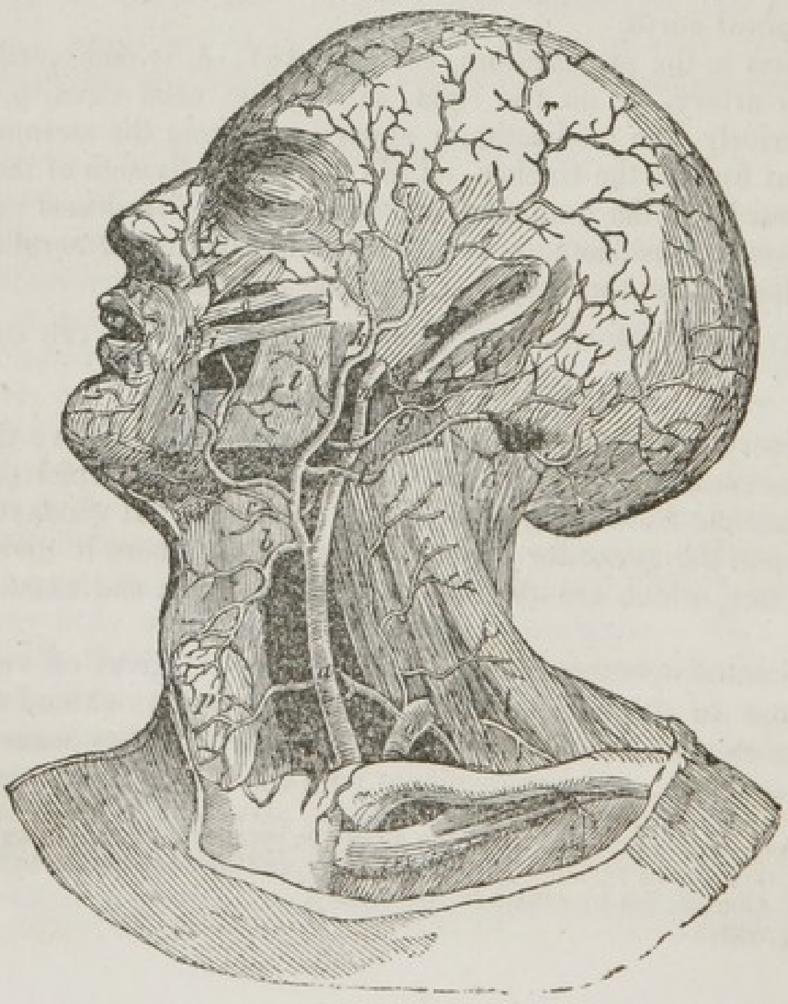
There are three arterial trunks arising from the arch of the aorta, destined for the head and the superior extremities ; they are shown in Fig. 186, and designated the *arteria innominata*, *g* ; the left *carotid*, *h* ; and the left *subclavian artery*, *i*.

ARTERIA INNOMINATA.

This artery ascends obliquely to the right, on the side of the trachea, and after the course of an inch divides into two trunks, of which the one is the right carotid, the other the right subclavian artery.

PRIMITIVE CAROTID ARTERIES.

Fig. 187.



It has been already mentioned, that the right carotid artery arises from the arteria innominata, while the left takes its origin from the aorta. But their volume is precisely the same; they ascend obliquely on each side of the neck, *a*, to the upper part of the larynx, *b*, where they divide into two branches, the *external* and the *internal carotid arteries.*

The interval between these two arteries is occupied by the larynx, the trachea, and the œsophagus.

Anteriorly, the left carotid is connected with the left subclavian vein, the thymus gland, and the clavicle. Posteriorly, the common carotids are situated upon the vertebral column, and more immediately upon the inferior thyroid arteries, the longi colli, and the recti capitis antici majores muscles. Internally, they correspond to the trachea, the thyroid gland, the larynx, and the pharynx. Externally, they are connected with the internal jugular vein, the pneumo-gastric nerves, and the communicating cords of the middle and superior cervical ganglia.

EXTERNAL CAROTID ARTERY.

This artery extends from the upper part of the larynx to the neck of the condyle of the lower jaw, and is particularly destined for the face and the exterior of the skull. It passes behind the posterior portion of the digastric and the stylo-hyoid muscles, where it crosses its direction, winding outwards and backwards, between the zygomatic process of the temporal bone and the angle of the under jaw; then divides into two branches, which are named the *temporal* and *internal maxillary arteries.*

On the outer side, inferiorly, the external carotid is connected with the platysma myoides and integuments, afterwards with the hypo-glossal nerve, the digastricus, and the stylo-hyoid muscles; and lastly, it is covered by the parotid gland. On the inner side, and from below upwards, it is connected with the internal carotid artery, the stylo-pharyngeus, and the stylo-glossus muscles, and the styloid process of the temporal bone.

The branches which this artery furnishes are — 1st, anteriorly, the *superior thyroid*, the *external maxillary*, and the *lingual;* 2d, posteriorly, the *occipital* and *auricular;* 3d, on the inner side, the *inferior pharyngeal*, and those by which it terminates; the *temporal* and the *internal maxillary* arteries.

ANTERIOR BRANCHES OF THE EXTERNAL CAROTID ARTERY.

I. SUPERIOR THYROID ARTERY.

This artery is situated at the fore and upper part of the neck; it extends from the external carotid, *a*, to the larynx, *b*, and to the thyroid gland, *p*, where it divides into three branches, which are distributed by a great number of divisions in the parenchyma of this organ.

On the outer side it is connected with the platysma myoides, the omo-hyoideus, and the thyroid cartilage, to which it gives small ramifications, namely, the *laryngeal*, which is directed towards the upper part of the larynx, passing between the os hyoides and the thyroid cartilage into the larynx, to supply the epiglottis, the muscles, and the mucous membrane of that organ. The *crico-thyroid branch* is smaller than the preceding, and descends obliquely over the thyroid cartilage, furnishing ramifications to the adjacent parts.

II. EXTERNAL MAXILLARY ARTERY.*

This artery commences at the anterior part of the external carotid above the lingual, *e* ; it proceeds transversely inwards and forwards, and after describing several curves, gains the internal part of the angle of the lower jaw ; passes between the submaxillary gland and the base of the jaw ; then ascends towards the angle of the lips ; enters under the union of the levator anguli oris and triangularis muscles, and terminates upon the side of the nose as far as the inner angle of the eye, communicating freely with the nasal twig of the ophthalmic and the infra-orbitar arteries.

BRANCHES OF THE EXTERNAL MAXILLARY ARTERY.

There is beneath the inferior maxilla, 1st, the *inferior palatine*, which, after arising near the origin of the inferior maxillary artery, supplies the superior and lateral part of the pharynx, passes between the pillars of the velum palati, and is distributed to the pharynx, the tonsils, and the Eustachian tube, communicating with the superior palatine. 2d, the *submental*, which supplies the mylo-hyoideus and the digastricus, and ramifying above the chin, sends branches to the muscles of the superior hyoid region, the submaxillary gland, the internal pterygoid muscle, and the mucous membrane of the mouth. On the face the external maxillary artery furnishes external and internal branches, which are distributed to this region. 3d, the *coronary arteries of the lips*, which proceed in a serpentine direction on the border of the lips, and communicate with each other at the angles of the mouth. 4th, the *dorsal artery of the nose*, which supplies the muscles, cartilages, and integuments of this part, and is in general the termination of the maxillary artery.

III. THE LINGUAL ARTERY.

This vessel commences at the anterior part of the external carotid between the two preceding arteries, passing inwards and forwards ; it is directed a little upwards, and enters between the hyo-glossus and the genio-glossus as far as the root of the tongue, proceeding horizontally along its base under the name of the *ranine artery*. The lingual

* *Facial or labial artery.*

artery sends branches beneath the hyo-glossus muscle, and to the middle constrictor of the pharynx, the thyro-hyoideus, and the digastricus. From the same point the *dorsal artery of the tongue* arises, ramifying in the back of the tongue, the tonsils, and velum palati. Several twigs from the lingual artery penetrate the genio-glossus muscle ; and one considerable branch, named the *sublingual artery*, passes forwards above the sublingual gland, furnishing branches to those parts, to the mucous membrane of the mouth, and to the adjacent muscles. Lastly, the *lingual artery* supplies many branches under the tongue, which ramify in the substance of this organ ; at the tip, and above the frænum of the tongue, the two lingual, which have gained the name of the ranine arteries, anastomose with each other.

POSTERIOR BRANCHES OF THE EXTERNAL CAROTID ARTERY.

IV. OCCIPITAL ARTERY.

This artery, Fig, 187, *f*, commences at the posterior part of the external carotid under the parotid gland ; passes obliquely backwards, beneath the posterior portion of the digastricus ; ascends between the transverse process of the atlas and the mastoid process of the temporal bone, and finally terminates in a tortuous manner upon the back part of the head. The occipital artery furnishes superior, posterior, and inferior branches, which supply the muscles in that region. One of them, which is larger than the others, is named the *posterior mastoid artery*, from traversing the mastoid foramen, and is subsequently lost on the dura mater ; others descend in the substance of the muscles on the lateral part of the neck. The extreme branches are more superficial, and lose themselves in the muscles of the posterior region of the neck.

V. THE POSTERIOR AURICULAR ARTERY.

This, Fig. 187, *g*, is one of the smallest branches of the external carotid ; it passes between the auditory canal and the mastoid process, and gaining the inferior part of the external ear, divides into two branches, which are distributed to the posterior auricular and temporal muscles, and the integuments. But before its division, it furnishes the *stylo-mastoid artery*, which enters the foramen of the same name, passes through the aqueduct of Fallopius, and supplies the mucous membrane of the tympanum, the semicircular canals, etc.

VI. INTERNAL BRANCH OF THE EXTERNAL CAROTID ARTERY, OR INFERIOR PHARYNGEAL ARTERY.

This artery passes vertically along the lateral and posterior part of the pharynx, between the external and internal carotids, and divides into two branches, namely, the *pharyngeal*, which is distributed to the constrictor muscles of the pharynx, and the *meningeal branch*, which passes between the internal carotid artery and the internal jugular vein, and entering the foramen lacerum posterius, is distributed to the dura mater.

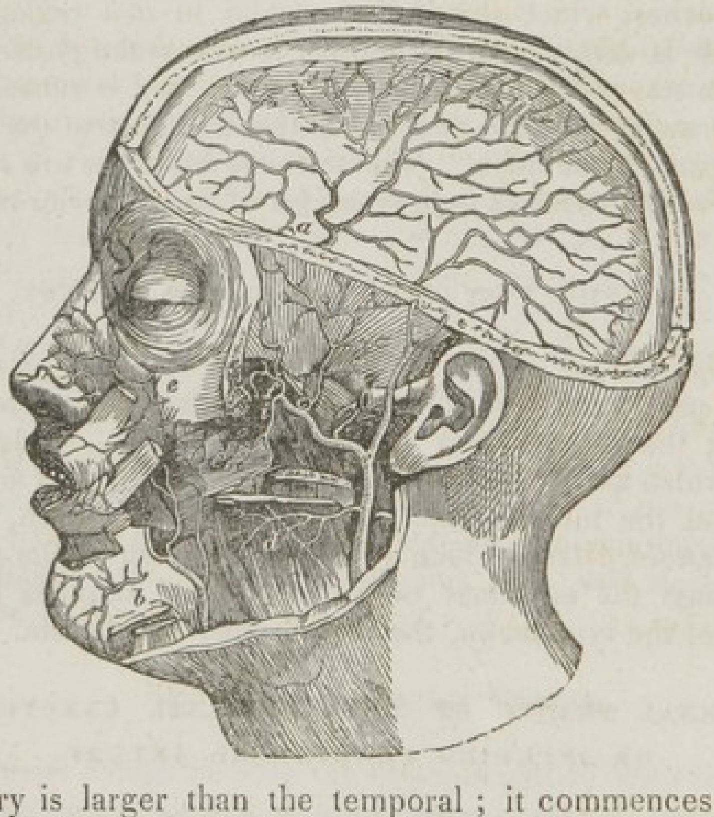
BRANCHES WHICH TERMINATE THE EXTERNAL CAROTID ARTERY.

VII. TEMPORAL ARTERY.

The temporal artery, *k*, separates from the internal maxillary artery opposite the neck of the condyle of the jaw, and passes obliquely upwards beneath the parotid gland; it passes over the zygomatic arch, and glides in a tortuous manner under the anterior and the superior muscles of the ear and becomes subcutaneous, dividing into three branches, namely, the *transverse artery of the face*, *l*, which ramifies on Steno's duct and the muscles about this region; the *anterior auricular artery*, which supplies the external ear; the *middle temporal*, which pierces the temporal aponeurosis near the zygomatic arch, and is lost in the temporal muscle. Ultimately, the temporal artery divides into the anterior and posterior branches, which diffuse themselves over the occipito-frontalis muscle and the pericranium.

VIII. INTERNAL MAXILLARY ARTERY.

Fig. 188.



This artery is larger than the temporal; it commences at the external carotid about the same point, and is remarkable for the great number of important branches which it supplies to the deep parts of the face. In this figure the temporal zygoma and the ramus of the jaw are removed, to show its course between the pterygoid muscles to the floor of the orbit, and spheno-maxillary fossa.

BRANCHES OF THE INTERNAL MAXILLARY ARTERY BEHIND THE NECK OF THE CONDYLE OF THE JAW.

I. MIDDLE MENINGEAL ARTERY.

This is the largest branch, *a*, of the internal maxillary artery ; it mounts almost vertically between the two pterygoid muscles, and passes into the cranium by the foramen spinosum of the sphenoid bone. It furnishes branches to the dura mater, the fifth pair of nerves, and to the aqueduct of Fallopius, and then divides into the anterior and posterior branches ; the former is found in a deep groove of the parietal bone, and supplies the exterior surface of the dura mater ; the latter is distributed to the posterior part of that membrane.

The ultimate ramifications of the meningeal artery communicate with those of the opposite side of the dura mater.

II. INFERIOR DENTAL, OR INFERIOR MAXILLARY ARTERY.

This vessel descends anteriorly along the inner surface of the ramus of the lower jaw, at the outer side of the pterygoideus internus, enters the inferior dental canal, and emerges by the mental foramen. Before entering the dental canal it supplies the pterygoid muscle ; in the canal it furnishes the teeth with branches, which pass through the foramina at their roots. One of its branches passes out of the mental foramen, is distributed to the triangularis and quadratus muscles, at *b*, and communicates with the facial artery ; another branch continues its course to the chin, and gives twigs to the canine and incisor teeth.

BRANCHES OF THE INTERNAL MAXILLARY BETWEEN THE PTERYGOID MUSCLES.

I. POSTERIOR DEEP TEMPORAL BRANCH.

This artery, *c*, ascends between the temporal and external pterygoid muscles, and is distributed to the temporal muscle and periosteum in the temporal fossa.

II. MASSETERIC ARTERY.

This branch passes between the temporal muscle and the neck of the condyle of the lower jaw, and ramifies in the masseter muscle, communicating with the transverse artery of the face.

III. PTERYGOID ARTERIES.

These arteries, *d*, are distributed to the pterygoid muscles.

BRANCHES OF THE INTERNAL MAXILLARY ARTERY IN THE ZYGOMATIC FOSSA.

I. BUCCAL ARTERY.

This artery, *i*, descends, then advances between the internal peterygoid muscle and ramus of the inferior maxilla, supplying the buccinator and the zygomaticus major muscles, and the mucous membrane of the mouth.

II. ANTERIOR DEEP TEMPORAL ARTERY.

This artery, *f*, ascends into the anterior part of the temporal fossa, and is lost in the temporal muscle.

III. ALVEOLAR ARTERY.

This artery descends on the maxillary tuberosity, and sends branches into the superior and posterior dental canals, to supply the molar teeth and the membrane of the maxillary sinuses.

IV. INFRA-ORBITAR ARTERY.

This artery, *e*, commences from the maxillary at the anterior superior part of the zygomatic fossa, enters the infra-orbitar canal, and emerging from it, communicates freely with the facial, alveolar, buccal, and ophthalmic arteries.

BRANCHES OF THE INTERNAL MAXILLARY ARTERY IN THE SPHENO-MAXILLARY FOSSA.

I. VIDIAN OR PTERYGEAL ARTERY.

This is a very slender artery penetrating the pterygoid canal, and passing out is distributed to the Eustachian tube.

II. SUPERIOR PHARYNGEAL ARTERY.

This artery passes obliquely backwards, and entering the pterygopalatine canal, terminates at the pharynx.

III. SUPERIOR PALATINE ARTERY.

This artery is larger than the two last mentioned, and proceeds vertically into the pterygo-maxillary fissure, afterwards into the posterior palatine canal, and passing out is reflected forwards to supply the mucous membrane of the palatine arch.

IV. SPHENO-PALATINE ARTERY.

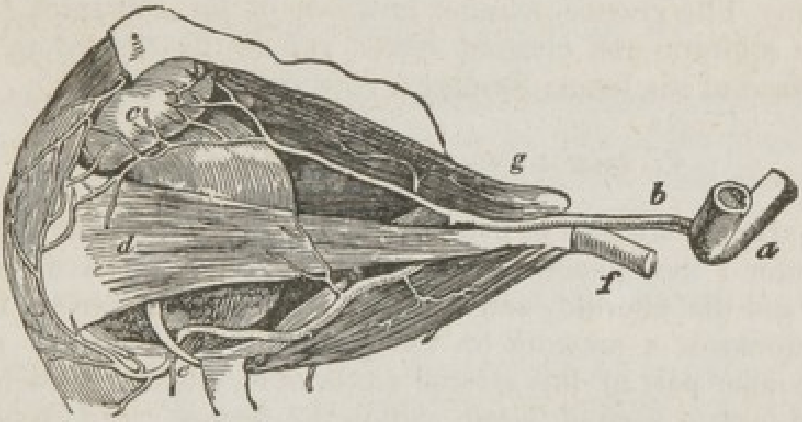
This may be considered as the ultimate distribution of the internal maxillary artery, which, passing into the spheno-palatine foramen, supplies the nasal fossa, the maxillary, the sphenoidal, and the frontal sinuses.

INTERNAL CAROTID ARTERY.

The internal carotid, Fig. 187, *n*, separates from the external behind the digastric muscle, mounts between the anterior and lateral part of the vertebræ of the neck and the pharynx, and then enters the carotid canal. After emerging from this canal it passes upwards and forwards, penetrates the cavernous sinus of the dura mater, and making two inflexions, like the curves of a Roman S, arrives beneath the anterior clinoid process; here it ascends obliquely backwards, pierces the dura mater, and terminates in very many branches. While the internal carotid is in the cavernous sinus, it sends two or three twigs to the dura mater, the pituitary body, the membrane of the sphenoidal sinus, and to the nerves of the orbit.

OPHTHALMIC ARTERY.

Fig. 189.



This artery enters the orbit, traversing the optic foramen with the nerve *f*, of the same name, on the outer side of which it is situated; afterwards it crosses above it, being covered by the rectus superior of the eye, *g*, and proceeds horizontally along the internal wall of the orbit as far as the internal canthus, where it terminates in sending off the following branches:

I. THE LACHRYMAL ARTERY.

This artery arises from the ophthalmic immediately after its entry into the orbit, passes outwards between the external side of this cavity and external rectus muscle, as far as the lachrymal gland, *c*, where it ramifies, and supplies the muscles in this region, as also the muscles of the superior and inferior eyelid.

II. THE CENTRAL ARTERY OF THE RETINA.

This artery is exceedingly slender; it obliquely perforates the coverings of the optic nerve, reaches its centre, and passes into the eye, where it sends a great number of branches to the inner surface of the retina, as far as the corpus ciliare ; one of its branches penetrates the vitreous humor, and may be traced, when injected with mercury, to the posterior part of the capsule of the crystalline lens.

ARTERIES SENT OFF BY THE OPHTHALMIC ABOVE THE OPTIC NERVE.

III. THE SUPRA-ORBITAR ARTERY.

This artery passes forwards along the superior wall of the orbit, and makes its exit by the supra-orbitary foramen, where it divides into an internal and an external branch, the former supplying the muscles in that region, the latter extending to the integuments of the forehead.

IV. THE POSTERIOR CILIARY ARTERIES.

These arteries are very numerous, generally thirty or forty ; they communicate with each other round the optic nerve, and traverse the sclerotica. The greater number however of these arteries pass between the sclerotic and choroid coats, and are distributed to the external surface of the latter, forming a very delicate network.

V. THE LONG CILIARY ARTERIES.

These arteries are two in number, one on the inner side, the other on the outer ; they penetrate the sclerotica, pass forwards between this coat and the choroid, and arriving at the ciliary circle, form by their anastomoses a network on the great circumference of the iris. From the inner part of this arterial circle other smaller branches proceed, and form a second circle within the former ; and these again form a third circle of vessels of greater tenuity, which immediately surrounds the pupil.

VI. THE SUPERIOR AND INFERIOR MUSCULAR ARTERIES.

These arteries are distributed to the superior and inferior muscles of the eye, to the periosteum of the orbit, and to the lachrymal sack.

ARTERIES SENT OFF BY THE OPHTHALMIC IN ITS COURSE ALONG THE INSIDE OF THE OPTIC NERVE.

VII. THE POSTERIOR AND ANTERIOR ETHMOIDAL ARTERIES.

These arteries are directed towards the internal part of the orbit, traverse the posterior internal orbitar canal, and are lost on the dura mater within the cranium.

VIII. THE SUPERIOR AND INFERIOR PALPEBRAL ARTERIES.

These arteries supply the anterior parts of the orbit, the caruncula lachrymalis, the lachrymal sack, and the eyelids, and communicate with the lachrymal artery.

BRANCHES WHICH TERMINATE THE OPHTHALMIC ARTERY.

IX. THE NASAL ARTERY.

This artery issues from the orbit above the tendon of the orbicularis palpebrarum, passes to the root of the nose, and unites with the terminating branches of the external maxillary artery.

X. THE FRONTAL ARTERY.

This artery passes out of the orbit, and ascends on the forehead, where it is entirely distributed.

After the internal carotid has given off the ophthalmic artery, it furnishes the following branches :

I. THE COMMUNICATING ARTERY OF WILLIS.

This artery commences from the internal carotid after the ophthalmic, passes backwards and a little inwards on the side of the pituitary body and mammillary eminences, and communicates with the posterior cerebral artery, which is furnished by the basilar.

II. THE ARTERY OF THE CHOROID PLEXUS.

This artery commences above the preceding ; it passes outwards and backwards near the crus cerebri, penetrates into the lateral ventricle, and is distributed to the choroid plexus.

III. THE ANTERIOR CEREBRAL ARTERY.

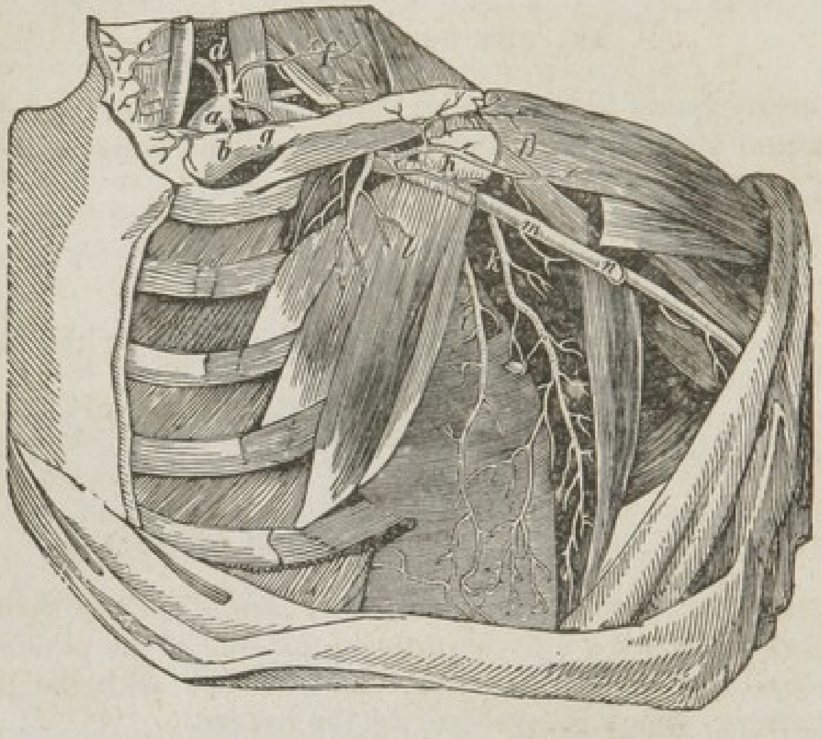
This artery passes under the anterior lobe of the brain, *e*, Fig. 193, where it approaches that of the opposite side, and anastomoses with the communicating artery of Willis. It sends off branches to the fornix, the anterior commissure, and the septum lucidum. Afterwards the cerebral artery is directed forwards, turns round the anterior part of the corpus callosum, and takes the name of that part, terminating on its posterior surface.

IV. MIDDLE CEREBRAL ARTERY.

This artery passes outwards and backwards, and dips into the fissure of the anterior and middle lobes of the brain, where it divides into two branches, one for the anterior, the other for the middle lobe of the brain.

SUBCLAVIAN ARTERY.

Fig. 190.

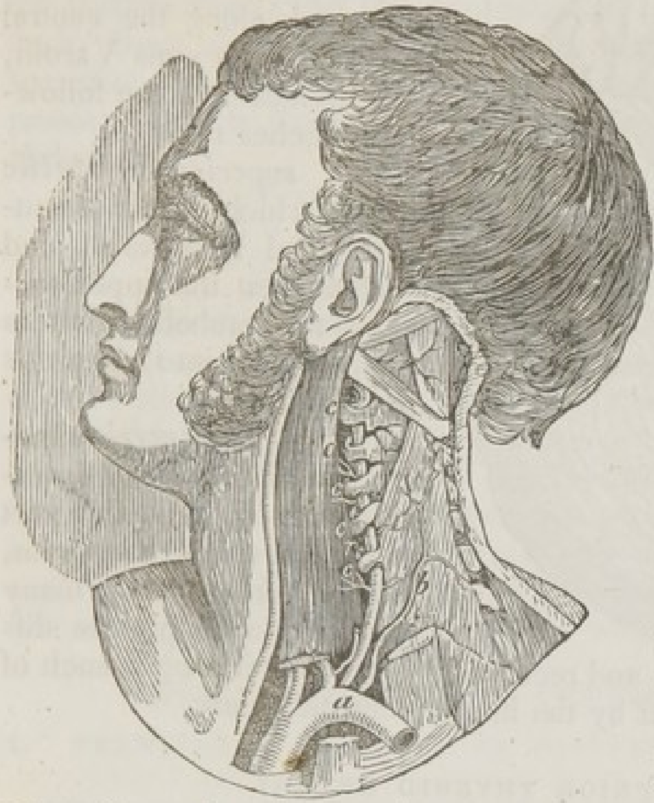


This artery, *a*, is so named from its situation under the clavicle ; it is situated at the superior part of the chest, and extending from the arch of the aorta ; it proceeds under the clavicle, *b*, *g*, and over the middle of the first rib, passing between the anterior and middle scaleni muscles, then runs under the arch of the pectoralis minor, *l*, and enters the axilla, where it assumes the name of the axillary artery. The right subclavian arises from the arteria innominata, the left separates from the aorta at the termination of its arch. These arteries, give branches directly upwards, and directly downwards to the neck throat, and chest.

BRANCHES OF THE SUBCLAVIAN ARTERY.

I. VERTEBRAL ARTERY.

Fig. 191.



This artery is the largest branch of the subclavian, and extends to the brain. It arises from the upper and back part of the subclavian, *a*, ascends behind the inferior thyroid artery on the vertebral column, enters the foramen at the base of the transverse processes of the sixth cervical vertebra, and takes its course through the canal formed by the union of the foramina of the transverse processes, *c*, *c*, *c*, *c*, *c*, of the other vertebræ of the neck. At the dentata, or second vertebra, it leaves this canal, curving upwards, backwards, and outwards, and perforates the transverse process of the atlas or first vertebra; it then passes between this vertebra and the occiput, forming a second curve; lastly, it enters the skull at the great occipital foramen by the side of the spinal marrow, and penetrating the dura matter, mounts upwards and forwards between the corpora olivaria and pyramidalia, as seen in Fig. 193, *b*, *b*, uniting with the corresponding vertebral artery to form *c*, the basilar artery.

The vertebral artery sends off the following branches:

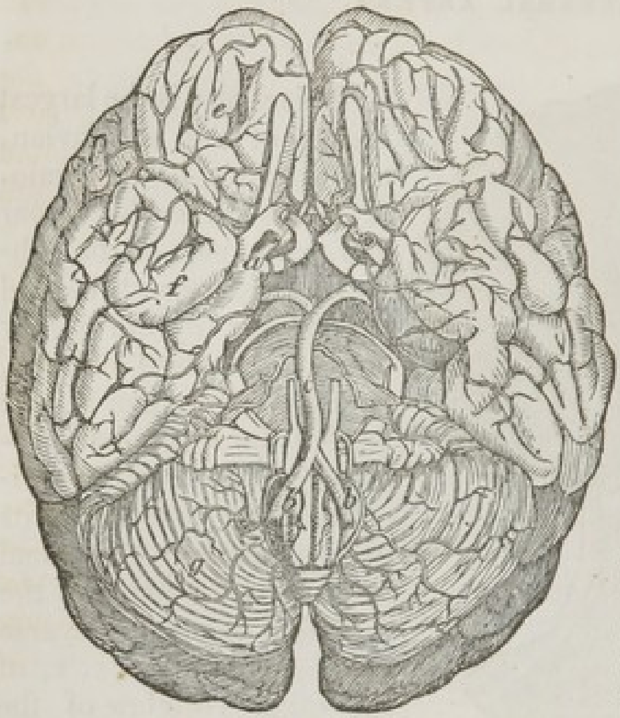
1. The *posterior spinal artery*, which arises near the corpora pyramidalia, proceeds downwards and inwards behind the spinal marrow, and is distributed on its posterior surface as far as the second lumbar vertebra.

2. The *anterior spinal artery*, which commences near the termination of the vertebral artery, and descends on the anterior surface of the spinal marrow. On a level with the occipital foramen it unites with the artery of the opposite side to form a common trunk, which descends as far as the lower extremity of the spinal cord, distributing branches on either side of it, and finally communicating with the middle sacral artery.

3. The *inferior cerebellic artery*, which commences at the termination of the vertebral, or sometimes at the basilar, and proceeds in a serpentine course, distributing numerous branches to the eighth and ninth pair of nerves, to the pia mater, and to the fourth ventricle, and to *g*, the whole inferior surface of the cerebellum.

II. BASILAR ARTERY.

Fig. 193.



The basilar artery, *c*, is formed by the union of the two vertebral arteries, *b*, *b* ; it extends along the central groove of the pons Varolii, and divides into the following branches :

The *superior cerebellic artery*, which proceeds outwards and backwards, and descends on the upper surface of the cerebellum, where it spreads out into numerous ramifications.

The *posterior cerebral artery*, which proceeds downwards to the posterior part of the lobes of the brain, divides into very many branches to supply the different parts of this region, and receives the communicating branch of Willis, which is given off by the internal carotid artery.

III. INFERIOR THYROID ARTERY.

This vessel, Fig. 187, *p*, commences at the superior part of the subclavian artery, *o* : it extends vertically on the anterior scalenus as far as the fifth vertebra, where it turns inwards towards the thyroid gland, and sends off internal and external branches to the trachea, œsophagus, longus colli, and other muscles in this region ; a branch, called the ascending cervical, extends upwards as far as the rectus anticus major, and is distributed to the scalenus anticus, the longus colli, and the splenius muscles ; the inferior thyroid artery, at the lower part of the gland, divides into numerous branches, which supply this organ, and anastomose with those of the opposite side, and with those of the superior thyroid artery.

INFERIOR BRANCHES OF THE SUBCLAVIAN ARTERY.

I. INTERNAL MAMMARY ARTERY.

This artery, Fig. 197, *e*, arises from the subclavian, opposite the inferior thyroid, passes inwards and downwards in front of the scalenus anticus muscle, enters the thorax, descends along the sterno-costal cartilages, between these and the pleura costalis, and divides into two branches near the ensiform cartilage. It furnishes several branches to adjacent muscles, and afterwards sends off the following branches :

The *anterior mediastinal artery*, which descends in the superior separation of the anterior mediastinum and divides into branches, which supply the thyroid and thymus glands, the pleura, and the cellular tissue of the mediastinum.

The *superior diaphragmatic artery*, which accompanies the nerve of the same name, supplies the fibrous membrane of the pericardium, the thymus gland, and the mediastinum, and at length is lost in the fleshy fibres of the diaphragm. It also furnishes *external and internal branches:* the external supplying the intercostal muscles, the internal passing through them, and supplying the muscles of the thorax and abdomen.

II. SUPERIOR INTERCOSTAL ARTERY.

This artery, Fig. 196, *g*, commences at the lower and back part of the subclavian, and descends under the pleura, in front of the neck of the first and second ribs, where it generally terminates. In front of these ribs it sends off a *posterior* and an *external branch:* the former is distributed to the muscles of the back, the latter to the intercostal muscles, the periosteum of the vertebræ, the œsophagus, and the bronchi. In the second intercostal space it furnishes external and internal branches, which follow precisely the same course as the preceding, and are distributed to the muscles or communicate with the first intercostal artery arising from the aorta.

EXTERNAL BRANCHES OF THE SUBCLAVIAN ARTERY.

I. TRANSVERSE CERVICAL OR POSTERIOR SCAPULAR ARTERY.

This artery, *o*, is directed transversely outwards, winding along the scaleni muscles above the nerves which form the brachial plexus; then curving obliquely under the trapezius, the levator anguli scapulæ, and the rhomboideus, it terminates at the posterior border of the scapula, and may be traced to its inferior angle. Near its origin this artery gives off several branches, which ascend, and lose themselves in the muscles at the side of the neck.

II. SUPERIOR SCAPULAR ARTERY.

This artery commences often at the preceding or at the superior thyroid, takes a tortuous course behind and beneath the clavicle, and arrives at the superior border of the scapula; it afterwards passes above the coracoid ligament, sending branches to the trapezius, and ultimately descends into the infra-spinatus fossa, between the bone and the infra-spinatus muscle.

III. POSTERIOR OR DEEP CERVICAL ARTERY.

This artery commences at the posterior part of the subclavian, behind the anterior scalenus; it passes between the transverse processes of the two last vertebræ of the neck, and extends to the great complexus muscle.

AXILLARY ARTERY.

This artery is the direct continuation of the subclavian; it is situated at the superior and lateral part of the thorax; and in the axilla it extends from the first rib, in the interval of the two scaleni muscles, as far as the inferior margin of the tendon of the latissimus dorsi. The axillary artery is seen in Fig. 190, proceeding under the clavicle, *b*, *g*, and under the arch formed by the pectoralis minor, *h*, *l*. In the axilla it is surrounded by branches of nerves of the brachial plexus, which form a sort of sheath for the artery. The corresponding vein is always placed before the artery, and it is further protected by a quantity of cellular tissue and lymphatic glands. When it has passed the anterior edge of the pectoralis major, it assumes the name of the brachial artery.

BRANCHES OF THE AXILLARY ARTERY.

I. ACROMIAL ARTERY.

This artery, *h*, commences at the anterior part of the axillary ; it descends obliquely towards the deltoid muscle, and in the narrow space which separates this muscle from the great pectoral ; it then divides into a superior and inferior branch ; the former ramifies on the shoulder joint, the latter is distributed to the deltoid and the great pectoral muscles.

II. SUPERIOR THORACIC ARTERY.

This artery, *l*, generally arises with the former artery, and descends between the two pectoral muscles, to which it is distributed.

III. LONG THORACIC OR EXTERNAL MAMMARY ARTERY.

This artery, *i*, commences a little lower down than the preceding ; it descends from behind forwards, on the upper and lateral part of the chest, along the inferior margin of the pectoralis major, supplying this muscle, the serratus magnus, the intercostals, the lymphatic ganglia of the axilla, the integuments, and the mamma.

IV. INFERIOR SCAPULAR.*

This artery, *k*, arises from the inferior part of the axillary, opposite the inferior border of the tendon of the subscapularis muscle ; it descends along the lower border of this muscle, and gives off an inferior and superior branch ; the former supplies the serratus magnus, the latissimus dorsi, the teres major, and the integuments ; the latter is distributed to the various muscles of the scapula, and to the articulation of the shoulder.

V. POSTERIOR AND ANTERIOR CIRCUMFLEX ARTERIES.

The former of these arteries, *m*, arises from the posterior part of the axillary, passes backwards, turns round the upper part of the humerus, and is lost in the deltoid muscle ; the latter, *n*, is generally furnished by the preceding, and proceeds under the coraco-brachialis and short head of the biceps ; it turns also round the humerus, and is distributed to the deltoid muscle.

* Frequently termed the *subscapular artery*.

BRACHIAL ARTERY.

Fig. 194.

This artery, *a*, is a continuation of the axillary; it is situated at the inner and fore part of the arm, and passes along the inferior edge of the coraco-brachialis. About the middle of the os brachii it crosses over the tendinous attachment of that muscle, being situated between the fleshy mass of the biceps and the upper fibres of the brachialis externus. This artery then proceeds behind the inner edge of the biceps, descending between that muscle and the fibres of the brachialis internus; in approaching the lower extremity of the os brachii, it is inclined forwards towards the bend of the arm, and lies at *i*, beneath the aponeurosis, which is continued from the tendon of the biceps flexor cubiti. The brachial artery sends off numerous branches to the different muscles of the arm, two of which are more considerable than the others, and are termed muscular branches.

I. SUPERIOR MUSCULAR BRANCH, OR DEEP HUMERAL.

This artery, *b*, commences at the inner side of the brachial artery, immediately after it has left the axilla, passes between the triceps and the humerus, accompanied by the muscular spiral nerve, and proceeds between the brachialis externus and the short portion of the triceps, then divides into branches, which supply the triceps near the olecranon and the superadjacent integuments.

II. THE INFERIOR MUSCULAR ARTERY.

This artery, *c*, is sent off from the brachial about two inches lower than the preceding; it descends among the muscles of the inside of the arm, and is lost about the inner condyle, *k*.

III. THE RAMUS ANASTOMOTICUS MAGNUS.

This artery, *e*, commences about two or three inches above the inner condyle of the os brachii; it is distributed about the elbow, and its principal branches communicate with the recurrent branches of the arteries of the fore-arm.

IV. THE EXTERNAL BRANCHES OF THE BRACHIAL ARTERY.

The arteries, *f*, are small, and supply the coraco-brachialis, the brachialis internus, the biceps, and the integuments.

The *anterior* and *posterior branches* of the brachial artery are short and slender, their number is very indeterminate, and they penetrate the muscles, of the front or back part of the arm.

BRANCHES BY WHICH THE BRACHIAL ARTERY TERMINATES.

Fig. 195.

The brachial artery, *a*, divides at *k*, into three branches : 1st, the *radial*, *n*, *o* ; 2d, the *ulnar*, *l* ; and 3d, the *interosseous artery*, *m* ; the last two, however, generally arise by one trunk, as at *l*, in this figure.*

THE RADIAL ARTERY.

This artery is situated at the anterior and front of the fore-arm : it follows the direction of the brachial artery, *a*, and at the bend of the arm, *k*, separates at an acute angle from the ulnar. The radial artery extends from the upper extremity of the radius, *k*, as far as the articulation of the carpus, *o*, here it turns outward, passes between the two first metacarpal bones into the palm of the hand, where it forms the deep palmar arch, *p*. But it is important more particularly to understand its relative connexions. Above, it lies between the pronator teres and the supinator longus, and about the middle of the fore-arm passes over the lower attachment of the pronator teres, continuing its course between the supinator longus and the flexor carpi radialis, accompanied by a branch of the musculo-spiral nerve. At the lower extremity of the radius it divides into two branches, which are distributed to the hand.

The branches of the radial artery, in its course along the fore-arm are as follows :

* The division of the brachial artery is not always at the same point. I have not unfrequently observed it about the middle of the arm, and sometimes as high as the axilla.

1. The *radial recurrent*, which passes outwards and upwards near the elbow, and is distributed to the outer condyle, where it anastomoses with branches of the brachial. See Fig. 194.

2. The *internal branches*, which are very numerous, are distributed to the muscles of the anterior and superficial layer of the fore-arm.

3. The *superficiales volæ*, Fig. 194, *h*, which descend upon the anterior annular ligament of the wrist, distributing a number of twigs to the muscles and integuments of the palmar region.

4. The radial artery at the back of the wrist is only covered by the tendons of the abductor pollicis longus, the extensores pollicis, and the integuments, and ramifying on the back of the hand, is named the *dorsal artery of the wrist.*

5. The *dorsal artery of the metacarpus* passes immediately over the second metacarpal bone, descends on the back of the hand, and is sometimes prolonged to the fore-finger.

6. Small vessels supply the back part of the thumb, termed the *dorsal arteries of the thumb.*

On entering into the palm of the hand, the radial artery divides into two branches :

7. The *artery of the thumb*, which supplies a branch to the outer edge of the fore-finger.

8. The *deep palmar arch*, *p*, which is obvious in the preceding figure, passes transversely from the thumb over the metacarpal bones, and terminates by anastomosing with a branch of the ulnar artery. The deep palmar arch furnishes twigs to the interosseous muscles, and to the deep-seated parts of the palm of the hand.

THE ULNAR ARTERY.

This artery, *l*, is larger than the radial ; it is situated at the anterior and inner part of the fore-arm, and extends from the bend of the arm as far as the palm of the hand. It takes its course under the pronator teres, the flexor carpi radialis, the palmaris longus, and the flexor sublimis perforatus, but passes over the flexor profundus perforans. It descends between the two last mentioned muscles, and is found on the ulnar edge of the arm, at the outer edge of the flexor carpi ulnaris ; it then proceeds over the annular ligament of the wrist, and under the palmar aponeurosis, until it arrives at the metacarpal bone of the little finger, where it forms the superficial palmar arch, seen in Fig. 194, *g*.

The branches given off by the ulnar artery in its course along the fore-arm and wrist, are the following :

1. The *anterior and posterior recurrent arteries* arise from the ulnar artery, immediately below the elbow. The anterior is distributed to the fore part of the inner condyle, the posterior to the back part of the same process of bone. These arteries communicate with branches of the brachial.

2. The *ulnar artery* furnishes numerous branches to the muscles of the fore-arm.

3. The *anterior and posterior interosseous arteries ;* the former,

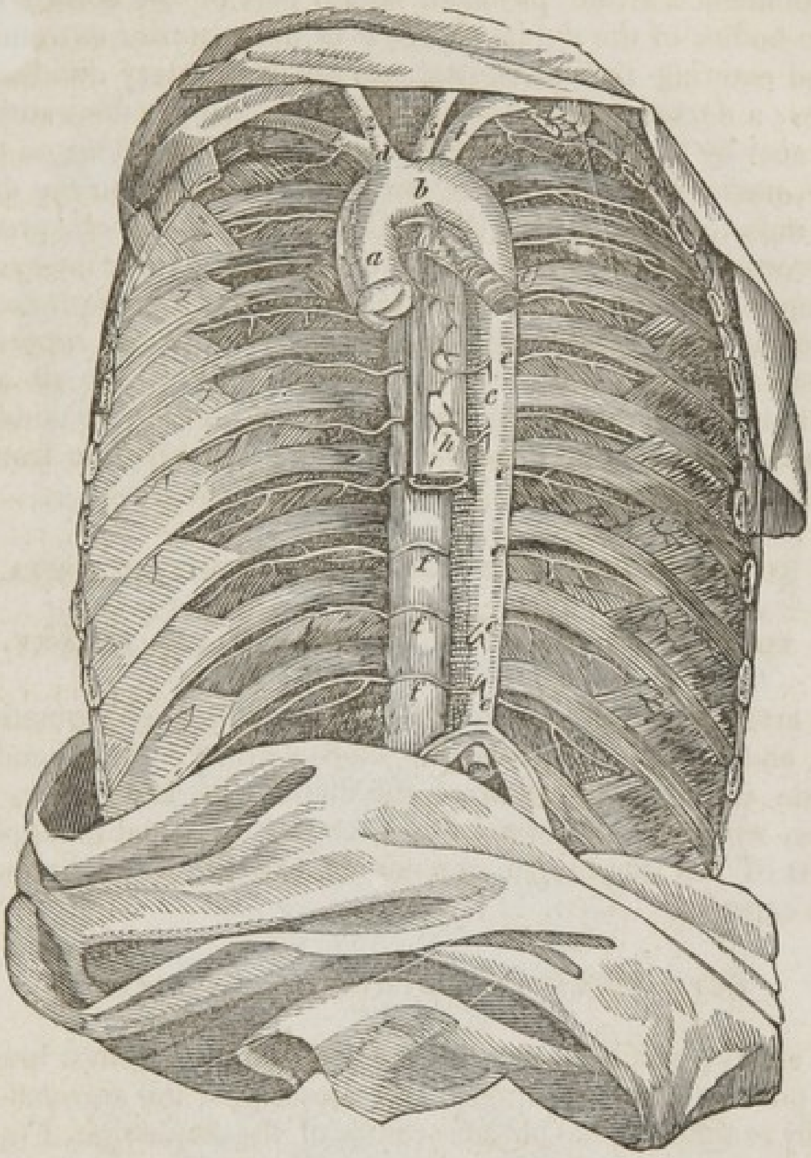
Fig. 195, at *l*, descends in front of the interosseous ligament, between the flexor longus pollicis and flexor profundus perforans, and arriving at the edge of the pronator quadratus, *m*, passes between the radius and ulna to the back part of the arm, and spreads its extreme branches on the wrist and back of the hand. The latter, or posterior interosseous artery, after traversing the interosseous ligament beneath the anconeus, sends off the *interosseous recurrent*, which ramifies on the back part of the elbow joint, and extends between the supinator brevis and abductor longus pollicis manus, and afterwards between the two layers of the posterior muscles of the fore-arm as far as the wrist.

4. The *superficial palmar arch*, Fig. 194, *g*, is a continuation of the ulnar artery, and is situated above the tendons of the flexor sublimis perforatus, immediately beneath the palmar aponeurosis ; it commences at the inner side of the hand, crosses the metacarpus, and terminates at the root of the thumb by branches which unite with the radial artery. The convexity of the arch is turned towards the fingers, and furnishes the collateral branches of the fingers, namely —

1. A branch to the muscles and inner edge of the little finger.
2. The *first digital artery*, which furnishes two branches, one to the outer side of the little finger, the other, to the inner side of the ring finger.
3. The *second digital artery*, which in a similar manner furnishes branches to the outer edge of the ring finger, and to the inner side of the middle finger.
4. The *third digital artery*, which is distributed to the outer edge of the middle finger, and to the inner edge of the fore finger.
5. The *ramus pollicis ulnaris*, or last branch of the ulnar artery, which supplies the muscles of the thumb.

ARTERIES FURNISHED BY THE THORACIC AORTA.

Fig. 196.



BRONCHIAL ARTERIES.

There are generally two bronchial arteries, *a*, *b*, one on the right side, the other on the left; they are distributed to the bronchi, and ramify in the pulmonary tissue.

ŒSOPHAGEAL ARTERIES.

These arteries vary in number from two to five or six, and curving to the right and left ramify on the œsophagus.

POSTERIOR MEDIASTINAL ARTERIES.

These arteries are very numerous, and ramify in the posterior mediastinum and on the aorta.

INFERIOR INTERCOSTAL ARTERIES.

There are nine or ten inferior intercostal arteries on each side; these commence at the posterior lateral part of the aorta; they pass over the bodies of the dorsal vertebræ to the posterior extremity of the ribs, and entering the intercostal spaces, each artery divides into two branches, a *dorsal* and an *intercostal;* the former penetrates the vertebral canal by the inter-vertebral foramen, and ramifying on the spinal marrow, passes out between the transverse processes to the dorsal and lumbar muscles; the latter, which is the largest branch, proceeds in the intercostal space beneath the pleura, and divides into an inferior and a superior branch. The *inferior intercostal artery* proceeds along the superior edge of the rib which is beneath it; the *superior intercostal* passes along a groove in the inferior edge of the rib above it; but towards the sternal end of the rib it is situated in the middle of the intercostal space. The intercostal arteries terminate in front of the thorax by communicating with the internal mammary.

ARTERIES FURNISHED BY THE ABDOMINAL AORTA.

THE RIGHT INFERIOR DIAPHRAGMATIC ARTERY.

This artery generally arises from the aorta by itself, sometimes with the left, and occasionally from the cœliac artery. It ascends on the outer side of the right pillar of the diaphragm, and divides into two branches, which pass between the liver and diaphragm, supplying the right part of the diaphragm, and giving two or three branches to the surrenal capsule.

LEFT INFERIOR DIAPHRAGMATIC ARTERY.

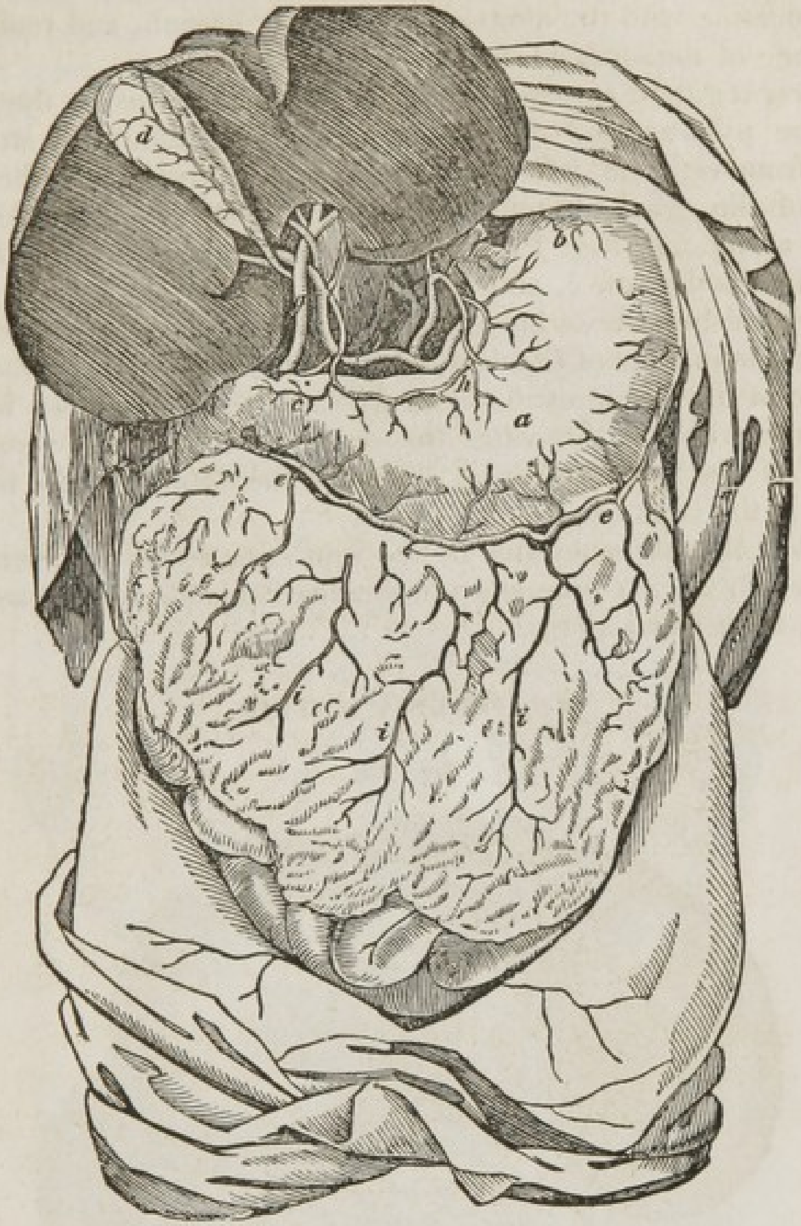
This artery, which arises with the preceding, furnishes branches to the left pillar of the diaphragm, the œsophagus, the surrenal capsule, and finally ramifies on the phrenic centre of the diaphragm, Fig. 201, *a*.

CŒLIAC ARTERY.

This artery is large and short, and is situated between the small lobe of the liver (*the lobulus Spigelii*) and the small curvature of the stomach; it proceeds at a right angle from the abdominal aorta, between the pillars of the diaphragm; opposite the last dorsal vertebra it passes horizontally forwards and divides into three branches, namely, the coronary artery of the stomach, the hepatic and the splenic arteries. The cœliac artery is seen in Fig. 201, *e*.

I. CORONARY ARTERY OF THE STOMACH

Fig. 197.



This artery, *h*, follows the small curvature of the stomach as far as the pylorus, where it communicates with the pyloric artery. It furnishes —

The *œsophageal branches*, which arise near the cardia, and ascend upon the œsophagus.

The *gastric branches*, *c*, which originate at the small curvature of the stomach, and pass over the surface of *a*, this organ.

Frequently the coronary artery sends a very considerable branch to the liver.

HEPATIC ARTERY.

This artery, *l*, is much larger than the preceding, and directs itself transversely to the right and under the lobulus Spigelii as far as the neck of the gall-bladder; it furnishes the following branches:

The *pyloric artery*, which is found on the right side of the pylorus, *c*; passing from right to left along the small curvature of the stomach, communicating with the stomachic coronary branch, and ramifying on the surface of the stomach and pylorus.

The *right gastro-epiploic artery*, *e*, *e*, which arises on the right beneath the pylorus, and descending vertically behind the stomach, it passes from right to left along its greater curvature in the anterior lamina of the great omentum, *i*, *i*, *i*, and unites with the left gastro-epiploic artery: in Fig. 198, it is seen giving branches to the stomach, *i*, the duodenum, *c*, and pancreas, *d*.

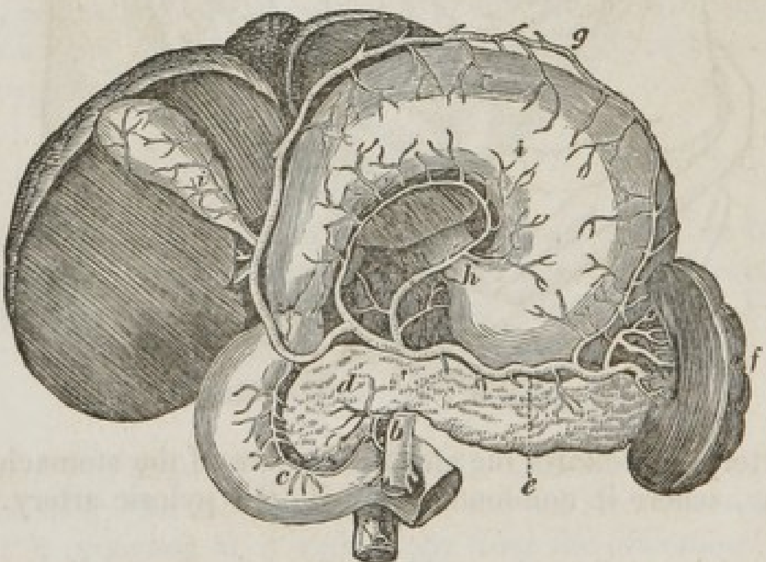
After furnishing these branches, the hepatic artery proceeds towards the right side in front of the vena porta, behind the hepatic duct, to the right side of the lobule of the liver, where it divides into two branches.

The *right branch* furnishes the *cystic artery*, which supplies the parietes of the gall-bladder, *d*, dips into the fissure of the liver, and ramifies in the right lobe.

The *left branch* penetrates by the same fissure of the liver, and is distributed to the left lobe and the lobulus Spigelii, accompanying the divisions of the vena porta.

II. SPLENIC ARTERY.

Fig. 198.



In this figure the stomach and liver are turned up to show the pancreas and spleen. The splenic artery, *e*, at its commencement proceeds from the right to the left, forming several inflexions along the upper part of the pancreas, *d*, as far as the fissure of the spleen, *f*. In this course it furnishes —

The *pancreatic branches*, which supply the pancreas, *d*.

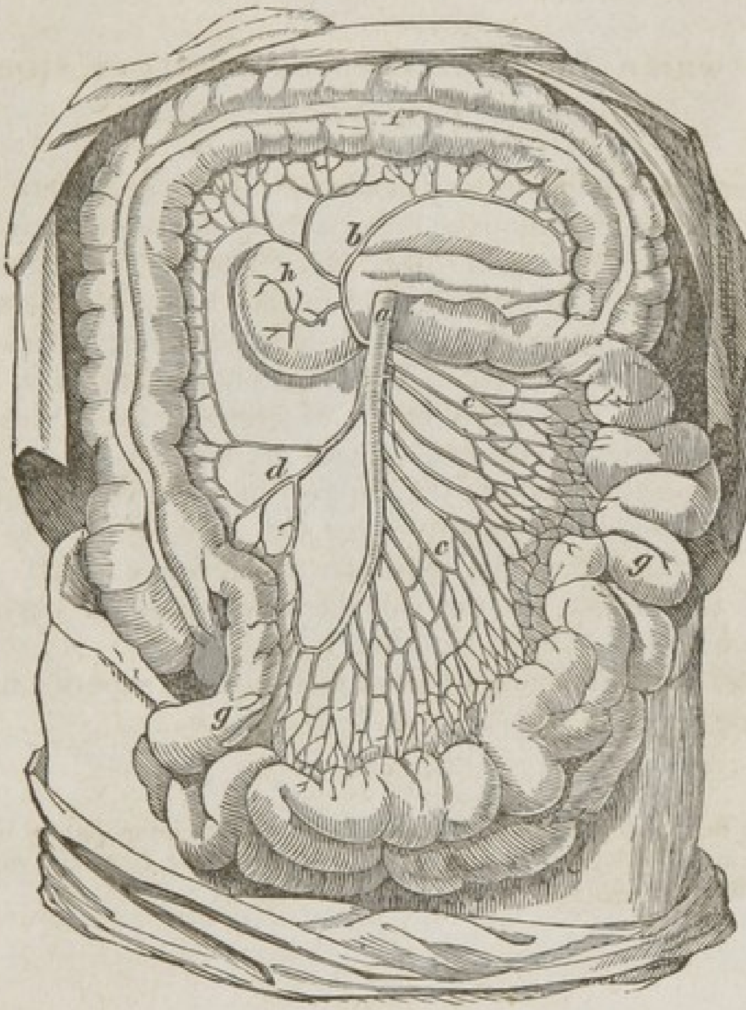
The *left gastro-epiploic branch*, which ascends a little to the left towards the great extremity of the stomach, and then descends along the great curvature, at the middle of which, at *g*, it communicates with the corresponding artery of the right side.

At a little distance from the spleen, *f*, the splenic artery divides into five or six branches, which penetrate this organ after furnishing —

The *vasa brevia*, which are short branches passing from the divisions of the splenic artery, and are distributed to the large extremity of the stomach.

SUPERIOR MESENTERIC ARTERY.

Fig. 199.



This artery, *a*, commences at the anterior right part of the aorta a little below the cœliac, and passing downwards behind the pancreas and before a portion of the duodenum, it gains the upper part of the mesentery, between the two folds of which it enters, and passing from left to right forms a curve, the convexity of which is turned to the left and forwards. It terminates at the end of *g*, the ilium, communicating with *d*, the inferior right colic artery. It furnishes the following branches :

1st. The *superior right colic artery*, *b*, which supplies the arch, and left side of the colon, *f*, where that intestine begins to run over the kidney.

2d. The *middle right colic artery:* this branch, *h*, proceeds to the right, and a little upwards in the mesocolon divides, and on the right side communicates with the superior right colic artery, and on the lower side furnishes fifteen or twenty branches, which after frequently communicating in the form of arches, proceed to the right side of the colon.

The *inferior right colic*, *d*, or ilio-colic artery, which passes downwards to supply the caput coli, and the last portion of the ilium. Its branches communicate with the descending branch of the middle right colic artery and with the extremity of the superior mesenteric artery itself.*

BRANCHES WHICH ARE FURNISHED ON THE LEFT SIDE OF THE SUPERIOR MESENTERIC ARTERY.

The convexity of this artery sends off fifteen or twenty branches, *c*, *c*, which proceed obliquely downwards, divide into small twigs there, and unite with each other very frequently in the form of arches. From these primary arches smaller twigs commence, which divide in the same manner, and constitute secondary arches by communicating similar to the first. These secondary arches in like manner produce twigs in a third series of arches; from these again a fourth and fifth series of minuter arterial arches may be traced to the border of the intestine, where they appear as a network, which finally ramify and subdivide to infinity over the surface of the small intestines, *g*, *g*, and supply the muscular and mucous coats. The distribution of this artery on the valvulæ conniventes is very apparent when these vessels are filled with fine injection.

The distribution of the several branches of the superior mesenteric artery is seen also in Fig. 200, *a*, *b*, *f*. *h*, *i*, *k*.

* Although this artery is generally named as a branch immediately issuing from the superior mesenteric, yet it more commonly proceeds from the superior right colic; it is therefore represented as such in this figure.

THE INFERIOR MESENTERIC ARTERY.

Fig. 200.

This artery commences at the anterior part of the aorta, *c*, it descends a little to the left, enters the iliac mesocolon, and is extended to the rectum as far as the anus. It furnishes the following branches :

1st. The *superior left colic artery*, *e*, which extends to the left side of the colon, and communicates with the left branch of the right colic artery, *f*.

2d. The *middle left colic artery*, *o*, which is generally a branch of the preceding ; its distribution to the colon, *p*, *p*, is obvious in the figure.

3d. The *inferior left colic artery*, which proceeds towards the sigmoid flexure of the colon, and divides into two branches, *d*, *g*.

The left colic arteries are arranged precisely the same as those of the right side ; namely, after forming arches and areolæ, they supply the coats of the intestine.

When the inferior mesenteric artery arrives at the posterior part of the rectum, it divides into the *superior hæmorrhoidal arteries*, which descend along the posterior surface of this intestine, and communicate with the middle and inferior hæmorrhoidal arteries.

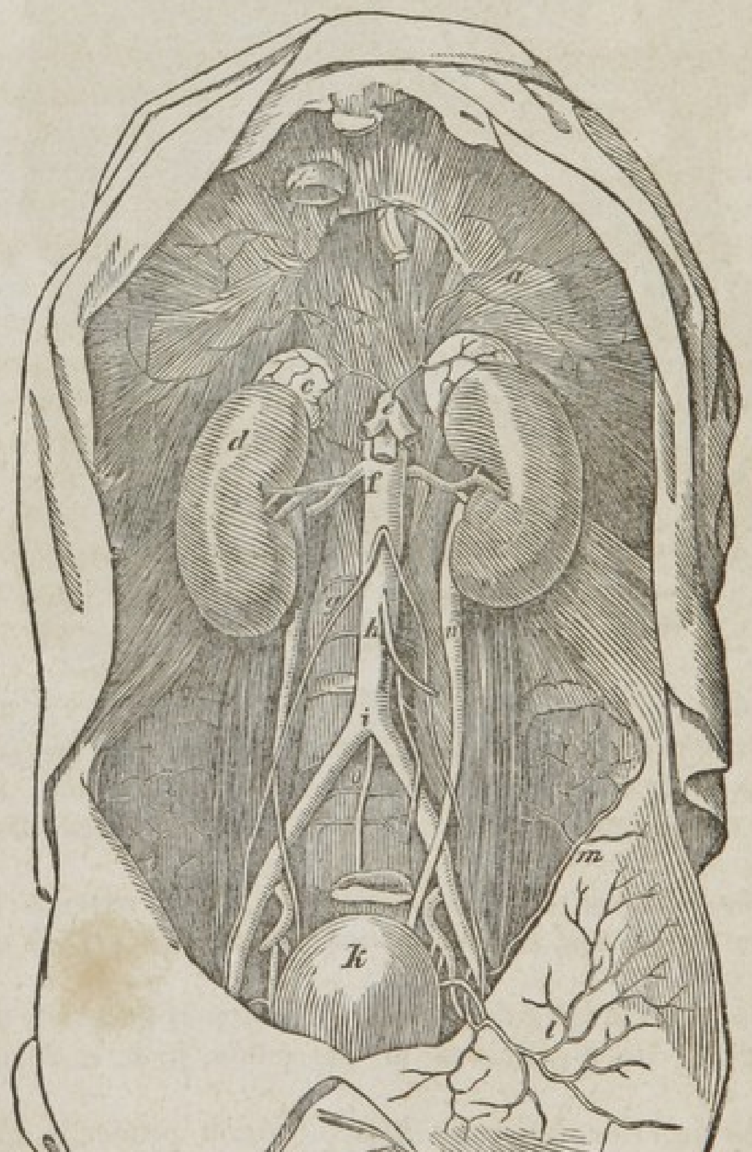
ARTERIES WHICH ARE FURNISHED LATERALLY BY THE ABDOMINAL AORTA.

SURRENAL ARTERIES.

There is one of these arteries on each side; they arise a little above the renal, pass transversely across the vertebral column, and are distributed to the surrenal capsules, marked *c*, in Fig. 201.

RENAL OR EMULGENT ARTERIES.

Fig. 201.



These arteries are of a large size, and very short; there is one on each side; they pass off from the aorta at *f*, transversely across the vertebral column, and arriving at the kidney, *d*, divide into two, three, or four branches, which enter between the pelvis of the ureter and the renal vein.

SPERMATIC ARTERIES.

These arteries, *g*, are two in number, very slender, and of considerable length ; they commence at the anterior or lateral parts of the aorta, and sometimes form the renal ; they descend on the sides of the vertebral column, in front of the psoas muscles, and ureters, *n*, and accompany the spermatic veins. *In the male,*— they pass out by the inguinal ring, and sending some branches to the spermatic cord, they terminate in the epididymis and the testis. *In the female,*— they pass to the ovary, to the Fallopian tubes, the round ligament, and the sides of the uterus.

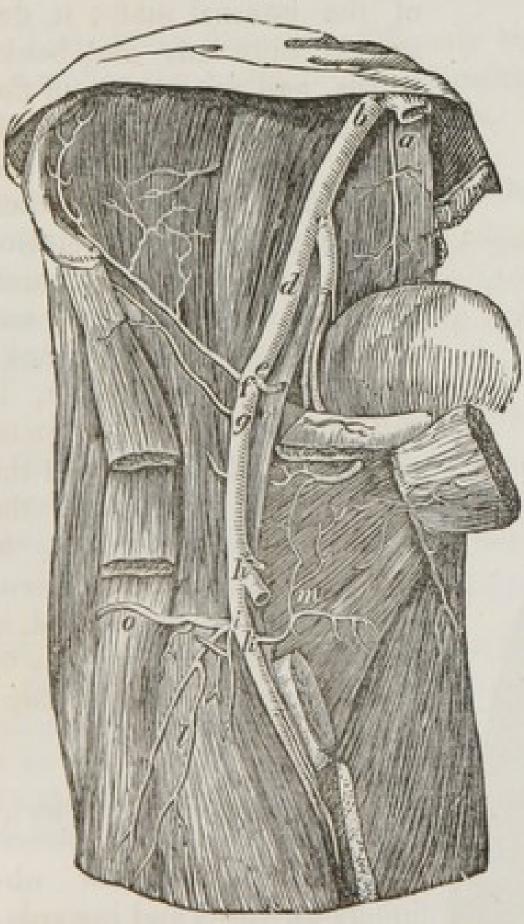
LUMBAR ARTERIES.

There are commonly four or five of these arteries on each side, which commence at the back part of the aorta, and are distributed to the spinal canal, the peritoneum, the muscles of the loins, and to the sides of the abdomen and pelvis.

THE ARTERIES WHICH TERMINATE THE AORTA BELOW.

MIDDLE SACRAL ARTERY.

Fig. 202.



At the fourth lumbar vertebra the aorta divides, Fig. 201, at *i*, into the primitive iliacs ; and the middle sacral artery, *o*, commences at the back part of this division, and descends along the anterior surface of the sacrum, and terminates near the summit of the os coccygis : in the annexed figure this vessel is marked *a*.

PRIMITIVE ILIACS.

These vessels, *b*, *c*, are formed by the bifurcation of the aorta. Separating from each other at an acute angle, they descend along the edge of the psoas muscle as far as the sacro-iliac articulation, where they divide each into the external and internal iliac arteries. The course of these vessels is very obvious in the figure preceding.

INTERNAL ILIAC OR HYPOGASTRIC ARTERY.

This artery divides almost vertically into the pelvis, in front of the sacro-iliac articulation; and after a short course divides into a great number of branches.

BRANCHES OF THE INTERNAL ILIAC ARTERY.

I. ILIO-LUMBAR ARTERY.

This artery proceeds from the internal iliac, opposite the base of the sacrum; it varies much in size, and ascends outwards and backwards, under the psoas muscle, then divides into an *ascending* and a *transverse branch*, which are distributed to the lumbar muscles.

II. THE LATERAL SACRAL ARTERY.

Sometimes there are two of these arteries on either side; these vessels descend in front of the anterior sacral foramina, as far as the os coccygis. They furnish *external* and *internal branches:* the former enter the sacral canal, and ramifying on the membrane which lines it, they pass out, and are lost on the muscles at the posterior part of the sacrum; the latter ramify in the sacral nerves and ganglia, and in the pyramidalis muscle.

III. GLUTEAL OR POSTERIOR ILIAC ARTERY.

Fig. 203.

This is the largest branch of the internal iliac; it descends outwards and backwards, and passes out of the pelvis through the sacro-sciatic notch, above the pyriformis muscle; it then proceeds to the posterior part of the pelvis, covered by the gluteus maximus, and divides into two branches: the superficial branch, *c*, is distributed to the gluteus maximus and medius and the sacro-sciatic ligament; the deep-seated branch *a*, *b*, ascends between the gluteus medius and minimus, and is distributed to the muscles of this region, and to the capsule of the hip-joint.

IV. UMBILICAL ARTERY.

This artery passes obliquely forwards and inwards, as far as the superior lateral part of the bladder, from whence it ascends behind the anterior parietes of the abdomen to the umbilicus. In the adult, this artery is almost obliterated ; but in the fœtus, it appears to be a continuation of the internal iliac, and passes out by the umbilicus to form a part of the umbilical cord.

V. VESICAL ARTERIES.

These arteries present many variations in number and origin ; they arise from the umbilical, middle hæmorrhoidal, internal pudic, and obturator arteries. The internal iliac furnishes a considerable branch, which supplies the fundus of the bladder, commencement of the urethra, prostate gland, the vesiculæ seminales, and vas deferens ; the ultimate ramifications reach to the rectum.

VI. OBTURATOR ARTERY.

This artery generally commences at the internal iliac, or the gluteal, and sometimes from the epigastric ; it proceeds to the obturator muscle, and advances as far as the obturator foramen, the superior part of which it traverses ; it issues from the pelvis through the space left by the obturator membrane, and divides into *two branches*, which are distributed to the hip-joint, and to the muscles on the inside of the thigh.

VII. MIDDLE HÆMORRHOIDAL ARTERY.

This artery descends obliquely on the anterior part of the rectum ; it supplies the tunics of this intestine, and communicates with the superior and inferior hæmorrhoidals.

VIII. UTERINE ARTERY.

The size of this artery is always in relation to the development of the uterus ; arising from the internal iliac, or internal pudic, it passes upon the broad ligament, and is distributed to the lateral and inferior parts of the uterus.

IX. VAGINAL ARTERY.

This vessel is not constant in its origin, for it commences at the internal pudic, the middle hæmorrhoidal or the umbilical artery ; it proceeds to the vagina and external parts of generation.

X. ISCHIATIC ARTERY.

This vessel appears to be a continuation of the internal iliac artery ; after supplying the rectum and bladder, it descends in front of the pyramidalis muscle, it proceeds through the great sciatic notch, and at its exit from the pelvis divides into numerous branches, which supply the gluteus maximus, the levator ani, the sciatic nerve, and the muscles of the posterior crural region.

XI. INTERNAL PUDIC ARTERY.

This artery is smaller than the ischiatic, and is frequently furnished by it. It descends before the sciatic plexus and the pyriformis muscle, and issues from the pelvis by the lower parts of the sciatic notch, between the pyriformis and posterior border of the levator ani; it afterwards proceeds between the two sacro-sciatic ligaments, to the internal surface of the ischium, as far as the common attachment of the ischio-cavernosus and transversus perinæi, and here divides into two branches, which take a different course in the male and in the female, and of which one is inferior, the other superior.

1st. The *inferior branch, or perineal artery*, proceeds between the integuments and transversus perinæi, as far as the lower part of the scrotum, and is distributed to the muscles of the perinæum; some branches pass towards the rectum, termed the *inferior hæmorrhoidal arteries.* The inferior branch afterwards penetrates the septum scroti, and supplies the integuments of the genitals.

2d. The *superior branch* ascends above the transversus perinæi, along the ascending branch of the ischium, and the ramus of the pubis to the symphysis of this latter bone, where it divides into two branches, the *dorsal artery of the penis*, and the *artery of the corpus cavernosum.*

3d. The *transverse artery of the perinæum* is furnished by the superior branch of the internal pudic, near the origin of the latter; it passes above the transversus perinæi muscle, and supplies the bulb of the urethra.

4th. The *artery of the corpus cavernosum* passes into the cavernous body, and divides into a great number of branches to supply its tissue.

5th. The *dorsal artery of the penis*, Fig. 204, *f*, supplies the fibrous membrane of the corpus cavernosum, and terminates in the glans penis.

In the female, the inferior branch of the internal pudic artery terminates in the external labia; the superior is distributed to the clitoris and orifice of the vagina.

EXTERNAL ILIAC ARTERY.

This vessel, *b*, *d*, is formed by the bifurcation of the primitive iliac artery; it extends to the crural arch, where it takes the name of femoral artery. The external iliac descends obliquely outwards, along the inner and fore part of the psoas muscle, having on its inner side the external iliac vein. It furnishes the following branches:—

I. THE EPIGASTRIC ARTERY.

This artery proceeds from the inner side of the external iliac, at *e*, about an inch before it passes into the thigh; it extends inwards and a little forwards, behind the spermatic cord, the direction of which it crosses towards the external border of the rectus abdominis muscle. About two inches above the pubis it is situated on the posterior surface of this muscle, and terminates by several twigs at the umbilicus. Its distribution may be seen in Fig. 201, *l*.

II. CIRCUMFLEX ILIAC ARTERY.

This vessel, Fig. 202, *f*, commences at the outer part of the iliac artery, and ascends obliquely outwards along the external border of the iliacus muscle, as far as the anterior superior spinous process of the ilium ; it then passes backwards, and divides into two branches : its external branch supplies the transversalis and the internal oblique muscles ; its internal branch follows the line of the crista ilii, and terminates in the same muscles. In the subsequent figure it is marked *b*.

FEMORAL ATRERY.

Fig. 204.

Immediately the external iliac artery has immerged from under the crural arch at *c*, it assumes the name of *femoral :* it commences at the middle of the space which separates the anterior superior spine of the ilium from the pubis ; it descends on the anterior and internal part of the psoas muscle, and upon the external femoral vein ; towards the lower part of the thigh it enters the aponeurotic sheath of the triceps adductor magnus, *m*, on its exist from which it takes the name of *popliteal artery*. To the surgeon, an acquaintance with the femoral artery is of so much importance that its relative situation claims further notice.

Anteriorly the femoral artery is connected with the crural aponeurosis, the integuments, and the inguinal lymphatic glands ; it is situated in a triangular space, bounded above by the crural arch, on the outer side by the sartorius and on the inner side by the middle adductor and the vastus internus. Farther down it is covered by the sartorius muscle, which crosses its direction. Posteriorly, it is situated upon the pectineus and the middle adductor muscles.

On the outer side it is connected at first to the crural nerve ; then to the tendon of the psoas and the iliac muscles ; and lastly, it is placed upon the inner portion of the triceps, which separates it from the shaft of the femur.

On its inner side, it is in contact with the femoral vein and the pectineus muscle, and at the lower part of the thigh it is concealed by the sartorius muscle.

INTERNAL BRANCHES OF THE FEMORAL ARTERY.

I. EXTERNAL PUDIC ARTERY.

These vessels are two in number ; one superficial, *c*, which commences near the crural arch, proceeds transversely inwards, and divides into branches, which are lost in the integuments of the inferior part of the abdomen, the penis, *f*, and the labia in the female ; the other is a deep-seated branch, distributed under the crural aponeurosis.

EXTERNAL BRANCHES OF THE FEMORAL ARTERY.

II. SUPERFICIAL MUSCULAR ARTERY.

This artery commences nearly on a level with the profunda ; it passes transversely outwards between the sartorius and rectus, and divides into ascending and descending branches, which supply the muscles and integuments of the upper part of the thigh. See Fig. 203, *o*.

ANTERIOR BRANCHES OF THE FEMORAL ARTERY.

ABDOMINAL SUBCUTANEOUS, OR EXTERNAL EPIGASTRIC ARTERY.

This is a very small artery ; it commences immediately above the crural arch, and ascends between the abdominal aponeurosis and the integuments, as far as the level of the umbilicus.

The other anterior branches of the femoral artery are very small, and are distributed to the cellular tissue of the integuments.

POSTERIOR BRANCHES OF THE FEMORAL ARTERY.

ARTERIA PROFUNDA FEMORIS, OR DEEP MUSCULAR ARTERY.

This vessel, *h*, is nearly as large as the femoral artery itself ; it commences about two inches below the crural arch ; it descends backwards between the adductor muscles and internal portion of the triceps, as far as the middle of the thigh. It then diminishes in size, passes through the aponeurosis of the adductor longus to the back part of the limb, and terminates in two branches, which enter into the short portion of the biceps femoris and the semimembranosus. The deep muscular artery, which we have just described, furnishes the following branches :

1. The *external circumflex artery*, *n*, which commences at the outer side, passes outwards behind the sartorius and rectus femoris, and divides into two branches ; the one is distributed to the parts above the hip-joint, the other descends in the fore part of the thigh between the triceps extensor and the rectus femoris, in which it ramifies.

2. The *internal circumflex artery*, which is larger than the preceding, passes backwards between the pectineus and the tendons of the psoas and the iliac muscles, then divides into two branches, one of which supplies the muscles at the neck of the femur, the other is distributed to the flexors of the leg.

3. The *superior perforating artery*.

4. The *middle perforating artery*.

5. The *inferior perforating artery.**

These vessels comprehend all the great muscular branches of the profunda, except the two circumflex arteries ; they vary in number, and are proportioned in size to the bulk of the limb. These arteries perforate the adductors and proceed to the back part of the thigh. A particular knowledge of the distribution and branches of the perforating arteries is really unattainable, for they ramify in every direction, supply all the large mass of muscles on the back part of the thigh, and communicate freely with the sciatic, the gluteal, and the obturator arteries. A branch of the middle perforating artery penetrates into the femur by the nutritious canal which we observe on the linea aspera of that bone.

POPLITEAL ARTERY.

Fig. 205.

This vessel, *a*, is a direct continuation of the femoral artery, the latter merely changing its name after it has perforated the adductor magnus ; it descends into the ham between the condyles of the femur, and extends from the commencement of the inferior third of the thigh to the superior fourth of the leg. On the back part it is connected with the sciatic nerve, the popliteal vein, and the semimembranosus ; afterwards, and more inferiorly, with the gastrocnemius, the soleus, and the plantaris; it is separated above from the femur by a quantity of adipose tissue ; farther down it rests upon the back of the knee joint ; and below upon the popliteus and the tibialis posticus muscles. The popliteal artery, after giving off a number of small branches to the neighboring parts, divides into three principal branches to supply the leg.

BRANCHES OF THE POPLITEAL ARTERY.

There are three superior articular arteries arising from the popliteal in the ham.

1. The *internal superior articular arteries*, *e*, *f* : there are generally two or three of these vessels, which vary much ; they descend inwards, pass under the tendon of the long adductor, proceed on the internal part of the femur above the condyle, and are distributed into the triceps muscle and the articulation of the knee.

2. The *external superior articular artery*, *b*, passes outwards, turns on the ex-

* These arteries are irregular in place, size, and number; they are frequently named numerically, as the 1st, 2d, 3d, and sometimes branches are termed the 4th and 5th perforating arteries.

ternal part of the femur above the condyle, and divides into two branches, the superior of which is lost in the triceps; the inferior descends on the external condyle of the femur.

3. The *middle superior articular artery* proceeds from the anterior part of the popliteal to supply the cellular and adipose tissue posterior to the crucial ligaments of the articulation of the knee.

These and the following branches are given off by the popliteal to the upper part of the leg. The arteries just named are distributed to the posterior surface, and dive into the substance of the gastrocnemii muscles, terminating in the soleus, the popliteus, and plantaris.

There are two *inferior articular arteries*, which arise from the popliteal at the superior part of the leg, namely,

1. The *internal inferior articular artery*, *g*, which descends immediately behind the internal tuberosity of the tibia, to the internal part of the ligamentum patellæ, ramifying on the articulation of the knee and the periosteum of the tibia.

2. The *external inferior articular artery*, *c*, which descends between the popliteus and gastrocnemius, then passes under the tendon of the biceps and external lateral ligament, and is distributed to the articulation of the knee, the ligamentum patellæ, and parts in this region.

The popliteal artery having given off these arteries, descends behind the popliteal muscle, and divides into the anterior tibial, the peroneal, and the posterior tibial arteries.

ANTERIOR TIBIAL ARTERY.

The anterior tibial artery, *b*, Fig. 206, at its commencement is directed horizontally forwards; it passes from the ham between the inferior edge of the popliteus and the superior fibres of the soleus, then proceeding through the upper extremity of the tibialis posticus and a perforation in the interosseous ligament to arrive at the fore part of the leg; the artery afterwards passes downwards upon the interosseous ligament, between the tibialis anticus and the extensor proprius pollicis, *c*; below the middle of the leg it advances more forward, crosses under the tendon of the extensor proprius pollicis, and is situated between that tendon and the tendon of the extensor longus digitorum, *e*; at the ankle it is extended over the front of the tibia; then having passed under the anterior annular ligament of the instep at *d*, it assumes the name of the dorsal artery of the foot. The posterior tibial artery furnishes the following branches:

1. The *recurrent artery of the knee*, which passes upwards and inwards, supplies the upper extremity of the tibialis anticus, and is lost in the articulation of the knee, *a*, and the integuments.

2. *Numerous small branches* to the muscles on the fore part of the leg.

3. The *internal malleolar artery*, which ramifies over the inner ankle.

4. The *external malleolar artery*, which ramifies over the outer ankle.

DORSAL ARTERY OF THE FOOT.

Fig. 206.

This artery, *d*, is the direct continuation of the anterior tibial, and extends over the upper surface of the foot to the posterior extremity of the first metatarsal bone, where it descends into the sole of the foot, by passing through the abductor of the second toe. It distributes numerous but very slender *external* and *internal branches*, to supply the adjacent parts of the foot. Two of these branches have been named the *tarsal* and *metatarsal* arteries ; these cross the tarsal and metatarsal bones, and pass obliquely to the outer edge of the foot.

The *interosseal arteries* come off from the tarsal or metatarsal, and supply the interosseous spaces and superior surface of the toes.

A considerable branch proceeds from the dorsal artery of the foot, along the space between the two first metatarsal bones, and divides into,

The *dorsal artery of the great toe*, and an artery which is extended on the inner edge of the toe next to the great toe.

PERONEAL ARTERY.

This artery, *h*, Fig. 207, is smaller than the anterior tibial, and situated at the posterior and deep part of the leg ; it descends upon the inner side of the fibula, giving numerous branches to the peroneal muscles at *i*, and the flexor of the great toe. At the lower part it divides into the *posterior fibular* artery, which, properly speaking, is the termination of the peroneal, descending behind the inferior articulation of the fibula, at *k*, to the posterior part of the foot, and is distributed to the heel and the ankle.

POSTERIOR TIBIAL ARTERY.

Fig. 207.

This vessel, *e*, is the continued trunk of the popliteal, *a* ; it descends under the superior attachment of the soleus, between that muscle and the more deeply seated flexors of the toes ; it does not lie, however, in immediate contact with the muscular fibres, but like the femoral artery is invested by a strong sheath of condensed cellular membrane. In its course the posterior tibial artery furnishes a number of small branches, which are chiefly distributed to the tibialis posticus and the flexor muscles, the skin, and the periosteum of the tibia ; one of these branches, termed the *nutritious artery of the tibia*, descends upon the posterior surface of this bone, and penetrates into the medullary canal. As this artery descends it gradually advances more forwards, follows the course of the flexor tendons, passing behind the inner ankle, *f*, and upon this bone its pulsation may be felt ; then sinking under the abductor pollicis, it divides into two branches —

1st. The *internal plantar artery*, which supplies the muscles situated on the inner edge of the sole of the foot, Fig. 208, *b*.

Fig. 208.

2d. The *external plantar artery*, *a*, which crosses obliquely the three middle metatarsal bones, and forms the *plantar arch*, *c*, the convexity of which furnishes numerous branches to supply the lumbricales muscles ; and taking a similar course to the branches of the palmar arch, each anterior branch supplies the corresponding sides of the toes, in the same manner as the collateral arteries are distributed to the fingers.

CHAP. II.

OF THE VEINS IN GENERAL.

It has been already stated, that it is the office of the arteries to convey the blood from the heart to the different parts of the body, for the purpose of nourishing and building up the animal fabric : now there is a corresponding series of sanguineous canals which return the blood from all the organs, again to continue the stream of the circulation ; these are the VEINS. By the aid of a microscope, the extreme branches of the arteries may be observed communicating with the minute radicles of the venous system, and transferring their blood to that series of vessels. The curious and beautiful phenomena of the circulation are evident, when the tail of a fish, or the web of a frog's foot, is placed in the field of a powerful magnifier ; and we are assured of the fact of the continuity of the two sets of vessels in the human subject, by the circumstance of fine injections passing readily from the arteries into the veins.

There are two departments of the venous system ; the 1st, or *general department of the venous system*, more extensive than the other, commences in the head, trunk, and limbs, and transmits the blood to the heart by the venæ cavæ. The 2d, or *abdominal department of the venous system*, is confined to the cavity of the abdomen, and is formed by the veins of all the chylopoetic viscera, with the exception of those of the liver, and terminates in the vena portæ, which subdivides and distributes the blood through the liver.

The veins are far more numerous, and, considered as a whole, they are much more capacious than the arteries.

The distribution of veins is somewhat similar to that of the arteries, but their number and size are greater. In general a cellular space, common to all, receives both the trunks of the two species of vessels and those of the nerves. In the head, limbs, and every other part, there are two sets of veins ; the superficial and the deep-seated ; the 1st lie immediately under the skin, or run above the fasciæ, and are in some parts very large and numerous, and do not possess any corresponding arteries. The 2d, or deep-seated veins, directly attend the arteries. The union between the branches of the veins is very frequent ; they communicate in right lines or in arches, and the smaller are so multiplied as to form complicated meshes of network ; but the minute ramifications of veins ultimately form an inconceivable number of small canals in the tissue of organs, of such extreme tenuity, as to render it impossible to understand their final distribution.

STRUCTURE OF VEINS.

The veins are formed of only two membranes ; the *outer* is composed of longitudinal fibres, very easily distinguished in the large trunks, and surrounded by a sheath of cellular tissue, the layers of which are placed very densely on each other. The *inner membrane* is thin, smooth, and glossy ; and in appearance resembles the membrane which lines the arterial tubes, but it is more extensible and less brittle.

Valves are formed in the general department of the venous system ; but there are none in the system of the vena portæ, the umbilical vein, the trunk of the inferior cava, in the veins of the brain, of the vertebræ, of the spinal marrow, of the heart, of the kidneys and of the uterus. There are but very few in the vena azygos, and pulmonary veins. These valves consist of a number of semilunar folds of the inner membrane of the vein, precisely similar to those which exist at the commencement of the aorta and the pulmonary artery.

The valves are sometimes single ; they are, however, more frequently arranged in pairs, at other times there are three together. Apparently, their office is to support the column of blood, and to prevent its return by the veins from the heart to the surface of the body ; for the valves are pressed close to the sides of the vessels during its flow towards the heart, but they are raised when the blood, from any accidental circumstance, is disposed to pass in a retrograde direction. Fig. 209 represents a vein laid open, thus showing the single, duplex, and triplex valvular apparatus.

Fig. 209.

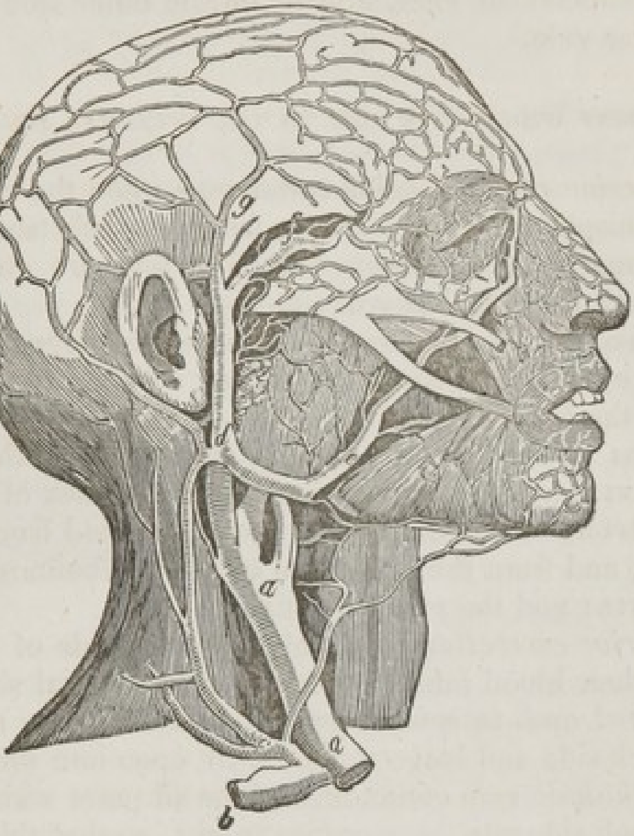
The veins are supplied by very minute nutrient vessels (*vasa vasorum*) and nervous filaments, which ramify in the cellular membrane, and which, penetrating the venous tissue, finally terminate in the inner surface of the vessels.

Veins may be distinguished from the arteries by their membranes being much thinner, by their great number and size, by their having no pulsation, by the dark color of the blood they contain, and in many instances by the peculiarity of their numerous valves.

GENERAL DEPARTMENT OF THE VENOUS SYSTEM.

I. VEINS WHICH, BY THEIR UNION, FORM THE SUPERIOR VENA CAVA.

Fig. 210.



I. VEINS WHICH GIVE RISE TO THE EXTERNAL JUGULAR VEIN.

The *internal maxillary vein* commences in all the parts to which the artery of the same name is distributed ; it is consequently composed of the *pterygoid*, *spheno-palatine*, *alveolar*, *infra-orbitar*, *mental*, *inferior dental*, and *deep temporal veins*. It communicates with the sinuses of the base of the skull by means of small twigs which pass through the foramina of that region. Upon the side of the neck the internal maxillary vein frequently communicates with the facial and pharyngeal veins. This disposition produces the *pharyngeal plexus*.

The *superficial temporal vein*, *g*, commences in all those parts where the corresponding artery is distributed. It is composed of the *middle temporal vein*, *f*, the *anterior auricular veins*, and the *transverse veins of the face*. Thus formed it descends before the ear, and unites with the preceding.

The vein which results from this union passes through the parotid gland, communicates with the internal jugular vein, and receives the following :

The *posterior auricular vein*, which collects the blood from the mastoid region and from the ear. The trunk then takes the name of

The *external jugular vein;* it extends from *d* to *c*, and is placed between the sterno-cleido-mastoideus and the platysma myoides muscles. In its course along the neck it receives the following :

The *cervical cutaneous*, the *trachelo-scapular*, and other veins which arise in the vicinity of the neck and shoulder. At the inferior part of the neck the external jugular opens near *c* into *b*, the superior part of the subclavian vein, a little on the outer side of *a*, *a*, the internal jugular vein.

2. VEINS WHICH GIVE RISE TO THE INTERNAL JUGULAR VEIN.

The *superior cerebral veins* commence upon the convex surface of the two hemispheres of the brain, from the substance of which they issue by a multitude of minute branches, and are continued into the superior longitudinal and lateral sinuses.

The *vein of the corpus striatum* is extended over the surface of that body, and, exactly following the course of the tenia semicircularis, unites with the following :

The *veins of the choroid plexus*, which return the blood into the *venæ* GALENI, and from thence into the right sinus of the dura mater.

The *superior cerebellar veins* convey the blood from the whole upper surface, and from the substance of the cerebellum, into the torcular HEROPHILI and the venæ GALENI.

The *inferior cerebellar veins* unite on each side of the cerebellum, and return their blood into the corresponding lateral sinuses.

The *lateral and inferior cerebral veins* are very numerous ; they unite on each side and leave the brain to open into the lateral sinuses.

The *ophthalmic vein* commences from all parts within the orbit, and unites on each side into three or four trunks, so that this vein is formed of the *lachrymal*, the *central vein of the retina*, the *infra-orbitar*, the *ciliary*, the *ethmoidal*, the *palpebral*, and the *nasal veins*. The ophthalmic then passes out of the orbit, by the inner part of the sphenoidal fissure, and conveys the blood into the cavernous sinus.

All the blood of the brain is returned into the sinuses of the dura mater, which terminate at the foramen lacerum posterius. This point is the commencement of the jugular vein, and as it is here considerably dilated, it is named the *sinus of the internal jugular vein*. This vein advances a little forwards, and descends with the carotid artery, covered by the styloid process of the temporal bone, and by the muscles which are attached to it. It communicates at first with the external jugular vein, by a branch of large size, and at the level of the upper part of the larynx, it receives the facial vein.

The *facial vein*, *e*, commences on the summit of the head and forehead, and when it has arrived at the side of the nose, near the eye, it has the name of the *angular vein*, and receives the blood from the ophthalmic, the *palpebral*, and the *superciliary veins*. It follows the direction we observe in the figure, receiving the *dorsal veins of the nose*, the *superior* and the *inferior coronary veins of the lips*, and several *buccal* and *masseteric veins*. It is afterwards augmented by the *ranine*, the *submental*, and the *inferior palatine veins*, and then becomes united to the internal jugular vein.

A little below the facial vein, the internal jugular is augmented by the *lingual* and *pharyngeal veins* ; and at the level with the superior edge of the larynx, it receives the *superior thyroid*, the *occipital*, and the *veins of the diploe* of the bones of the skull.

After receiving the above branches, the internal jugular vein descends vertically at the side of the neck, and opens into the subclavian vein.

3. VEINS OF THE SUPERIOR EXTREMITY WHICH, BY UNITING, FORM THE SUBCLAVIAN VEINS, Fig. 211.

Fig. 211.

The collateral arteries of the fingers, the radial and ulnar arteries, and all their divisions, are each accompanied by two venous branches, which become larger as they ascend toward the elbow joint, where they unite so as afterwards to constitute two large trunks, which run along the brachial artery and open into the axillary vein. They receive in their course all the veins which attend the divisions of the artery.

The *cephalic vein* commences by a great number of branches, disposed in the form of a network, on the back of the hand and upon the muscles of the thumb ; these unite into a trunk, which ascends upon the anterior and external part of the fore-arm, where it forms the *superficial radial vein*, and on arriving at the bend of the arm unites with the *median cephalic vein*, which communicates with the *median basilic*.

The united veins which form the trunk of the cephalic ascend on the outer and fore part of the arm, then bending inwards, open into the axillary vein.

The *basilic vein* is larger than the cephalic, and is formed of three branches, which are named from their situation, the *posterior ulnar*, the *anterior ulnar*, and the *median basilic veins*.

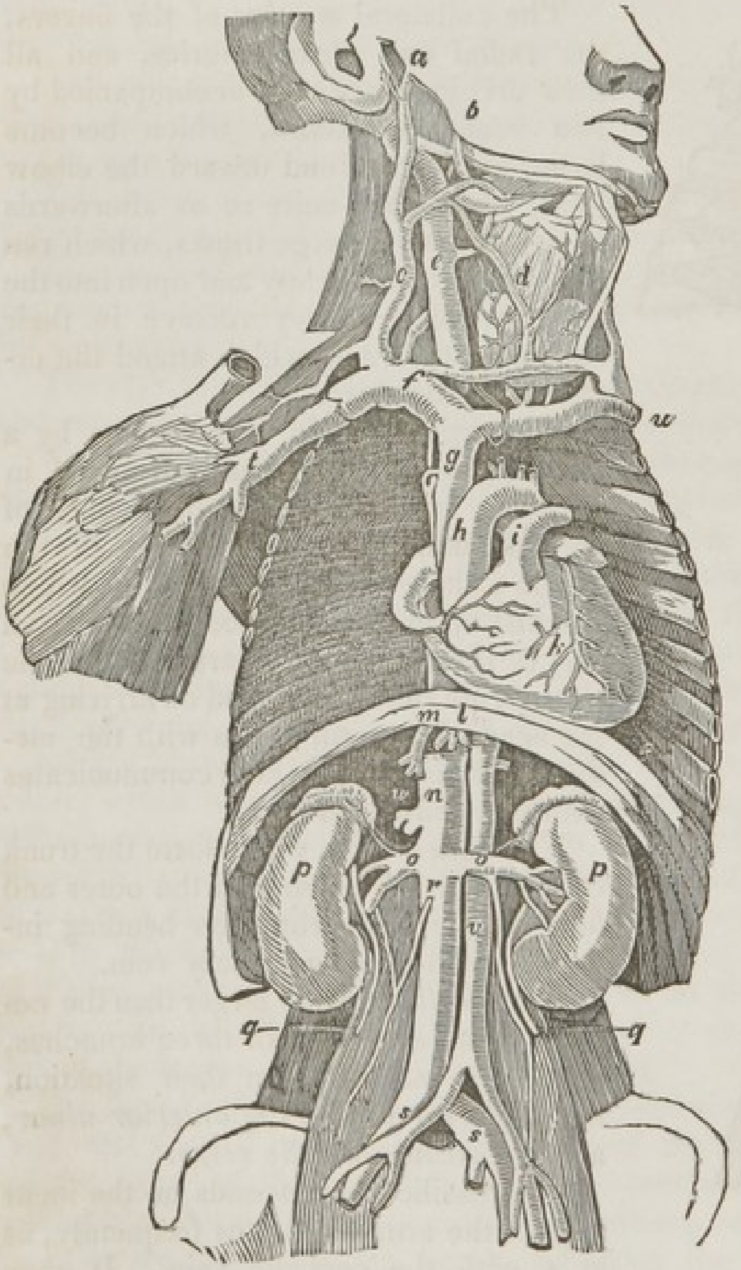
The basilic vein ascends on the inner part of the arm and unites frequently, as at *e*, with the cephalic vein. It then passes into the axilla, being continuous with the axillary vein.

Fig. 211, *b*, the axillary vein.
d, the cephalic vein.
c, the basilic vein.
f, the radial vein.
g, the anterior ulnar vein.

The *axillary vein* is therefore the result of the union of the veins of the hand, fore-arm, and arm; it proceeds obliquely under the clavicle, and in front of the axillary artery, and becomes continuous with *a*, the subclavian vein. See also, Fig. 212, *t*, the axillary, and *f*, the subclavian veins.

In this course it receives the *circumflex veins*, the *inferior scapular*, the *long thoracic*, the *superior thoracic*, and the *acromial veins*.

Fig. 212.



The *subclavian veins*, Fig. 212, *f*, *u*, extend from the inferior extremity of the scalenus anticus muscle to the superior vena cava: but they present differences according as they are examined on the right or on the left side, on account of the position of, *g*, the superior vena cava. Thus the right subclavian vein, *f*, is very short, and its size is always less than that of the left.

The left subclavian vein, *u*, is much longer than the right, and receives two veins which the right does not receive; viz., the *left internal mammary* and the *left inferior thyroid*.

That part of the left subclavian vein nearest the descending cava, which lies before the trachea, is generally known as the *vena innominata*.

The two subclavian veins equally receive, besides the internal and the external jugular veins, the *vertebral* and the *superior intercostal veins.*

The *vertebral vein* descends in the canal which contains the vertebral artery, and issuing from thence at the sixth or seventh cervical vertebra it unites with another considerable vein, which communicates with the lateral sinus of the dura mater by the mastoid foramen. After this union it receives numerous branches from the adjacent muscles, and opens into the subclavian vein.

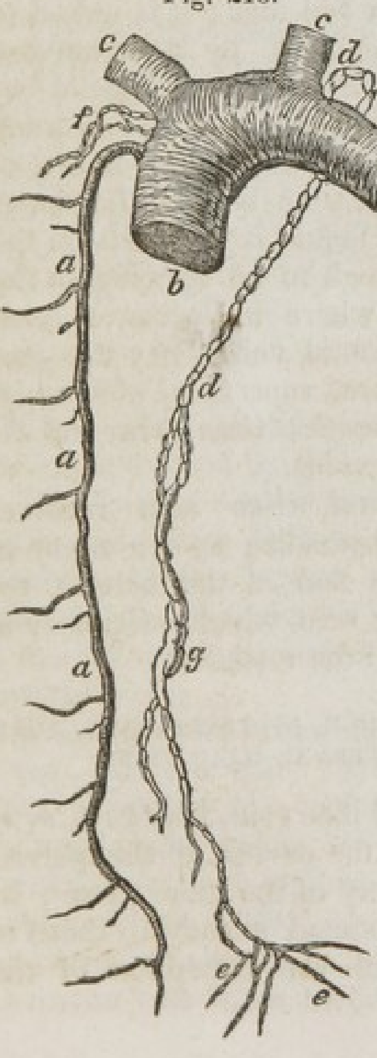
The *right* and *left superior intercostal* veins also discharge their blood into the subclavian veins.

SUPERIOR VENA CAVA, *g*.

The *superior vena cava* forms the grand trunk which transmits the blood of the head, the neck, the superior extremities, and a portion of the circulation of the thorax, to the heart. This vein commences opposite the cartilage of the first rib, and descends to the base of the pericardium, from which it receives a fibrous sheath. It then enters that membranous sac, descends vertically on the right of the aorta, and opens into the right auricle of the heart.

Before entering the pericardium the superior vena cava receives the following branches :

Fig. 213.



1st. The right *internal mammary vein*, which differs from the left only in its termination.

2d. The *inferior thyroid vein*, opening into the superior vena cava, between the two subclavian veins.

3d. The *vena azygos*, Fig. 213, *a*, *a*, *a*, is remarkable for having no corresponding vein, and in forming a communication between the two venæ cavæ. It opens into the superior vena cava immediately above the right branches, and, passing through the pillars of the diaphragm, with the aorta and thoracic duct, opens into the inferior vena cava, or into one of the lumbar veins.

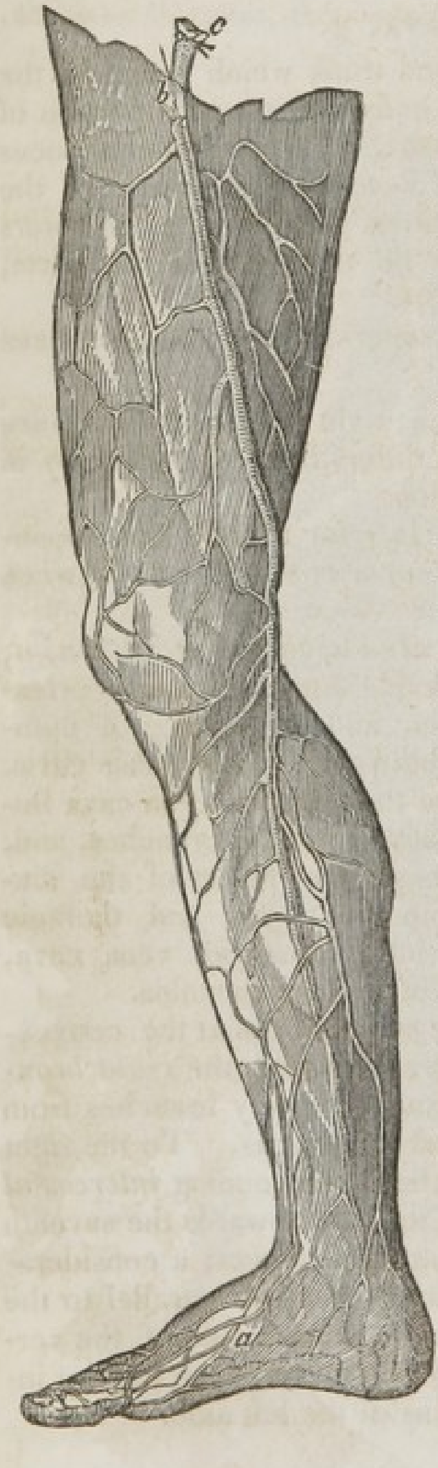
4th. The vena azygos at the convexity of its curve receives the *right bronchial vein*, and anteriorly branches from the aorta and œsophagus. To the right it receives the corresponding *intercostal veins*. To the left, towards the seventh rib, the *vena semi-azygos*, a considerable branch which ascends parallel to the vena azygos, on the left side of the vertebræ, and which receives the inferior intercostal veins of the left side.

II. VEINS WHICH, BY THEIR UNION, FORM THE INFERIOR VENA CAVA.

I. VEINS WHICH, BY THEIR UNION, FORM THE EXTERNAL ILIAC VEINS.

The *popliteal vein* commences by *three veins* which accompany the anterior, posterior, and fibular arteries ; the *external saphena vein* also contributes to its formation, by collecting the blood upon the front and outer side of the foot, and passing into the ham, opens into the popliteal vein.

Fig. 214.



The *femoral* or *crural vein* is a continuation of the popliteal vein ; it ascends obliquely at the inner and fore part of the thigh, close to the femoral artery, following the same course up to the crural arch. In its progress it receives a great number of deep branches, precisely similar to those of the artery, and the following remarkable superficial branch :

The *internal vena saphena*, Fig. 214, collects the blood from the inner part of, *a*, the foot and toes ; it is united to the external saphena by a transverse arch ; these united branches ascend before the inner ankle, and form a trunk which is continued on the inner part of the leg, and passing behind the inner condyle of the femur, it proceeds on the inside of the thigh to an opening in the fascia lata, *b*, where it discharges itself into *c*, the femoral vein. At this part it receives *several superficial abdominal veins*, the *circumflex iliac vein*, and *the external pudic veins*.

The *external iliac vein* receives branches corresponding to the artery of the same name and in the male it receives a large vein which originates in the envelope of the testicle.

2. THE VEINS WHICH, BY THEIR UNION, FORM THE INTERNAL ILIAC VEIN.

The internal iliac vein, Fig. 212, *s*, *s*, is situated in the cavity of the pelvis, behind the artery of the same name ; its branches correspond exactly to those of the artery, with the exception of the following :

The *vesical veins* are large and very numerous, but differ according to the sex of the subject we examine.

In the *male* they commence upon the glands and unite into two trunks, the *dorsal veins of the penis*, which run upon the back of that organ, and afterwards wind downwards upon the organs of generation, and continuing their course on the sides of the bladder, and over the prostate gland, open into the internal iliac vein.

In the *female* the vesical veins commence by the *veins of the clitoris* and the labia, and unite with the numerous vessels of the vagina and rectum.

The *sacro-lateral veins* communicate in the sacral canal with the vertebral sinuses, and, emerging from the anterior sacral foramina, join the internal iliac vein.

COMMON ILIAC VEINS.

The *common iliac veins* result from the union of the external and internal veins ; they extend from the sacro-iliac symphysis to the fifth lumbar vertebra, where they give rise to the inferior vena cava.

INFERIOR VENA CAVA. Fig. 212, *n*, *r*.

The *inferior vena cava* is larger than the superior, and extends from the articulation of the fourth and fifth lumbar vertebræ to the right auricle of the heart. It ascends on the right side of the bodies of the lumbar vertebræ, passes above and behind the liver, and advancing through a wide aperture of the aponeurosis of the diaphragm, introduces itself into the pericardium, and enters the right auricle of the heart by an aperture which is bounded by the Eustachian valve.

BRANCHES OF THE INFERIOR VENA CAVA.

The *middle sacral vein* ascends upon the coccyx and sacrum, in the angle formed by the union of the common iliac veins.

The *lumbar veins* are four in number on each side, and commence by an *abdominal branch*, and a *dorsal branch*, corresponding to the branches of the lumbar arteries ; the dorsal communicates by the intervertebral foramina, with the vertebral sinuses. The lumbar veins of the left side pass under the aorta, and are in consequence longer than the right.

The *spermatic veins*, see Fig. 212, *r*, differ in their origin in the two sexes. In the *male* they commence by the *spermatic plexus*, the roots of which are expanded in the testicle, they anastomose with the neighboring veins, and collect into four or five branches, which envelope the vas deferens, and, passing through the inguinal ring, unite and form a single trunk, which extends upwards and inwards on the psoas muscle, as far as the upper part of the pelvis, where the spermatic vein forms another plexus, named the *corpus pampiniforme:*

these veins again unite and convey their blood into the inferior vena cava on the right side, and into the corresponding renal vein on the left side.

In the *female*, the spermatic veins originate in the ovarium, Fallopian tube, ligamentum teres, and sides of the uterus ; they afterwards collect between the laminæ of the broad ligament of the uterus, and then follow the same course as in the male.

The *renal veins*, see Fig. 212, *o*, *o*, are of great size. Their roots exactly correspond to the minute ramifications of the renal arteries. They unite in the fissure of *p*, *p*, the kidneys, into several branches, which collect into a trunk opening into the cava.

The *capsular* and *adipose veins* frequently open into the renal veins, and in other respects have the same disposition as the arteries to which they correspond.

The *hepatic veins* have their roots in the substance of the liver : some of them are of small size and enter the vena cava separately ; others, namely, the *middle hepatic veins*, open into the vena cava between the right and left hepatic veins.

The *middle hepatic veins* open into the vena cava between the right and left hepatic veins.

The *left hepatic veins* ramify in the left lobe of the liver, and proceed from thence into the vena cava, opposite the aperture of the diaphragm, through which it passes.

The *right hepatic veins* issue from the right lobe of the liver, and open into the vena cava below the preceding.

The *inferior diaphragmatic veins* are two in number, and are similar to the arteries of the same name.

VERTEBRAL SINUSES AND VEINS OF THE SPINAL MARROW.

There exist in the whole length of the vertebral cavity two great venous canals, named the *vertebral sinuses*, and which communicate with the internal jugular vein. These sinuses have the same structure as the sinuses of the dura mater, it being traversed in various directions by irregularly distributed membranous bridles.

At their inner side, they communicate with each other by *transverse sinuses*, occupying the middle of the body of each vertebra, then passing under the posterior vertebral ligament, they receive the veins which transmit the blood from the envelopes of the spinal marrow, and the spongy tissue of the vertebræ.

The *veins of the spinal marrow* accompany the arteries of that name, and open into the inferior cerebellar veins.

The *veins of the sacral canal* are of considerable size ; they are immersed in cellular tissue, and have no adhesion to the osseous parts. Their inferior extremities are lost in very delicate ramifications upon the os coccygis. Externally, they form communications with the lateral sacral veins ; and, internally, their transverse branches anastomose with each other.

VEINS OF THE HEART.

CORONARY VEINS.

The *great right coronary vein* collects the blood from the apex of the heart, passes into the groove which separates the auricles from the ventricles, and receives a great number of lateral branches which terminate in the right auricle, close by the entrance of the inferior vena cava, where the coronary is covered by a semilunar valve.

The *small right coronary vein* unites with the preceding, and passes in the same direction to the posterior surface of the heart.

The *left coronary veins* are smaller than the right. They commence, with the preceding, at the apex of the heart, by numerous roots, which unite, upon the convex surface of that organ, into a single trunk, which discharges its blood with the other veins at the posterior part of the right auricle.

There are a number of veins which terminate directly in the cavity of the right side of the heart, by minute orifices, which have been termed by their original describer, the foramina THEBESII.

ABDOMINAL DEPARTMENT OF THE VENOUS SYSTEM.

VENA PORTÆ.

BRANCHES OF THE VENA PORTÆ.

The *vena portæ* derives its blood from all the organs of digestion in the cavity of the abdomen, excepting the liver. It is formed principally by three large trunks, the coronary vein of the stomach, the splenic and the mesenteric veins, all which unite to form the middle part of the trunk of the vena portæ.

The *coronary vein of the stomach* corresponds to the artery of the same name. It is the smallest of the three branches. It empties into the trunk of the vena portæ, behind the pyloric portion of the stomach.

The *splenic vein* collects the blood from the spleen by a number of branches, which, after a short course, unite upon the pancreas into a single trunk, which extends from left to right to unite with the superior mesenteric vein, opposite the vertebral column. It likewise receives the veins which correspond to the *vasa breviora*, the *right* and *left gastro-epiploic*, the *duodenal*, and the *pancreatic veins* and the *small mesenteric vein*. The last-named vein receives the blood from the left part of the colon and the rectum. Its branches correspond to those of the inferior mesenteric artery.

The *superior mesenteric vein* is distributed in the same manner as that of the artery of the same name, to the right, and a little in front, of which it is placed. It is formed by the veins of the small intestines, and by those which correspond to the right colic arteries ;

and in the mesentery it constitutes a net-work, very similar to the ramifications of the artery. At the edge of the transverse mesocolon, the trunk of this vein, after receiving several branches from the duodenum and pancreas, unites with the splenic vein.

The *trunk of the vena portæ* is formed by the junction of the splenic and superior mesenteric veins with the coronary vein of the stomach; it extends from the vertebral column to the groove of the liver, and separating into two branches, nearly at a right angle, seems to form under the liver a horizontal canal, which has been termed the *sinus of the vena portæ*. These vessels are extended through the lobes of the liver in innumerable ramifications. In its passage under the small extremity of the pancreas, it is united to the cystic and hepatic ducts, the hepatic artery and a number of nervous filaments and lymphatic vessels; all which are surrounded by a fibrous envelope named the *capsule* of GLISSON.

Injections thrown into the vena portæ penetrate into the other vessels of the liver, and *vice versa*.

CHAP. III.

OF THE CAPILLARIES.

THE delicate branches of the final ramifications of the arteries and of the minute origins of the veins, are called the *capillaries*. In these small vessels most of the important functions of life take place, as secretion, nutrition, exhalation, calorification, &c. They are of such extreme tenuity that they escape detection by the naked eye. Their existence may be demonstrated not only by microscopical observation, as observed in the last chapter, but by the fact, that a colored fluid may be thrown from the arteries into the veins, without any extravasation between them.

There are two parts in the capillary system. One is diffused over the whole body, being placed between the terminating branches of the arteries and the roots of the veins, the other part is between the minute ramifications of the pulmonary arteries and the origins of the pulmonary veins. In the first, the arterial blood is changed to venous; in the last, the reverse. Their intimate organization is unknown.

Though these capillaries exist everywhere in the body, still they are more or less numerous in the various organs. They are more abundant in the secretory organs, the skin, the mucous membranes, and the lungs, and less so in the fibrous structures; in short, the capillary system is as much more developed in a part, says Bichat, as it has more functions to sustain, and does not exist in organs in proportion to their size.

ART. VI.

CHAP. I.

ORGANS OF ABSORPTION.

THE organs of absorption consist of *lymphatic vessels* and *lymphatic glands*; the latter also are named *lymphatic* ganglia. This system of vessels was perfectly unknown until a celebrated anatomist of the name of ASELLIUS, in the year 1622, discovered, upon the mesentery of a dog, white lines extending from the intestine to the glands. He observed that they contained a milk-like fluid, and hence termed them *lacteals*. By a series of experiments he found that these vessels absorbed the chyle, and conveyed it to the blood; and subsequent inquires proved that the same system of vessels was minutely distributed over the whole human frame; and that, at the angle formed by the union of the subclavian with the internal jugular vein, upon either side of the neck, one or more of these vessels discharge their contents into the current of blood.

The lympathic vessels are small pellucid tubes which occur in all parts of the body; they originate on the surface of the membranes, and in the tissue of all the organized structures; and they transport all the absorbed fluids to the venous system. Those absorbents which take up the chyle in the intestines, during the process of digestion, are named *lacteals*; and, although they differ in their uses from the other absorbent vessels, they have precisely the same anatomical character.

The ultimate arrangement of the lymphatic vessels has not been demonstrated, but the whole exterior of the body is known to be covered by a net-work of these vessels, placed in the subjacent cellular tissue, and others occupy the muscular intervals and organs of the body; nor is this system of vessels confined to the limbs only, for it exists in the surface and substance of each particular organ, as in the lungs, liver, spleen, pancreas, and other viscera, where both superficial and deep-seated lymphatics are uniformly distributed.

Generally these vessels are straight in their course; but their communications with each other are very numerous, and they frequently form successive meshes. They are also remarkable for their alternate unions and divisions, so that a great number of vessels, after being collected into a single trunk, separate a second time, and again form one or more trunks, which appear most conspicuous in the vicinity of their glands.

THORACIC DUCT.

All the absorbent vessels discharge themselves into the subclavian and internal jugular veins, by considerable trunks, called the *thoracic duct*, and *great lymphatic duct*. These convey the absorbed fluids into the circulation. See Fig. 213, *d*, the left, and *f*, the right thoracic ducts.

STRUCTURE OF THE LYMPHATIC VESSELS.

The lymphatic vessels are formed of an external cellular membrane, and an internal membrane similar to that of the veins; the latter is folded upon itself, producing valves at intervals, which are generally disposed in pairs. These valves are usually more numerous as the vessels diminish in calibre. So that the thoracic canal contains fewer than the others.

LYMPHATIC GLANDS IN GENERAL.

The branches of the principal lymphatic trunks traverse a greater or less number of *lymphatic glands ;* that is to say, small bodies of various forms and size, and collected together in greater or less quantity, or sometimes isolated. These glands are not numerous in the extremities, but they occur abundantly in the thorax and abdomen. Each gland receives lymphatic vessels, which subdivide and form an inextricable interlacement, which is lost in its substance, without our being able to trace its distribution, or display the minute structure. These glands vary in diameter from the twentieth of an inch to an inch. They are in general red and vascular ; some, however, are of a gray or blackish color. These bodies have been denominated also lymphatic *ganglions*, because some anatomists have supposed, that they bear the same relation to their vessels, as the nervous ganglions do to the nerves.

The absorbents which enter the glands are called *vasa inferentia*, and those which pass out of them, are termed vasa *efferentia*.

Fig. 215.

Fig. 216.

Fig. 217.

Fig. 215, a lymphatic vessel.

Fig. 216, a lymphatic vessel laid open, showing its valves.

Fig. 217, lymphatic vessels and their glands.

LYMPHATIC GLANDS IN PARTICULAR.

LYMPHATIC GLANDS OF THE INFERIOR EXTREMITIES.

The *anterior tibial gland* is the only gland in the leg. It is found between the tibia and fibula, on the lower extremity of the inter-osseous ligament.

The *popliteal glands* are three or four in number, and are situated in the ham.

The *inguinal glands* are situated on the upper part of the thigh, and in the groin; the *superficial* are found between the skin and aponeurosis, surrounding the termination of the internal saphena vein; their number varies from eight to twelve, and they are sometimes observed to form a chain of glands, extending from the middle and inner part of the thigh to the groin.

There are three or four *deep-seated* inguinal glands, situated under the aponeurosis, and about the femoral artery.

LYMPHATIC GLANDS OF THE PELVIS.

The *hypogastric glands*, ten or fifteen in number, are situated in the lateral parts of the cavity of the pelvis, and about the internal iliac vessels.

On the outside of the pelvis, very small lymphatic glands are met with in the course of the glutæal and ischiatic arteries; and in the interior of the pelvis, a number of minute glands are found upon the bladder, the uterus, and the vesiculæ seminales.

The *sacral glands* are situated in the hollow of the sacrum, between the laminæ of the meso-rectum.

The *external iliac glands* vary in number from six to fifteen; they are situated in the course of the external iliac vessels, and form a chain of glands extending from the crural arch to the lower part of the vertebral column.

LYMPHATIC GLANDS OF THE ABDOMEN.

The *lumbar glands* are large and numerous; they occupy the region of the loins, and surround the aorta and the inferior vena cava; they are also situated upon the crura of the diaphragm, and are thickly arranged over the renal arteries. These glands furnish vessels which immediately communicate with the thoracic duct.

The *hepatic*, *pancreatic*, and *splenic glands* are situated round the vena portæ and along the splenic artery; they receive the lymphatic vessels of the liver, aorta, and pancreas.

The *mesenteric glands* are numerous, sometimes exceeding a hundred, and are in general of considerable size; they are situated between the two laminæ of the mesentery, and receive the lacteals or absorbents of the chyle. See Fig. 219, *c*, *d*.

The *mesocolic glands* are fewer than the preceding, and are placed between the laminæ of the mesocolon.

The *gastro-epiploic glands* occupy the greater and smaller curvature of the stomach; they surround the the gastro-epiploic arteries, and the coronary artery of the stomach.

LYMPHATIC GLANDS OF THE THORAX.

The *glands of the mediastinum.* Upon the diaphragm and pericardium there are six or eight of these bodies ; and there are twelve or sixteen surrounding the thymus gland, and large vessels of the base of the heart.

The *bronchial glands* are very numerous ; they are situated before the division of the trachea, around the bronchi, and even in the interior of the lungs ; but they will be more particularly noticed in the description of the trachea and bronchi.

LYMPHATIC GLANDS OF THE SUPERIOR EXTREMITY.

The *glands of the arm* are distributed in the line of the brachial artery ; they are not often met with in the fore-arm, although, not unfrequently, we find a few at the bend of the arm near the inner condyle.

The *axillary glands* are situated in the cellular tissue of the arm-pit, around the axillary vessels and their branches ; they are of large size, and vary from six to twelve in number. Some are met with under the collar bone and between the ribs.

LYMPHATIC GLANDS OF THE HEAD AND NECK.

The *glands of the skull* are few in number ; several small glands are found behind the ear, and two or three are also observed under the zygomatic arch. No lymphatic glands have been traced in the interior of the skull.

The *glands of the face* are situated upon the buccinator muscle, and along the base of the jaw, where they surround the anterior portion of the digastric muscle.

The *glands of the neck* are *superficial* and *deep-seated ;* the former are situated beneath the platysma myoides, in the course of the external jugular vein and its branches. The others, called *glandulæ concatenatæ*, occur in the vicinity of the internal jugular vein and common carotid artery. Their size is small, but their number is very great. In children they frequently present a kind of knotty cord, extending from behind the ear to the collar bone.

CHAP. II.

PARTICULAR LYMPHATIC VESSELS.

LYMPHATIC VESSELS WHICH TERMINATE IN THE THORACIC DUCT.

1. LYMPHATICS OF THE INFERIOR EXTREMITY.

The *superficial lymphatics of the lower extremities* consist of very numerous vessels, which are found in the cellular tissue, between the skin and muscles. Their commencement can be traced with little difficulty in the toes, round which they form a very delicate plexus, and form by their successive union from sixteen to twenty branches, which cover the surface of the foot and pass up the inner side of the leg; those of the side of the foot collect and form two or three branches, which ascend around the tendo Achillis.

Thus united, the principal trunks of the lymphatics of the leg pass over the calf, and the ham, and ascend upon the inner and outer side of the thigh, approaching each other, and continually communicating, until, at length, they terminate in the superficial inguinal glands.

Fig. 218.

Fig. 218, the lymphatic vessels of the inner part of the thigh.

All these vessels are immersed in the subcutaneous cellular tissue; and their communications are so frequent and numerous, that they form, upon the foot, leg, and thigh, a net-work, which completely surrounds these parts.

The *deep lymphatic vessels of the lower extremities* may be distinguished into four series; namely, the *anterior tibial*, the *posterior tibial*, and the *fibular lymphatics*, according as they accompany the anterior and posterior tibial and fibular arteries. They terminate in the popliteal glands. Indeed, most of the deep-seated lymphatics of the leg and foot have the same termination. These glands are connected together by a great number of smaller vessels, which form a plexus, whence issue several trunks which ascend upon the popliteal and femoral vessels, receiving all the deep lymphatics of the thigh, and subdividing up to *a*, the deep inguinal glands.

2. SUPERFICIAL LYMPHATIC VESSELS OF THE HIPS, PERINÆUM, LOINS, EXTERNAL PARTS OF GENERATION, ETC.

The *lymphatics of the hips* are numerous, and pass over the outer and inner part of the thigh, to unite with the superficial absorbents of the perinæum, and inguinal glands.

The *lymphatics of the loins* descend from the lumbar vertebræ over the crest of the ilium, and divide in the superficial inguinal glands.

The *lymphatics of the lower part of the parietes of the abdomen* commence on the level of the umbilicus, and form a net-work over the whole anterior region of the abdomen ; they collect inferiorly into a few trunks which terminate in the superficial glands.

The *lymphatics of the perinæum*, *scrotum*, *and penis*, are very numerous ; those of the scrotum ascend on each side to the inner part of the thigh, where they unite with those of the perinæum and penis : they all terminate in the superficial glands.

In the female, the lymphatics of the external parts of the organs of generation have the same termination.

3. DEEP-SEATED OBTURATOR, ISCHIATIC, AND GENITAL LYMPHATIC VESSELS.

The *obturator lymphatics* are distributed over the adductor muscles and neighboring parts, and take the direction of the obturator artery, through the obturator foramen, to terminate in the hypogastric glands.

The *ischiatic lymphatics* are distributed to the muscles of the pelvis, and terminate in the same glands as the former.

The *glutæal lymphatics* have the same distribution as the glutæal artery, and, passing into the pelvis, terminate in the same glands as the preceding.

The *deep lymphatics of the penis and clitoris* follow the course of the internal pudic artery, and terminate in the same glands.

The *lymphatics of the testicle* are numerous, and are among the largest of the body ; some of them are the size of a crow-quill : they unite upon the spermatic cord into six or eight branches, and ascend with it towards the inguinal ring, through which they pass to follow the spermatic artery, and terminate in the lumbar glands.

The *lymphatics of the prostate gland and vesiculæ seminales* unite with those of the bladder, and enter into the hypogastric glands.

The *lymphatics of the uterus* unite with those which are distributed to the vagina, to terminate in the same glands. Those which are found upon the broad ligament and ovarium ascend with the spermatic lymphatics to the lumbar glands.

4. LYMPHATIC VESSELS OF THE URINARY ORGANS.

The *lymphatics of the bladder* follow the course of its blood vessels, and open into the hypogastric glands.

The *lymphatics of the kidneys* unite towards their fissure,and then proceed upon the sides of the aorta to the lumbar glands. The ureters also are furnished with numerous absorbents, which surround those tubes, and communicate freely with each other, and with the last-named glands.

The *capsular lymphatics* proceed to the hepatic and splenic glands, and several pass to the glands upon the pillar of the diaphragm.

5. LYMPHATIC VESSELS OF THE PARIETES OF THE PELVIS AND ABDOMEN.

The *ileo-lumbar lymphatics* are a set of absorbents which originate in the iliacus muscle, and upon the hip bone; they pass under the psoas muscle, and communicating with the inferior lumbar glands, contribute to the formation of the *external iliac lymphatic plexus*, or the assemblage of lymphatics which accompany the external iliac vessels.

The *sacral lymphatics* are extended over the adipose tissue of the rectum, and region of the sacrum; they terminate in the inferior lumbar or hypogastric glands. Those lymphatics, which contribute to form the *hypogastric plexus*, are placed on the sides of the pelvis, and consist of an interlacement of vessels and glands, in which the obturator, glutæal, ischiatic, uterine, and vesical lymphatics terminate.

The *epigastric lymphatics* commence in the vicinity of the umbilicus, and proceed from the interior, through the abdominal muscles and their aponeuroses; then unite into several trunks, which descend in the course of the epigastric vessels, and terminate in the external iliac plexus.

The *circumflex iliac lymphatics* are distributed in the integuments of the sides of the abdomen, and descend towards the crest of the ilium, to one of the external iliac glands.

The *lumbar lymphatics* are distributed to the muscles of the lumbar region; but they unite before the vertebral column, where their numerous communications, with those of almost all the other trunks, which have just been described, constitute the *lumbar lymphatic plexus*.

6 LYMPHATIC VESSELS OF THE STOMACH AND INTESTINES.

The *lymphatics of the stomach* are distributed into two distinct orders; the *superficial*, which are situated beneath the peritoneal, and the *deep*, which are distributed to the muscular and mucous membranes. Some of these commence at the large extremity of the stomach, and join the lymphatics of the spleen; others proceed from the small curvature of the stomach, and communicate with the glands in that situation, and in the vicinity of the liver. After this, they descend behind the pancreas to the roots of the thoracic duct.

Although in some animals these vessels have been found to contain chyle, in the human subject they have never been observed to be filled with it.

The *lymphatics of the intestines* are usually called the LACTEALS, on account of their conveying a fluid like milk from the intestines to the thoracic duct. Each lacteal takes its origin from the villi of the intestines, by numerous short radiated branches, and each branch is furnished with an orifice for imbibing the chyle.

From the villi, the lacteals pass under the muscular membrane of the intestines, and then obliquely through it, uniting in their course into larger branches, following the course of the mesenteric blood vessels. They are found situated on each side of the arteries.

It is observed that there are a much greater number of lymphatics in the small intestines than in the larger; the descending colon and rectum present but few absorbents, and these are connected with the lumbar and hypogastric glands, or those of the mesorectum.

The lacteals of the small intestines, after passing through the different glands of the mesentery, form several trunks, which accompany the superior mesenteric artery, until they arrive at the thoracic duct.

Fig. 219.

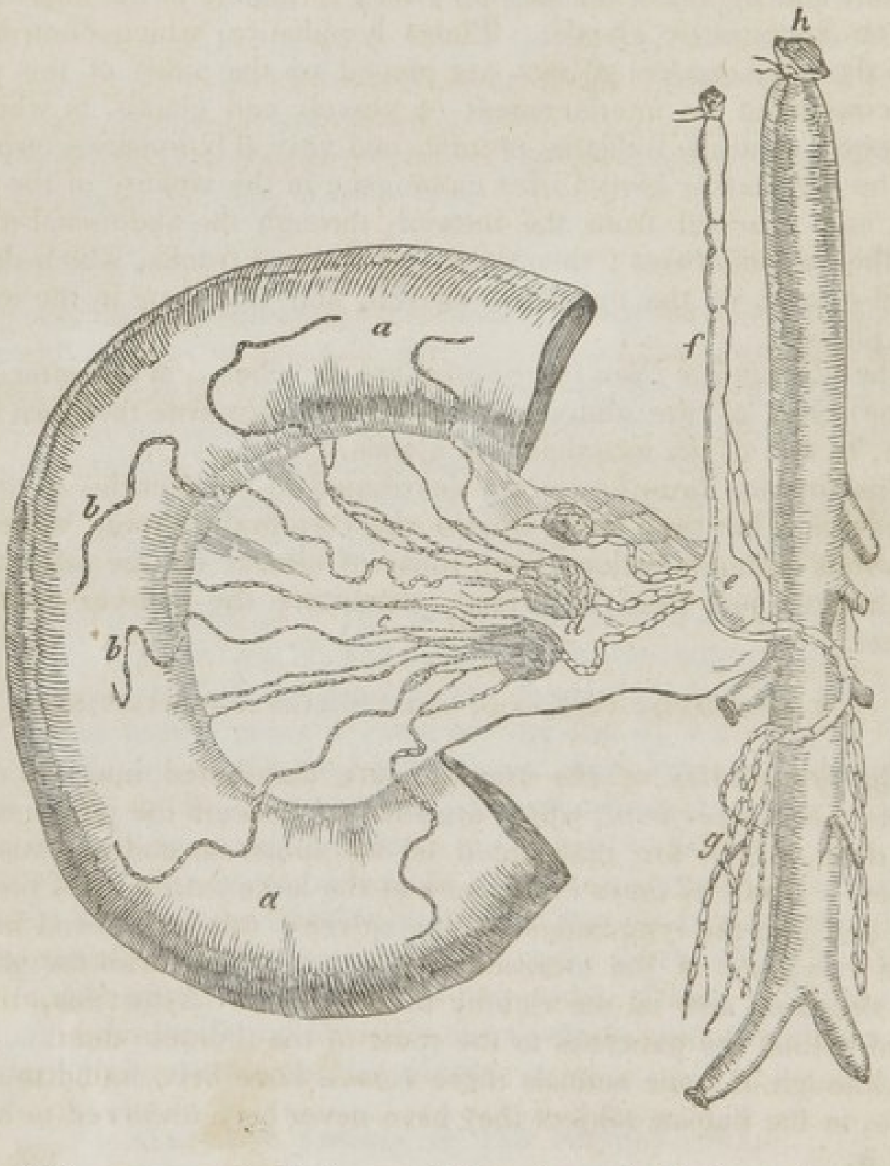


Fig. 219, *a*, *a*, part of the small intestine; *b*, *b*, lacteals; *c*, the mesentery; *d*, the mesenteric glands.

The *lymphatics of the great omentum* ascend to unite with the lymphatics of the stomach, and terminate in the glands of the great curvature.

7. LYMPHATIC VESSELS OF THE SPLEEN, PANCREAS, AND LIVER.

The *lymphatics of the spleen* are very numerous ; the superficial and deep branches, uniting at its fissure into a few trunks, form a plexus round the splenic vessels, and pass beneath the duodenal extremity of the pancreas, to the inferior lymphatics of the liver.

The *lymphatics of the pancreas* proceed from the substance of that gland, and unite with the lymphatics of the spleen and stomach.

The *lymphatics of the liver* are extremely numerous, nor does any organ in the body appear to contain so many ; and, like those of the other viscera, it has a superficial and a deep-seated series, which, however, so freely communicate, that, upon injecting the external lymphatics, the deep internal are readily filled from them. On the right lobe they collect into four fasciculi ; the first is formed by the lymphatic vessels, which commence between the laminæ of the suspensory ligament, and, uniting into two or three trunks, enter the thorax near the ensiform cartilage, traverse some of the glands, and open into the thoracic duct near the left internal jugular vein. The second traverses the right lateral ligament of the liver, and divides into two series ; the one superior, which mounts into the thorax, and afterwards returns into the abdomen with the aorta, to terminate in the neighboring glands ; the other inferior, which extends along the last ribs, and unites with the intercostal lymphatics, to open into the thoracic duct. The third fasciculus is distributed to the middle of the right lobe, and unites with the preceding at the posterior part of the liver. The fourth fasciculus commences in the anterior part of the right lobe, and unites with the deep series, and with some glands near the pylorus.

In the left lobe of the liver, the lymphatics unite with the preceding and to those of the spleen ; those from the posterior part of the left lobe descend towards the cardia, and proceed to the glands of the small curvature of the stomach.

8. THE THORACIC DUCT. See Fig. 219.

The thoracic duct, *f*, is the canal which receives the lymphatics from the lower half of the body, the interior of the chest, the left upper extremity, and the left side of the head and neck. It extends from the second or third lumbar vertebra as far as the left subclavian vein, and is formed by the union of, *g*, five or six large trunks, the result of the absorbent plexus of the abdomen. Near the aortic aperture of the diaphragm, the thoracic duct presents a very remarkable enlargement, *e*, the *receptaculum chyli*, which is placed at the anterior and left part of the second lumbar vertebra, behind, *h*, the aorta. Above this dilatation, the thoracic duct ascends into the chest, entering between the pillars of the diaphragm, with the aorta on the left side, and the vena azygos to the right. It then ascends behind the arch of the aorta, and arrives at the seventh cervical vertebra, turns inwards and downwards, then passes the thyroid artery, and the left internal jugular vein, and opens close to the latter into the subclavian vein of the same side. At its aperture there are two valves which prevent the blood from passing from the vein into the duct.

Although the lymphatics have hitherto been described by anatomists as collecting into trunks to transmit their contents into the subsclavians only; MAGENDIE* and a few other celebrated physiologists and experimentalists are of opinion, that many other communications, between the lymphatics and veins, take place in the extremities and other parts of the body. Professor MAYO seems to have arrived at the same conclusion; I give his own words. "For my own part, I think it likely, that such communications do exist. At all events, when believing that they did not, I have witnessed the mercury thrown into the absorbents of the limbs unaccountably make its way into the veins."†

9. LYMPHATIC VESSELS WHICH THE THORACIC DUCT DIRECTLY RECEIVES.

Several branches of lymphatics from the liver, and the glands surrounding the cæliac artery, have been already described.

The *intercostal lymphatics* are so distributed to the muscles of the thorax and the intercostals; they communicate with some glands found between the external and internal intercostal planes of the muscles. On the sides of the vertebræ, these vessels unite with others which proceed from the spinal canal and the muscles of the back, then spread out into a plexus before the vertebral column. From thence they descend and open into the thoracic duct.

16. LYMPHATIC VESSELS OF THE LUNGS.

The *lymphatics of the lungs* are distributed upon their surface in a series of areolæ of various forms, more commonly hexagonal, and unite into a number of trunks which enter the glands, with which the bronchus is surrounded at its entrance into that organ. The deep lymphatics occupy the whole tissue of the lungs, communicate with the superficial, unite into the bronchial glands, and ascend upon the trachea.

From a large bronchial gland, which is found in the angle formed by the division of the trachea, there issue several lymphatic branches, which ascend upon the trachea, and, traversing some glands, unite and open into the right great lymphatic vessel. Others traverse glands upon the trachea, under the thyroid gland, and collect into two trunks, which incline obliquely to the left, behind the internal jugular vein, to discharge themselves into the thoracic duct.

11. SUBSTERNAL, DIAPHRAGMATIC, CARDIAC, THYMIC, AND ŒSOPHAGEAL LYMPHATIC VESSELS.

The *substernal lymphatics* commence from the upper part of the parietes of the abdomen; they enter the thorax between the ensiform

* MAGENDIE, in his Physiology, relates some very curious and striking experiments, which, if confirmed by others, must set the question at rest.

† Outlines of Human Physiology, by HERBERT MAYO, Professor of Anat. King's College, London.

cartilage and the diaphragm, ascend behind the sternum, traverse some glands, and form some meshes, which unite into trunks, one of which communicates with the inferior jugular glands, and terminates in the thoracic duct. The others open on the right side into the subclavian and internal jugular veins.

The *lymphatics of the diaphragm* are distributed on its convex surface, and unite with the intercostal and hepatic lymphatics, then proceed through the inferior glands of the mediastinum, and join the preceding behind the sternum.

The *lymphatics of the pericardium and thymus* are a numerous set of reticulated vessels, which are intimately connected with the sub-sternal and pulmonary lymphatics.

The *lymphatics of the heart* are distributed to the whole surface; the principal trunks following the course of the coronary vessels. Some of these trunks ascend upon the anterior part of the aorta, and terminate in the thoracic duct; others pass obliquely between the aorta and pulmonary artery, traverse some small glands, and arrive at the thoracic duct.

The *lymphatics of the œsophagus* are reticulated around that tube; they unite with those of the heart and lungs, and terminate in the pre-dorsal ganglia.

12. LYMPHATIC VESSELS OF THE SUPERIOR EXTREMITIES.

The *superficial lymphatics of the upper extremities* collect into fasciculi on the sides of the fingers, and proceed over the metacarpus to the posterior surface of the fore-arm, where their numbers are greatly increased by the addition of small vessels from that part of the extremity. Near the elbow joint the lymphatics are very distinct; and, upon the anterior surface of the fore-arm, they unite with others, which arrive from the fingers and palm of the hand. They then ascend on the fore and inner part of the arm, and, becoming large and numerous, terminate in the axillary and subclavian glands.

Some of the *brachial lymphatics* pursue the course of the cephalic vein, and unite with some reticulated vessels and glands under the clavicle.

The *deep lymphatics of the upper extremities* constantly accompany the arteries which are distributed to these parts, and terminate in the axillary glands.

13. LYMPHATIC VESSELS OF THE ANTERIOR PARIETES OF THE THORAX.

The *lymphatics of the anterior part of the thorax* commence immediately under the integuments, and, proceeding upwards and outwards, terminate in the glands of the axilla.

Some of these vessels originate more deeply in the substance of the pectoralis major, pectoralis minor, and serratus magnus muscles, but they have the same termination.

14. LYMPHATIC VESSELS OF THE POSTERIOR REGION OF THE NECK AND THORAX.

The *lymphatics of the neck* commence in the cellular tissue, towards the occiput, and upon the spinous processes of the neck; they descend outwardly in the direction of the fibres of the trapezius, and unite with the anterior thoracic, and dorsal lymphatics in the axilla.

The *lymphatics of the back* commence in the integuments, and are extended to the whole of the muscles of the back; like the preceding, they terminate in the axilla.

15. LYMPHATIC VESSELS OF THE AXILLA.

The *axillary lymphatics* are remarkably reticulated, in consequence of their connexion with a great number of glands, and with the vessels which terminate in them, or issue from them. The latter concentrate into three or four trunks, which proceed round the subclavian vein, and open into it, and into the thoracic duct. Those on the right side generally furnish a trunk, which transmits its fluid to the angle formed by the right internal jugular and subclavian veins; and is named the *right great lymphatic duct.* See Fig. 213, *f*.

16. LYMPHATIC VESSELS OF THE HEAD AND ANTERIOR PART OF THE NECK.

The *epicranial lymphatics* are arranged on all sides beneath the skin of the cranium, and may be distinguished into three orders of fasciculi. The *occipital*, the *temporal*, and the *frontal;* all which proceed to the glands of the neck.

The *lymphatics of the face* follow the direction of the principal veins, and proceed to the submaxillary glands.

The *superficial lymphatics of the neck* form a plexus, which accompanies the subcutaneous veins of the neck; they open into the right great lymphatic vessel, and the thoracic duct.

17. DEEP LYMPHATIC VESSELS OF THE HEAD AND NECK.

The *lymphatics of the brain.* Although the most minute researches have been made in those parts, there have been discovered a few lymphatics only in the dura mater.

The *deep lymphatics of the tongue*, *palate*, *nose*, *orbits*, *pharynx*, *muscles of the face*, etc. These absorbents accompany the blood-vessels, and terminate in the right and left great thoracic ducts.

THE OFFICE OF LYMPHATIC VESSELS AND THEIR GLANDS.

The most important office of the lymphatic system is to collect the chyle for the supply of the waste of the body, during the exercise of its several functions.

The lymphatics, therefore, take in the fluids, it is supposed, by capillary attraction, and afterwards, by a contractile power, inherent in the vessels, conduct their contents into the mass of the blood. The absorbents also have the power of removing the solid parts of the body, and by thus making way for the disposition of new matter, contribute to the growth and renovation of the animal fabric.

By means of these vessels, on the one hand, many contagious diseases are communicated: and, on the other hand, diseases are removed: thus, when lymph is formed, or pus collected, or blood effused in the tissue of organs, the lymphatics have the power of taking away the extraneous or diseased matter. And even solid tumors often are known to disappear entirely by the action of this system of vessels. The obvious use of the absorbent vessels is to convey the lymph and the chyle into the venous system; the former, the residue of nutrition, and the latter, the product of digestion.

I cannot dismiss this subject without informing the uninitiated student, that there is much difficulty in exhibiting the lymphatics. They must be injected with quicksilver, and, owing to the minuteness and delicacy of the vessels, it requires the most acute sight of the anatomist to distinguish, and to introduce an instrument into the smaller branches. Caution and patience, however, will surmount this difficulty; and nothing will more repay the trouble, or reflect more credit on the skill of a practical anatomist, than a good preparation of the lacteals, or other lymphatics.

ART. VII.

CHAP. I.

NERVOUS SYSTEM.

The *nervous system* is destined to regulate the functions of the animal economy, and to receive impressions of external objects, and transmit them to the understanding.

The nervous system consists of, 1st, the brain: 2d, the medulla oblongata; 3d, the spinal marrow; 4th, the nerves; 5th, the ganglia.

GENERAL DIVISIONS OF THE NERVOUS SYSTEM.

There are two general departments, essentially distinct from each other, to which the nervous system may be referred; the 1st *department* consists of the brain and its dependencies, the 2d, of the ganglia and their nervous radiations. The *first department* appertains particularly to animal life; on the one hand it is the agent which transmits impressions calculated to produce sensations; on the other hand it serves to convey the volitions to those organs which receive them. The *second department* is almost invariably distributed to the organs of digestion, of circulation, respiration, and the secretions, and belongs in a more particular manner to the internal organs, where it acts a more obscure part than the preceding. The two departments frequently communicate with each other, but there is a sufficiently distinctive line to establish their difference ; as a simple exposition of each will sufficiently demonstrate.

I. THE CEREBRAL DEPARTMENT OF THE NERVOUS SYSTEM.

This department of the nervous system, like all organs of animal life, is exactly symmetrical. The nerves commence alike from each side of the brain and spinal cord : hence the appellation of *pair of nerves*, by which the double corresponding trunk is described. This is a term which we cannot apply to the irregularly distributed gangliolic department.

Each department of the nervous system receives impressions of objects, and transmits them to the sensorium ; and these impressions or affections of the nerves, accompanied by consciousness, bear the name of sensation. The nerves, which constitute the immediate instruments of sensation, are of different kinds, and are distributed in different proportions in the various organs of the body : most of them are capable of being excited by agents both from without and from within, and the impressions they receive are transmitted to the brain, their common centre, and frequently to the other organs with which they are connected. That the nerves are truly the organs of sensation cannot be disputed ; for sensation is found to be most acute in those parts which are furnished with most nerves, and the sensation ceases when the nerves are destroyed. When the nerve is stimulated, the muscle which it supplies is convulsed ; when it is tied, compressed, or divided, palsy of the muscle ensues.

My present arrangement of the departments of the nervous system is chiefly founded on the anatomy and distribution of the nerves. And here science must acknowledge its obligation to Sir CHARLES BELL, for his important discoveries, relative to the functions of the nerves. So that, by the operation of new views, many formerly received opinions must be reformed or altogether expunged. As I proceed, therefore, in the work, I shall endeavor to demonstrate, from anatomical and physiological facts, that every part of the system has its peculiar endowment of nervous matter, fitting it for the peculiar function it has to perform. For example, it is necessary to distinguish nerves into sensitive, motive, compound, and organic, and in addition to the limited number of senses, usually reckoned in the human subject, there are other inward organs of sensation, which will subsequently be described, which have distinct functions, and depend on as distinct departments of the nervous system, as either seeing, hearing, or touch.

I shall now claim the attention of the reader to the general distribution of the nervous system.

The brain appears to be the most remarkable part of the nervous system, since all intellectual phenomena must be referred to the cerebral mass. This organ furnishes generally the motive for all our actions upon exterior bodies, exerts a greater or less influence upon all the properties of life, establishes an active relation amongst the different organs, and is the principal agent of sympathies. It is, moreover, in a sensible relation with the objects with which we are surrounded.

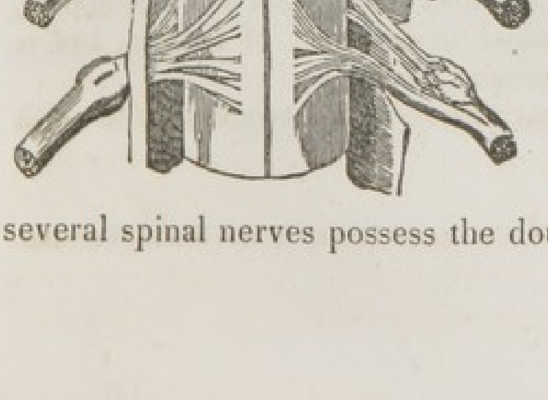
There are two orders of the cerebral department of nerves ; the 1st constitutes the nerves of sensation ; the 2d the nerves of motion.

The nerves of sensation of the first order, which are immediately connected with the brain, are endowed with particular properties, which adapt them to the impression of special bodies ; namely the first pair of nerves perceives odors, the second light, the eighth sound ; and the lingual branch of the inferior maxillary nerve distinguishes the taste and flavor of bodies. The special senses, however, I shall hereafter more particularly refer to.

The medullary column, or spinal marrow, appears next in importance to the brain. It is an irregularly cylindrical prolongation of the brain : it is not like the Grecian shaft, a simple column, but like the Gothic, a compound column, having several shafts combined. In other words, the spinal marrow is composed of four parts or cords, two on each side, which are united the whole length. From the anterior chord, of each side of the column, issue the nerves of motion ; from the posterior cords, the nerves of sensation. There is another column, which is only continued the length of the medulla oblongata, from which the respiratory nerves take their origin.

The spinal nerves are perfectly regular in their derivation and distribution. There are thirty, or thirty-two, on each side ; this variation in the statement of the number depends on the method of reckoning. Each nerve commences by two distinct roots : Fig. 220, the one, *c*, proceeding from the anterior ; the other, *b*, from the posterior division of, *a*, the medullary column ; and each of these roots is composed of a number of small filaments, which, immediately after their origin, approach each other ; the posterior filaments form, *d*, a ganglion, and then join the anterior to form, *e*, a spinal curve : each nervous filament must be considered as continuing distinct to its ultimate destination, though, by the union of the anterior and posterior, the several spinal nerves possess the double property of conveying sensa-

Fig. 220.



tion, and producing motion. There are other nerves of the fifth, sixth, and ninth, which are distributed separately, and are solely motive nerves; but the fifth nerve of the encephalon is like the spinal nerves, in having a double derivation, and a towfold function of sense and motion. Sir CHARLES BELL performed numerous experiments to prove the correctness of his theory, and these experiments have been repeated on the Continent by MAGENDIE and others, who have been perfectly satisfied with the accuracy of his conclusions.* It must, therefore, now be considered as an established fact, acknowledged by all anatomists, that the nerves, proceeding from the anterior cord of the spinal marrow, bestow the power of muscular motion; and that those which proceed from the posterior part of the medullary column, produce sensation. When, for instance, the roots of the anterior nerves of the leg are divided, the animal loses all the power of moving the leg, although the limb retains its sensibility; but, if the roots of the posterior nerves are cut, the power of motion continues, though sensibility is destroyed. The experiments have been repeated and varied, yet with similar results. Thus, on the posterior part of the spinal cord being irritated with a pointed instrument, the animal immediately manifests signs of pain; but no apparent effect was produced by irritating the anterior part. Every muscle, then, has two distinct orders of nerves; the one a motive, and the other a sensitive; and nerves of each of these orders are distributed to every muscular fibre.

It requires, therefore, for the full operation of muscular power, two different orders of filaments, and these establish a circle between the sensorium and the muscle; so that the nerves of the one order carry the influence of the will towards the muscles, which nerves have no power of transmitting an impression back again to the brain. The nerves of the other order connect the muscles with the brain, by acting as a sensitive agent in conveying the impression of the condition of the muscle to the common sensorium; but the last-mentioned nerves have no operation in a direction from the brain to the muscles, and, in consequence, do not excite the muscle however irritated.

We find, however, that the brain and medulla spinalis, as also the nerves communicating with them, are endowed with different properties; the common design of which is to give us correct intelligence of the relative condition of our existence. The assemblage of these different parts has, consequently, with propriety, been called THE NERVOUS DEPARTMENT OF EXTERNAL LIFE, or of animal life. When the functions of this part of the nervous system are suspended, as by a fit of apoplexy, the individual is deprived of feeling, and is perfectly insensible to every surrounding object.

It has already been observed, that these nerves are endowed with

* For details, I refer to the papers of Sir CHARLES BELL, in the Philo. Transac. of the Royal Society.

two properties, viz., sensibility, and vis-motrix ; hence, it follows, that there must be nerves of sensation and motion. And physiological experiments, and the observations drawn from pathological anatomy, evidently prove, that sensation resides in the nervous filaments connected with the posterior column of the medulla spinalis ; and motion in those which are extended from the anterior column.

As general corollaries, the nerves of sensation receive the impressions which external agents produce upon us, and transmit them to the brain. If a ligature be applied around a nerve, or if the nerve be cut transversely, we find that sensation is totally destroyed in that part to which the nerve is distributed, because the brain is not in direct communication with it. "The brain, therefore, is the only organ that enables us to appreciate the objects which surround us ; the senses being its advanced guards, and the nerves its media of communication."

1. The senses receive impressions.
2. The nerves convey impressions to the brain.
3. The brain perceives and judges, according as they appear useful, agreeable, or hurtful.

In conclusion it appears, that, without the due functions of the brain, we should neither possess external sensation nor be competent to execute any voluntary movement ; consequently, it has been said with much truth, that *the nervous system is, in fact, all the animal* ;* the other systems being vegetative and automatic, and existing only to nourish and defend it. Besides the properties of sensation and volition, which are common to other animals, man is distinguished from them by that faculty, which he possesses from the Creator, of being able, by means of his nervous system, to compare, associate, and judge of the impressions which he does or has received, and to deduce from them the greatest consequences.

Possessing a faculty which constitutes the most beautiful and most noble attribute of our species, nature also ordained that its functions should correspond with the degree of perfection and extension of the cerebral mass. A deficiency in the general conformation of the brain, the slight development of some of its parts, and the evident or obscure alteration occurring in its structure, are so many causes capable of deranging the whole or part of the intellectual faculties of man.† Anatomists and physiologists have failed in the attempt to trace the precise differences between the organization of the idiot and another man ; though there is no doubt that the defect exists in the organization of the brain, since an idiot possesses a soul in common with another man.

* Baron CUVIER. † MANEC.

CEREBRAL DEPARTMENT OF THE NERVOUS SYSTEM.

THE BRAIN IN GENERAL.

The brain is that mass which fills the cavity of the skull. It is distinguished by its divisions into the cerebrum, the cerebellum, the pons VAROLII, and the medulla oblongata, all of which, in the adult, weigh about three pounds ; occasionally the brain is found to exceed this weight by several ounces, according to the size of the head. In the dimensions of the brain there is a great difference in different individuals. The volume is generally in proportion to the mental capacity. Let us not suppose, however, that every person having a large head is necessarily a person of superior intelligence, for there are many causes of an augmentation of the head besides the size of the brain.

The color of the brain varies in different individuals and at different ages ; the color probably depending on the quantity of blood sent to it : hence, it has a redder hue in early than in advanced life, and becomes still more deeply colored in consequence of inflammation.

The weight of the brain of a full-grown man is about three pounds ; that of a woman is somewhat less.

Baron WENZEL paid great attention to this department of anatomy, and has published a very interesting table, of which the subjoined is an extract.

Age.	Weight of whole brain.	Weight of brain only.	Weight of cerebellum.	Proportion of brain to cerebellum.
	Grains.	Grains.	Grains.	
Male embryo of 5 months	720	683	37	$18\frac{17}{73}$: 1
Female embryo of 8 "	4960	4610	350	$13\frac{6}{35}$: 1
Girl at birth . . .	5150	5700	450	$12\frac{2}{3}$: 1
Girl at 3 years old .	15240	13380	1860	$7\frac{6}{11}$: 1
Boy 3 years . . .	13050	11490	1560	$7\frac{57}{156}$: 1
Man 18 years . . .	20940	18474	2466	$7\frac{202}{411}$: 1
Man 31 years . . .	24120	21480	2700	$8\frac{1}{21}$: 1
Man 54 years . . .	20580	18060	2320	$7\frac{35}{81}$: 1
Man 63 years . . .	22500	19780	2720	$7\frac{37}{116}$: 1
Man 72 years . . .	22620	20200	2420	$8\frac{42}{121}$: 1
Man 80 years . . .	19080	16500	2580	$6\frac{51}{129}$: 1

Fig. 221.

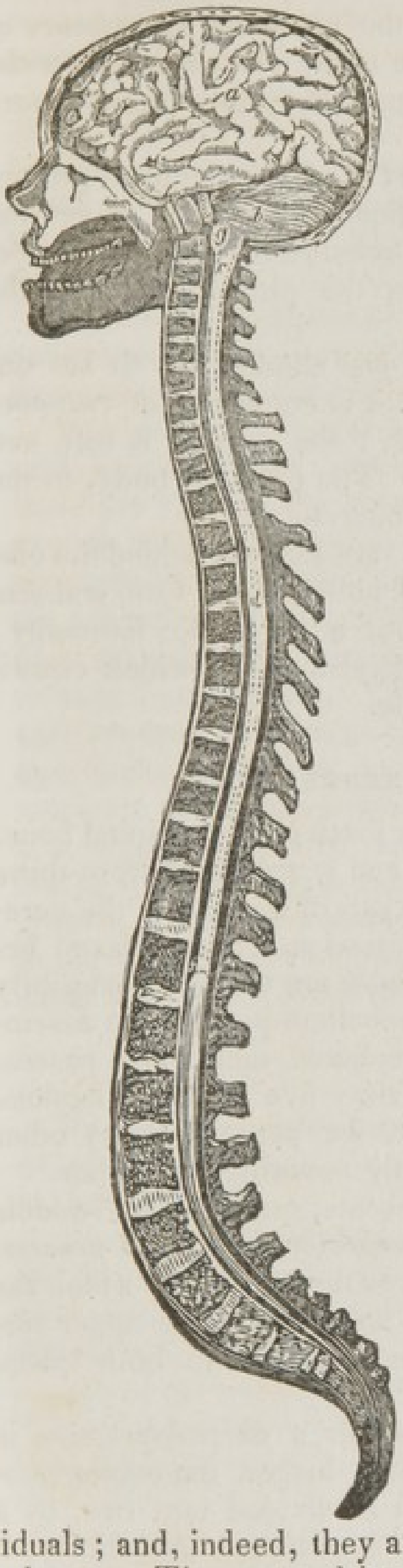


Fig. 221. The left side of the brain and spinal marrow, shown by making a section of the cranium, and the spinal column, and removing the dura mater.

a, the convolutions of the cerebrum.
b, the laminæ of the cerebellum.
e, the pons VAROLII.
g, the medulla oblongata.
c, *d*, *f*, the medulla spinalis, extending from the first cervical to the first lumbar vertebra, and terminating in the cauda equina.

The *cerebrum* is the largest portion of the brain, and occupies the whole upper cavity of the skull. It rests, anteriorly, upon the arches of the orbits; in the centre, upon the middle fossæ of the base of the skull; and posteriorly, upon the tentorium cerebelli.

THE EXTERIOR OF THE CEREBRUM.

The upper surface of the cerebrum is divided into two parts, termed *hemispheres*, which are separated by the falx cerebri.

The surface of the cerebrum in general, both above and below, is intersected by deep fissures and eminences, which produce numerous turnings and windings, termed *convolutions;* these take a variety of directions, and differ in extent in different parts of the brain.

The convolutions are smallest at the anterior part of the brain, larger posteriorly, and are largest at the superior and central part of the hemispheres, where each convolution is about half an inch in breadth.

The number and size of the convolutions vary exceedingly in different individuals; and, indeed, they are seldom found the same in the two hemispheres. They extend into the substance of the brain about an inch, and are lined by prolongations of the pia mater.

The lower surface of the brain is formed into three distinct regions, which are named *lobes*. The anterior lobes are separated by the termination of the grand division which separates the hemispheres. On each of these lobes we observe a deep rectilinear groove, directed from behind forwards, for lodging the trunk of the olfactory nerve.

The anterior and middle lobes are separated by the *fissura* SYLVII.

Between these interlobular fissures, is the union or *commissure of the optic nerves.* Behind this commissure is the *cineritious tubercle,* which forms the floor of the third ventricle, and contains in its centre a small white nucleus.

From the middle of this tubercle, a sort of slender conical prolongation, of a reddish color, descends obliquely forwards, named the *pituitary stem.** It passes under the commissure of the optic nerve, and terminates in a small body, situated in the pituitary fossa of the sphenoid bone.

The *pituitary body* † is the small organ just alluded to. It has not the vascular structure peculiar to glands, but is composed of two portions : the first is of a grayish yellow color ; the second is soft, and impregnated with a whitish viscid fluid. The pituitary body, in the adult, generally contains small calculous concretions.

The *corpora albicantia,* or mammalaria, are situated behind the cineritious tubercle ; they consist of two small bodies of the form and size of peas, which are white externally, and of a gray color internally ; they are united to each other by a small grayish band, which contributes to form the floor of the third ventricle.

THE EXTERIOR OF THE CEREBELLUM.

The *cerebellum* is situated in the inferior fossæ of the occipital bone, under the posterior lobes of the cerebrum, and is separated from those lobes by the tentorium. It is about a sixth part of the size of the cerebrum, and has been compared to two depressed spheroids, placed beside each other on a horizontal plane. These are divided posteriorly by the falx minor. The surface of the cerebellum presents an assemblage of gray laminæ, over which the arachnoid membrane passes. Each lobe commonly has from sixty to sixty-five of these laminæ. But, on separating these principal laminæ, we perceive many other smaller, concealed in the grooves, and partly covering each other.

The *upper surface of the cerebellum* presents, on its fore and middle part, an elongated eminence, termed the *superior vermiform process,* which is formed by the reciprocal crossing of the laminæ, of which the two lobes of this organ are composed. The whole of the upper surface is occupied by five fasciculated lobules, common to both lobes, and disposed in transverse arched bands.

The *lower surface of the cerebellum* presents a deep depression in the middle line, named the *valley,* in which is lodged the commencement of the spinal marrow ; posteriorly, it is divided into two, by a large eminence, called the *inferior vermiform process.* Anteriorly, it is terminated by a narrow rounded prolongation, named the *mammillary eminence* of the inferior vermiform process.

The inferior part of the cerebellum presents a convex surface, on which we may distinguish four lobules, which describe concentric

* Formerly denominated the infundibulum.

† Formerly denominated the pituitary gland.

arches. At the outer side of the first lobule is a small foliated tuft, distinguished by the smallness of its laminæ, named the *lobule of the par vagum.*

THE EXTERIOR OF THE PONS VAROLII.*

The *pons* VAROLII forms as it were the centre of the brain, and of which it weighs only the sixtieth part. It is placed between the cerebrum and cerebellum, and is formed by processes from them, termed their *crura.*

The *anterior surface of the pons* VAROLII is named, by GALL, the *commissure of the cerebellum.* Along the median line we observe a depression occasioned by the situation of the basilar artery.

The *posterior surface of the pons* VAROLII presents, on its upper part, four tubercles, which are white externally, and gray internally; these are termed the *tubercula quadragemina.* The two upper are named the *nates*, the two lower the *testes.* The pineal body corresponds to the point of intersection of the two grooves which separate the tubercles. Behind the tubercula quadragemina is a pulpy lamina, of a grayish color, which ascends towards the cerebellum, called the *valvula* VIEUSSENII. Behind the point where it leaves the pons VAROLII, we may observe an aperture, which is the posterior orifice of the *aqueduct of* SYLVIUS, by which the third and fourth ventricles communicate across the substance of the pons VAROLII. Farther down, is a slightly excavated surface, which forms the anterior part of the fourth ventricle. It is separated in its whole length by a narrow angular groove, which commences at the aqueduct of SYLVIUS, and terminates in the spinal marrow opposite the atlas. This group is called the *calamus scriptorius*, from its supposed resemblance to a pen.

THE MEDULLA OBLONGATA.

The *medulla oblongata* is that portion of the cerebral formation, which extends from the pons VAROLII, to the great foramen of the occipital bone.

Upon the surface of the medulla oblongata there are two small eminences, which run longitudinally, and contiguous to each other, and from their form have obtained the name of the *corpora pyramidalia.* Between these eminences there is a deep fissure, into which the blood-vessels of the pia mater penetrate, to supply the interior of the medulla.

On the outside of the former eminences are two others, which, having somewhat the figure of olives, they are termed the *corpora olivaria.*

* Tuber annulare, or nodus cerebri.

Fig. 222.

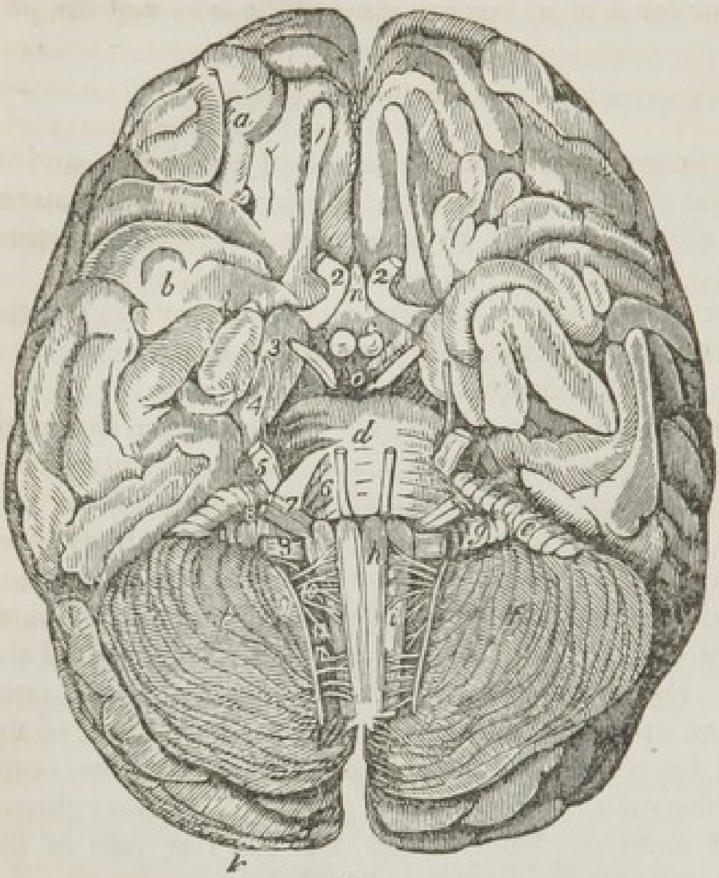


Fig. 222, the base of the brain.

a, the anterior lobes.

b, the middle lobes.

k, the posterior lobes.

n, the pituitary stem.

c, the corpora albicantia, or mammallaria.

d, the pons VAROLII.

h, *h*, the medulla oblongata. The letters are placed on the corpora pyramidalia.

f, the cerebellum.

i, *i*, the corpora olivaria.

e, the superior vermiform process.

g, the inferior vermiform process.

The *posterior surface* of the medulla oblongata is directly continuous with the pons VAROLII, and contributes to form the fourth ventricle. On each side of the upper and back part of the medulla oblongata, we observe two whitish oblong eminences, named the *corpora restiformia*, which contribute to the formation of the cerebellum.

THE MEDULLA SPINALIS.

The *medulla spinalis*, or *spinal marrow*, is a long, irregularly cylindrical cord, which extends within the vertebral canal, from the great occipital foramen to the second lumbar vertebra. Its weight is about one twentieth part of that of the brain.

The *anterior surface* of the medullary cord corresponds to the bodies of the vertebræ. A very deep and distinct fissure is extended its whole length, dividing it into two equal lateral portions. Its *posterior surface* is also divided by a similar median line, which commences between the two corpora restiformia. By this disposition, the spinal marrow is divided into a double cord, intimately connected in its total extent.

On the posterior and anterior surfaces of the body of the spinal cord, on each side, and at some distance from the median groove, are collateral depressed lines, in which we find the roots of the spinal nerves.

Finally, it presents a great number of small transverse grooves, particularly apparent from the last cervical to the ninth dorsal vertebra.

The exterior of the spinal cord consists of a layer of white substance, half a line thick, and after immersion in alcohol, this peels readily into longitudinal fibres, which are separable into filaments that continually branch, and thus attach themselves to those adjoining.

Upon making a *transverse section* of the spinal cord, a thin curved layer of gray matter is seen in each lateral half, the convex margin of which is inwards, and is joined to its fellow by a transverse layer.

THE INTERNAL ORGANIZATION OF THE BRAIN.

The brain is soft and pulpy ; but its density varies according to the age. In infancy it is extremely tender and yielding, and it acquires firmness as the person advances in life. Its specific gravity, in the adult, is 1310. The cerebral tissue is soluble in water, insoluble in alcohol and fixed oils.

CHEMICAL ANALYSIS OF THE BRAIN.

According to M. Vauquelin there is no difference of composition in the different parts of the nervous system : the analysis of the brain, of the cerebellum, of the spinal marrow, and the nerves, gives the same result. He found in them all the same matter, the composition of which is of

Water,	80.00	Phosphorus,	1.50
White fatty matter,	4.53	Sulphur and salts, such as	
Red fatty matter,	0.70	Phosphate of potass,	5.15
Ozmazome,	1.12	" of lime,	
Albumen,	7.00	" of Magnesia,	

The substance of the brain presents two distinct modifications.

1st. The *cortical* or *cineritious substance* covering the brain in general, about the sixth of an inch in thickness ; it also enters deep between its convolutions, and is distributed through different parts of its interior. This part of the brain, when examined with a microscope, appears to consist of minute molecules, smaller than the red particles of the blood. They are connected together by a transparent tissue, containing a serous fluid, and supplied with very minute and infinitely numerous blood-vessels.

2d. The *medullary* or *white substance* is firmer and denser than the former ; its mass is also much greater than that of the corticular substance, and is filled with a great quantity of vascular ramifications, which, on making a section of the brain, present so many red points with the blood oozing from them.

All the fasciculi of the medullary fibres placed in the medulla oblongata, appear to expand so as to form the mass of the brain ; and more especially to originate from the pyramidal and olivary eminences. The fibres of the former on the one side proceed to the opposite side, crossing each other, and progressively acquiring more volume as they ascend to form the cerebral mass.

These two substances of the brain do not constitute one homogeneous mass, but are arranged into a great variety of eminences, cavities, laminæ, partitions, etc. differing in their color, consistence and volume. I shall now proceed to demonstrate the brain in each of these particulars, not by attempting to unfold the structure in the manner of REIL and SPURZHEIM, but shall describe the several parts as they are exhibited in the recent and most familiar modes of dissection.*

The *corpus collosum* or *commissura magna*, is the centre of communication between the hemispheres: it is seen, without making an incision, by merely separating these hemispheres with the fingers. It consists of a large portion of medullary matter, which by transverse fibres, incorporates and unites the two lateral divisions of the cerebrum.

The *centrum ovale* is the appearance which is exhibited when the brain is cut horizontally, on the level of the corpus callosum; the corpus callosum constitutes the centre of the great medullary mass of the cerebrum, and the cortical substance, being on its edges, forms the central white mass into an irregular oval.

In the middle of the corpus callosum there is a longitudinal line called the *raphe*; it has a medullary cord on each side, from which numerous short transverse lines proceed, termed the *transverse medullary traces*.

Fig. 223.

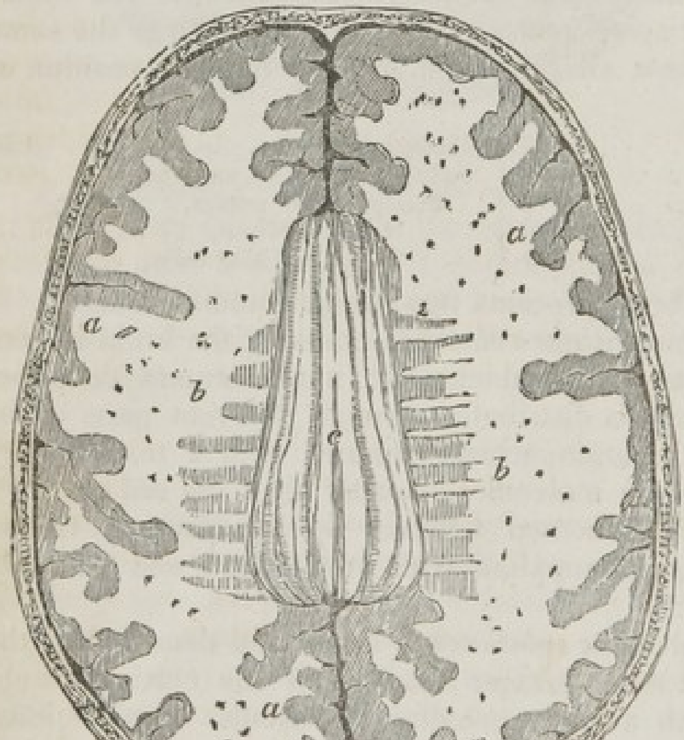


Fig. 223, a transverse section of the brain, upon a level with the corpus callosum.

a, *a*, *a*, the corticular part of the convolutions, with the fissures between them.

b, *b*, the medullary part, forming the centrum ovale of VIEUSSENS.

c, the raphe, on each side of which are longitudinal elevated lines, and transverse striæ.

In the substance of the brain we find four cavities, termed the *ventricles*.

There are two *lateral ventricles*, one is situated in the central part of each hemisphere. They are of an irregular form, lying under the centrum ovale, and each having three winding prolongations termed *cornua*. The anterior cornua are separated

* In order to examine the fibrous and lamelated structure of the brain, it must be immersed for a requisite time in alcohol.

from each other by a partition, called the *septum lucidum ;* the posterior cornua are at a considerable distance from each other, but as they curve inwardly and dip into the middle lobes of the brain, they approach nearer at their pointed extremities. The cavities of these ventricles are principally situated between the corpus callosum and the corpora striata, and thalami nervorum opticorum.

Fig. 224.

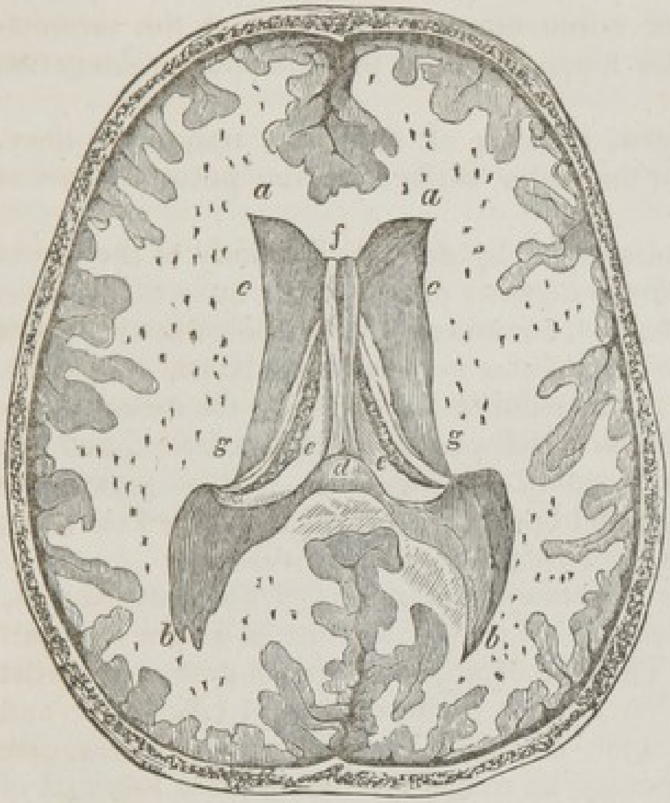


Fig. 224, a horizontal section of the cerebrum, a little deeper than in Fig. 223.

a. a, the anterior cornua of the lateral ventricles.

b, *b*, the posterior cornua.

c, *c*, the corpora striata.

e, *e*, the optic thalami.

f, *d*, the septum lucidum, showing the fissure termed the fifth ventricle, and extending between the two letters,—

g, *g*, the choroid plexus.

The lateral ventricles communicate with each other, and with the third ventricle by an opening, named the *foramen* MONROIANUM, under the arch of the fornix.

The *septum lucidum*, or septum of the ventricles, is a soft and thin medullary production, which is continuous above with the middle part of the inferior surface of the corpus callosum ; inferiorly, it is connected with the fornix, and forms a distinct partition between the lateral ventricles. It is composed of two laminæ with a narrow cavity between them, which has been considered by CUVIER as a *fifth ventricle*.

PARTS OBSERVED IN THE LATERAL VENTRICLES.

The *fornix* is a flat triangular medullary body, having its upper surface contiguous to the corpus callosum, and supporting the septum lucidum. Its lower surface is situated upon the choroid plexus and optic thalami ; one of the angles is forward and the other two are towards the back part ; and the foramen of MONRO is under the most anterior part.

The posterior angles of the fornix have a bifurcated prolongation ; one of the branches of which is short, and loses itself in the white layer of the cornua ammonis. The other, which is long, is named the *corpus fimbriatum ;* it is flattened, and extends into the lowest part of the lateral ventricle.

The *corpora fimbriata*, or *tænia hippocampi*, are the plaiting of the margin of the processes of the fornix, which pass into the inferior cornua of the ventricles.

The *pes hippocampi*, or cornu ammonis, is found at the termination of the line called tænia hippocampi, at the posterior prolongation of the fornix.

The *psalterium*, or *lyra*, consists of numerous transverse lines, which are impressed upon the under surface of the posterior part of the body of the fornix.

The *choroid plexus* is displayed by dividing the body of the fornix and inverting it. This plexus consists of a spongy mass of tortuous vessels and reddish granulations, covering the optic thalami and corpora striata, and continued into the inferior cornua of the lateral ventricles. The plexus of each side is connected to its fellow by the *velum interpositum*, a vascular membrane which passes under the fornix, and lies on the third ventricle and corpora quadrigemina. The plexus returns its blood by two parallel branches, termed the venæ GALENI ; these veins run backwards, and enter the sinus rectus.

The *corpora striata* are two smooth cineritious pyriform eminences, broad before and contracted behind ; they are situated in the fore part of the lateral ventricle. Their color at the outside is gray, somewhat tinged with brown ; but on cutting them obliquely, cineritious and medullary substances are seen disposed in their interior, in alternate streaks. The white fibres may be traced to the original fasciculi of the corpora olivaria.

The *optic thalami* are two oval medullary eminences, placed by the side of each other, between the diverging extremities of the corpora striata ; their upper surface forms a part of the floor of the ventricles ; their lower surface presents, externally, two prominences. The *corpora geniculata*, which furnish several filaments to the optic nerve, may be seen at the inferior surface of the cerebrum.

The *commissura mollis* is a band of gray color, connecting the convex surfaces of the optic thalami.

The *tænia semicircularis* is a line of white semitransparent substance, running between the convex surface of the optic thalami and the corpora striata.

Fig. 225.

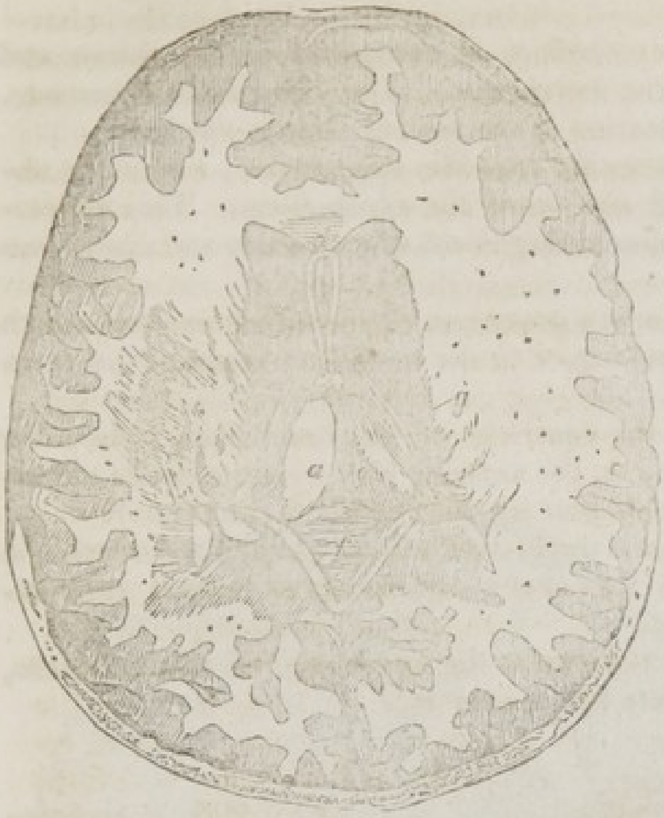


Fig. 225, *a*, *a*, the optic thalami, on the outer margin of which is seen the tænia semicircularis.

e, *e*, the corpora striata.

d, the cavity (termed the fifth ventricle) which exists between the two laminæ of the septum lucidum.

c, the anterior pillars of the fornix cut off at their base.

b, the fornix turned back, showing on its inferior surface —

f, the lyra.

g, the tænia semicircularis, or white line separating the surface of the corpora striata and the thalami.

The *commissura anterior cerebri* is a short cylindrical medullary cord, extending transversely between the corpora striata, immediately under the anterior prolongations of the fornix.

The *vulva* is a small aperture formed by the anterior prolongations of the fornix, bifurcating and adhering on each side, between the corpus striatum, and the thalamus nervi optici. This aperture is the part by which the three ventricles communicate.

The *third ventricle* is situated between the optic thalami and the crura cerebri; it is a deep fissure. At the upper and fore part it communicates with the lateral ventricles, and, at the lower part, with the infundibulum. The latter opening is called *iter ad infundibulum*. A canal extends backwards under the tubercula quadrigemina, into the fourth ventricle. This passage is called the *aqueduct of* SYLVIUS.

The *anus*, or *foramen commune posterius*, is situated behind the commissure of the optic thalami, and is the anterior aperture of the aqueduct of SYLVIUS.

The *commissura posterior* is a transverse cord at the posterior part of the third ventricle.

The *pineal gland* is situated beneath and behind the fornix, and above the tubercula quadrigemina; it is a small grayish body of the size of a pea; it is perfectly isolated from the cerebral substance, excepting at the fore part, where it is connected to the optic thalami by two medullary cords, — the *peduncles of the pineal gland*. In the adult it contains little calculi, very hard and resembling grains of coarse sand.

THE INTERNAL STRUCTURE OF THE CEREBELLUM.

The substance of the cerebellum is composed of cineritious and medullary matter, as in the cerebrum. The cineritious, however, bears a much greater proportion in the former than in the latter.

The *arbor vitæ* is a beautiful tree-like appearance, which we observe on making a vertical section of the cerebellum. This appearance is formed by the peculiar arrangement of medullary and cineritious matter.

The *corpora restiformia* are processes of medullary matter, which extend from the medulla oblongata to the medullary crura of the cerebellum.

The *fourth ventricle* is the ventricle of the cerebellum; the sides of this cavity are formed by it, the anterior part by the medulla oblongata, and the upper and back part by the valvula VIEUSSENII.

The *calamus scriptorius* is the groove and its pointed termination in the fourth ventricle, which VESALIUS conceived to have a great resemblance to a writing pen.

The aqueduct of SYLVIUS enters the upper part of this ventricle, and the valvula VIEUSSENII hangs over it.

Fig. 226.

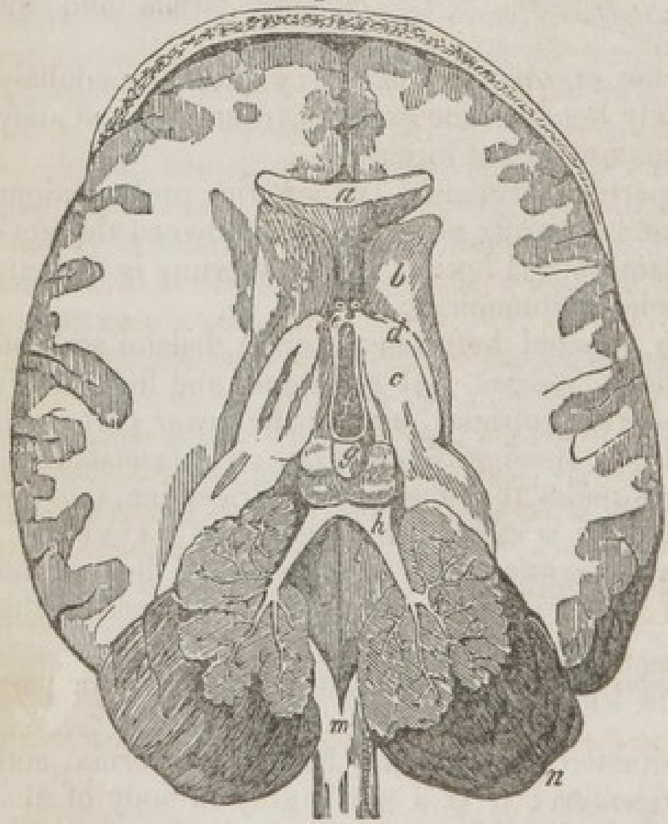


Fig. 226, a horizontal section of the cerebrum and an oblique division of the cerebellum.

a, the anterior part of the corpus callosum.

b, the corpus striatum.

c, the optic thalamus.

d, the tænia semicircularis.

e, the anterior pillars of the fornix cut off at their base.

f, the commissure of the optic thalami.

g, the pineal gland, situated on the four eminences, termed the corpora quadrigemina.

h, valvula VIEUSSENII.

k, the arbor vitæ, shown by an oblique section of, *n*, the cerebellum.

l, the fourth ventricle, terminating in, —

m, the calamus scriptorius.

n, the cerebellum.

The arteries of the cerebrum and cerebellum are branches of the internal carotid and vertebral arteries, from the latter of which arises the basilar artery ; ramifications of these vessels communicate with each other, and form, what is termed, the *arterial circle of* WILLIS.

The spinal marrow receives its arteries from the vertebral, dorsal, lumbar, and sacral arteries.

The veins of the brain are very delicate in their structure ; they communicate with the sinuses of the dura mater, and the sinuses pour their contents into the internal jugular veins.

The veins of the spinal marrow terminate in the vertebral, dorsal, lumbar, and sacral veins.

No lymphatic vessels have yet been discovered in the brain.

Fig. 227.

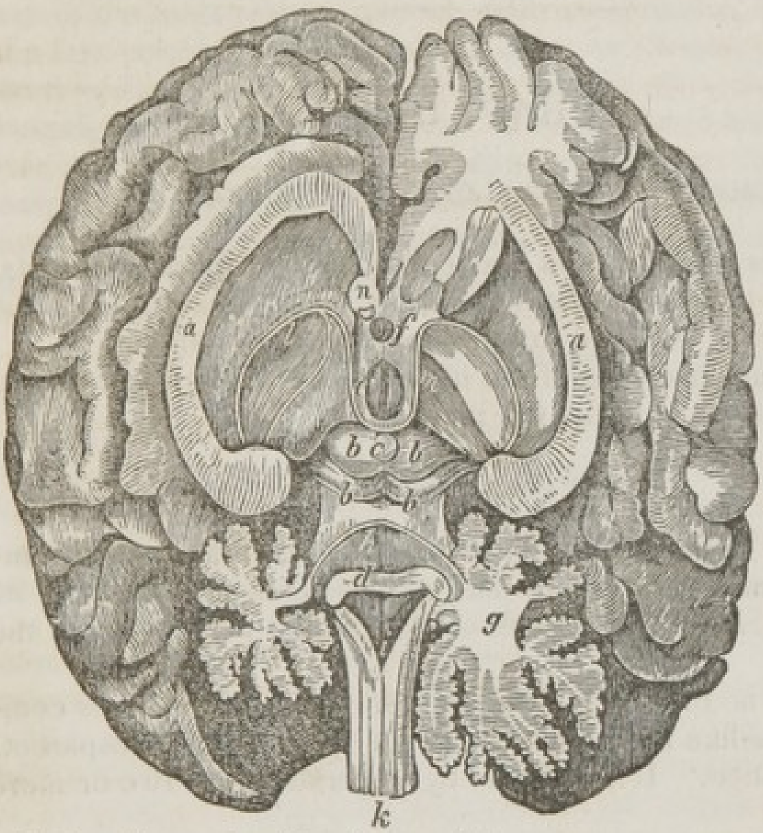


Fig. 227, exhibits the brain placed on its base, with a vertical incision made through the corpus callosum, as far as the anterior commissure, and continued posteriorly to the tubercula quadrigemina. The hemispheres are separated from each other and turned to each side. The septum lucidum and fornix are removed. The cerebellum, in a similar manner, is divided as far as the fourth ventricle.

a, *a*, the cut edges of the corpus callosum.

b, *b*, *b*, *b*, the tubercula quadrigemina.

c, the pineal gland.

d, medullary striæ in the fourth ventricle, which form the beginnings of the auditory nerves.

e, the third ventricle.

f, part of the pituitary stem.

g, the medullary portion of the cerebellum.

h, the fourth ventricle.

i, the calamus scriptorius, at the inferior part of the fourth ventricle.

k, the medulla spinalis.

l, the tænia semicircularis.

m, the peduncle of the pineal gland.

n, a section of the anterior commissure of the brain.

The brain is the primary organ of sensation; the mind is supposed to be most immediately and intimately connected with it, and, from observations and experiments, it is found to communicate nervous influence to all the other parts of the body. That the brain is the organ of the mind, is evident by the connexion between the brain and the organs of sense, by our consciousness, and by the mental disturbance which ensues under disease of the brain. In asserting, however, that the brain is the organ or instrument of the mind, it is not intended to convey an idea that the mind is material, but that the exercise of the mental powers depend on the living brain.

CHAP. II.

THE MEMBRANOUS ENVELOPES OF THE BRAIN.

The membranes of the brain are called *matres* by the ancients, from a notion that they gave origin to all the other membranes of the body: no argument is required to refute so absurd an opinion.

The membranous envelopes of the brain consist of the *dura mater*, the *tunica arachnoidea*, and the *pia mater*.

1. THE DURA MATER.

The *dura mater* is the outermost envelope of the brain; it is common to that organ and to the skull, that is, it incloses the brain and its appendages, and performs the office of an internal periosteum to the cranium.

This membrane is of a very firm and compact texture; it is composed of tendinous-like fibres, which have a glossy, semitransparent, and pearly appearance. It is divisible by maceration into two or more fibrous layers.

The *outer surface* of the dura mater adheres rather loosely to the bones of the skull, and is easily detached from them; but at the sutures and foramina it is more firmly connected than elsewhere.

The *inner surface* of the dura mater is remarkably smooth, and forms several folds, which are named the *falx cerebri*, the *tentorium cerebelli*, and the *falx cerebelli*.

The *falx cerebri* is a duplicature or process of the dura mater, and has some resemblance in shape to the blade of a sickle, from which circumstance it has obtained the name of falx. It separates the two hemispheres of the brain from each other. Its upper edge, which is extended from the frontal ridge to the middle groove of the occipital bone, lodges the superior longitudinal sinus. Its lower edge passes over the corpus callosum, and contains the inferior longitudinal sinus.

Its anterior extremity is attached to the crista galli; the posterior is continued into the tentorium, and contains the straight sinus.

The *tentorium cerebelli* is a membranous partition which separates the cerebrum from the cerebellum. Like the falx cerebri, it is in a continual state of tension. Its outer circumference contains the lateral sinus, and is connected to the edges of the lateral groove of the occipital bone. The inner edge corresponds to the cerebral protuberances. The extremities of the tentorium meet at an acute angle, and cross over each other, like the letter X, to be attached to the clinoid processes of the sphenoid bone.

The *falx cerebelli* is a process of the dura mater, which is placed between the lobes of the cerebellum, and is extended from the internal occipital protuberance to the great occipital foramen.

The dura mater is evidently fibrous, and its fibres are very apparent in the folds just mentioned, and, in particular, at the upper part of the falx cerebri. Some minute nervous filaments have been discovered in the course of the arteries of the dura mater. The blood-vessels are not very numerous. The principal branches of the arteries are distributed upon the external surface; minute ramifications only being observed on its inner surface. The smaller veins of this membrane accompany the arteries, the larger veins constitute the sinuses which I am about to describe.

SINUSES OF THE DURA MATER.

The sinuses of the dura mater are merely the large veins of the brain, which are received into triangular canals of the dura mater; they vary in their dimensions, and are disposed in a regular symmetrical manner. They are formed externally by the dura mater, and internally by a smooth membrane, similar to that which is met with in the veins. As they are constantly stretched in all points of their extent, they can neither change their situation nor contract upon themselves. They are remarkable for having at intervals fibrous bridles, which pass irregularly from side to side of the canal. All the veins of the dura mater and of the brain pour their blood into the sinuses.

Fig. 228.

Fig. 228, *a*, a transverse section of the superior longitudinal sinus.

b, a similar section of the inferior longitudinal sinus.

c, a portion of the cranium.

The *superior longitudinal sinus* is a long triangular canal, which, commencing at the crista galli of the ethmoid bone, and extending along the upper edge of the falx cerebri, becomes gradually larger in its progress, and terminates in the lateral sinuses.

The *inferior longitudinal sinus* is much smaller than the preceding, and is situated at the inferior margin of the falx, extending from its anterior third to the tentorium cerebelli, terminating posteriorly by two branches in the straight sinus.

The *torcular* HEROPHILI* is an irregular cavity situated at the union of the three great folds of the dura mater ; it presents six apertures, viz.: 1st, that of the superior longitudinal sinus ; 2d, two inferior, corresponding to the occipital sinuses ; 3d, one anterior belonging to the straight sinus ; 4th, two lateral openings on the right and left leading into the lateral sinuses.

The *straight sinus* is situated at the base of the falx ; it is a continuation of the vena GALENI, and extends from the termination of the inferior longitudinal sinus to the torcular HEROPHILI.

The *occipital sinuses* are situated on the sides of the occipital foramen, and passing into the falx cerebelli, open into the torcular HEROPHILI.

The *lateral sinuses* are very large, and extend from the torcular HEROPHILI to the commencement of the jugular veins, occupying the lateral grooves of the occipital bone, as far as the foramen lacerum posterius.

The *coronary sinus* surrounds the pituitary fossa ; it is very small in its whole course, and opens to the right and left into the cavernous sinuses.

The *cavernous sinuses* are very broad and short ; they are situated in the lateral grooves of the sphenoid bone. They commence beneath the anterior clinoid processes, and terminate in the inferior petrous sinuses. The outer parietes of this sinus contain, in their substance, the common motor, the pathetic, and ophthalmic nerves. The cavity of the cavernous sinus is occupied by a number of reticulated filaments; the internal carotid artery, and the external motor nerve of the eye.

Beneath the pituitary body the two cavernous sinuses communicate by the *sinus transversalis sellæ turcicæ*.

The *superior petrous sinuses* extend from the termination of the preceding sinuses, towards the summit of the petrous portion of the temporal bone, and open into the lateral sinuses.

The *inferior petrous sinuses* extend from the cavernous sinuses, to the inferior edge of the petrous and basilary processes, and terminate in the lateral sinuses.

The *anterior occipital sinus* forms a communication between the two petrous sinuses and the cavernous sinus, by extending transversely, at the upper part of the basilary process.

* The term *torcular* was originally applied, from a supposition that the blood is squeezed in this sinus as in a wine press.

Fig. 229.

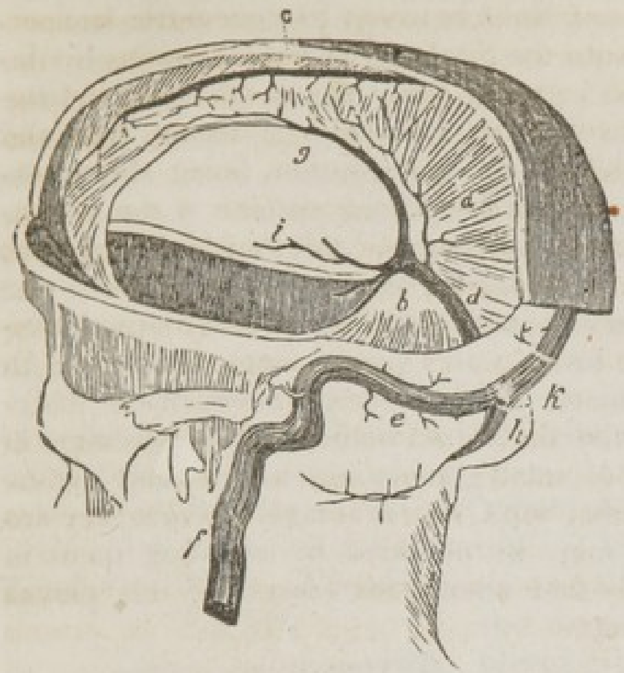


Fig. 229. A lateral view of the veins of the processes of the dura mater, termed the sinuses.

a, the falx.
b, the tentorium cerebelli.
c, the superior longitudinal sinus.
d, the straight sinus.
e, the lateral sinus.
f, the internal jugular vein.
g, the inferior longitudinal sinus.
h, the occipital sinus.
i, the vena GALENI.
k, the torcular HEROPHILI.

2. THE ARACHNOID MEMBRANE.

The *arachnoid membrane* is situated between the dura mater and pia mater ; it has been named arachnoid, from its extreme thinness, resembling a spider's web ; it is extended over the convolutions of the cerebrum, the cerebellum, and the base of the pons VAROLII.

The *exterior arachnoid membrane* does not adhere to the other membranes of the brain, for it can be very easily raised by insufflation with a blow pipe ; it possesses no apparent vascularity, but is constantly moistened with a serous fluid, and forms a sheath or envelope for all the nerves and all the vessels which enter or issue from the skull. This membrane also passes downwards into the vertebral canal, around the spinal marrow, and furnishes a conical sheath for each of the vertebral nerves.

The *interior arachnoid membrane* is continuous with the preceding ; penetrating into the third ventricle by a small oval opening, found between the corpus callosum and tubercula quadrigemina, and lining the third ventricle, and extending over the choroid plexus, it is continued over the parietes of the lateral and fourth ventricles, into which it passes through the aqueduct of SYLVIUS.

3. THE PIA MATER.

The *pia mater* is the third membrane of the brain ; it is a cellular, loose, transparent web, in which a multitude of blood-vessels, more or less delicate, cross each other in a thousand different directions, and it is attached to the surface of the brain by the minute branches of these vessels, which penetrate into the latter organ. It invests the brain on all sides, dipping into the convolutions of the hemispheres, and covering the superior surface of the corpus callosum ; covering inferiorly the base of the brain and the pons VAROLII ; it is also reflected over the cerebellum, and sinks between its concentric laminæ.

The pia mater penetrates into the third and lateral ventricles by the great fissure, which is situated between the corpus callosum and the pons VAROLII, and by the two lateral fissures. It forms, 1st, the *choroid web*, a triangular membranous prolongation, lining the posterior part of the corpus callosum, and the inferior surface of the fornix, to which it adheres by numerous small vessels. 2d, the *choroid plexus*, an elongated fold of the pia mater, having an appearance of vascular cords, attached to the choroid web, and extending into the lateral ventricles, along the sides of the fornix ; this plexus communicates with that part of the external pia mater which descends between the thalami of the optic nerves and the fimbriated bodies. We perceive in the choroid plexus a number of small granulations which many anatomists have considered as glands ; but CHAUSSIER asserts that they are membranous fringes, which may be unfolded by agitating them in water. We also occasionally find among the vessels of this plexus small vesicles filled with serum.

GRANULATIONS OF THE MEMBRANES OF THE BRAIN.

On the various parts of the dura and pia mater, there are small whitish bodies, of the intimate texture and office of which we are entirely ignorant.

The superior longitudinal sinus contains a great number of these granulations ; they are designated by the name of the *glands of* PACCHIONI.

Sometimes a few of them are found in the torcular HEROPHILI, and at the orifices of the venæ GALENI. All the other sinuses are destitute of them.

Graniform bodies, similar to those met with in the sinuses, are also found in the pia mater, especially about the outside of the superior longitudinal sinus, and around the cerebral veins.

The internal pia mater contains some of these granulations ; they are also observed in the choroid plexus, the velum interpositum, and in the web of the fourth ventricle.

THE PROPER MEMBRANE OF THE SPINAL MARROW.

The character of this membrane is sufficiently marked to distinguish it from the pia mater. It is not, therefore, a continuation of the latter, but a strong and somewhat fibrous tissue, of a yellowish color, corresponding, by its external surface, to the arachnoid, without uniting with it ; laterally it is continuous with the neurilemma of the vertebral nerves, and ligamentum denticulatum. By its internal surface it is adherent to the spinal marrow.

LIGAMENTUM DENTICULATUM.

The *ligamentum denticulatum* is a whitish, transparent, thin, but strong band, extending, on each side, between the anterior and posterior roots of the vertebral nerves, from the occipital foramen, to the termination of the spinal marrow. In the interval of each cervical and dorsal pair of nerves, its external border presents twenty or twenty-two denticulated portions, the points of which are fixed to the dura mater. Its internal border adheres to the proper membrane of the spinal marrow. Its use appears to be to keep the spinal marrow steady in its canal.

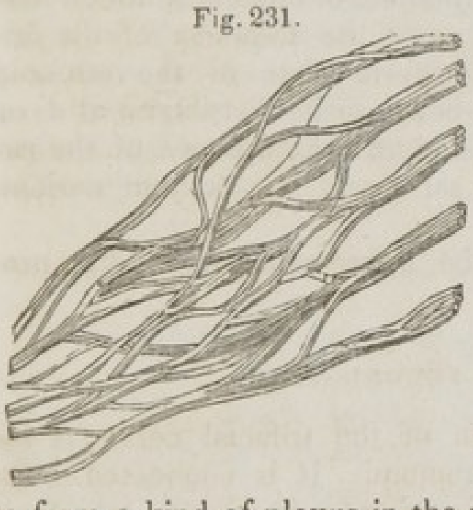
THE NERVES IN GENERAL.

The nerves are either cylindrical or flattened white cords, which are extended from the brain, or from the spinal marrow, to every part of the system.

All the nerves are arranged symmetrically and in pairs, and are composed of a greater or less number of filaments, connected together by cellular tissue. The filaments which terminate the branches of the nerves unite with other nervous filaments, or elude our observation in the tissue of the organs which they supply. Fig. 230, a portion of a nerve invested with its neurilemma, and consisting of distinct filaments, one of which is drawn out.

Fig. 230.

Fig. 231.



If two or more nervous branches are connected together by numerous filaments sent to each other, so that there results a sort of net-work, the name of *plexus* is given to this distribution. Fig. 231, is an instance drawn from the *axillary plexus*.

Most of the nerves are composed of a greater or less number of cords, formed of filaments of the same nature. On separating these cords and fibres, we perceive that they send frequent branches to each other, so as to form a kind of plexus in the very substance of the nerve.

The *neurilemma* is the external membrane which forms a canal for the white medullary matter of the nerve ; this may be readily shown by immersing a nerve in an alkaline solution, by which the medullary matter is removed ; and the nerve appears like a fasciculus of tubes. The olfactory nerve has no neurilemma, and it is only found round the optic nerve after its commissure.

The nerves are amply supplied with blood-vessels, which are distributed on their surface, and penetrate into their substance, and between their component fasciculi.

In some of the principal nerves absorbent vessels may be traced, and reasoning from analogy, we may conclude that there are no nerves destitute of them.

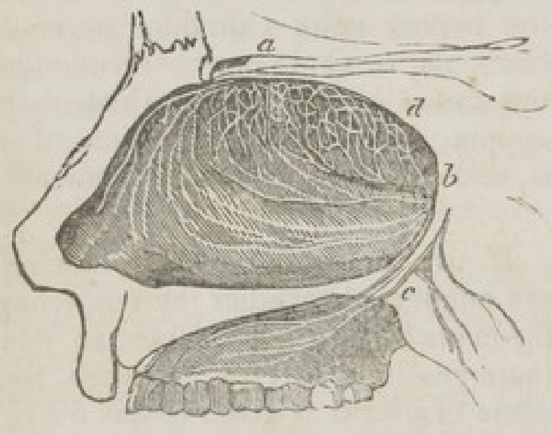
NERVES OF THE CEREBRAL DEPARTMENT.

By the older anatomists, the cerebral nerves were divided into nine pairs; the facial and auditory nerves being termed the seventh pair, and the eighth consisting of the glosso-pharyngæal, par vagum, and the spinal accessory. The division at present adopted, is into twelve pairs.

OLFACTORY NERVES, OR FIRST PAIR.

The *olfactory nerves* are very soft in their texture, and after death are soon decomposed; they should, therefore, be demonstrated in a recent subject. They are connected to the brain by three filaments; the 1st, is external and medullary, and is in union with the corpus striatum; the 2d, internal and medullary, is united to the white substance which occupies the internal part of the fissure of SYLVIUS; the third is cortical, and is situated at the point of junction of the two preceding, uniting to them by its summit. At the point of their union, the olfactory nerve presents a triangular enlargement. Fig. 232, *a*, extending horizontally forwards and inwards, and dividing into a greater or less number of branches, which traverse the foramina of the cribriform plate of the ethmoid bone, to be distributed at *d*, on the turbinated bones of the nasal fossa, the septum narium, and the roof of the nasal fossa.

Fig. 232.



This nerve transmits to the brain the impression which odors produce upon the pituitary membrane.

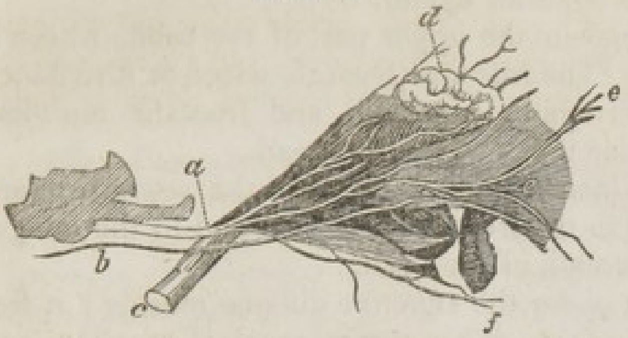
OPTIC NERVES, OR SECOND PAIR.

The *optic nerve*, with the exception of the trifacial nerve, is the largest nerve that issues from the cranium. It is connected to the optic thalami and the tubercula quadrigemina by two bands, which are extended from these eminences to the optic thalami. The two nerves unite in front of the pituitary fossa, and are so confounded with each other, as to render it impossible to affirm, in a positive manner, whether they cross each other, as many anatomists have supposed, or whether their substance is mingled and identified at their union; the latter opinion is most probable.

The optic nerves afterwards separate; each nerve being perfectly cylindrical, isolated, and enveloped in a neurilemma; it then passes through the optic foramen, and, surrounded by the recti muscles in the orbit, arrives at the posterior and inner part of the globe of the eye; entering the sclerotic and choroid membranes, it terminates in the retina.

THIRD PAIR OF NERVES.

Fig. 233.



The *third pair*, or *motores oculorum*, Fig. 233, *a*, are smaller than, *c*, the optic nerve ; each nerve is attached to the back part of the crura cerebri, by filaments which are soon collected into their several trunks. These pass on the upper part of the cavernous sinus, on the outside of the foramen lacerum, into the orbit, and divide into the following branches : 1st, the *superior branch*, *e*, *e*, which is distributed to the superior rectus and levator palpebræ ; 2d, the *inferior branch*, *f*, which supplies the other recti muscles ; 3d, a filament to the lenticular ganglion, and inferior oblique muscle.

FOURTH PAIR OF NERVES.

The *fourth pair of nerves*, or *nervi pathetici*, *b*, are the most slender of the body. Each nerve is attached by three or four filaments, beneath the tubercula quadrigemina, and the lateral part of the valve of Vieussens. This nerve turns round the crus cerebri, perforates the dura mater at the edge of the tentorium, passes the cavernous sinus on the outer side of the third nerve, and proceeds through the foramen lacerum, to supply the superior oblique muscle of the eye.

FIFTH PAIR, OR TRIFACIAL NERVES.

The *trifacial nerves* are the largest of the brain ; they are attached, first, between the corpora olivaria and restiformia by a fasciculus of white fibres, which ascend above the posterior part of the pons Varolii, at the outer edge of which they leave the brain ; each forms a large flat cord, composed of two distinct fasciculi ; the one anterior, consisting of five or six filaments ; the other, which is posterior, forms a grayish enlargement, termed the *Gasserian ganglion*, from the anterior part of which proceed three branches ; viz., the *ophthalmic*, the *superior maxillary*, and the *inferior maxillary*.

I. THE OPHTHALMIC, OR FIRST BRANCH OF THE FIFTH PAIR OF NERVES.

The *ophthalmic nerve* passes the external part of the cavernous sinus, receiving a filament from the superior cervical ganglion, and, passing through the foramen lacerum orbitale, divides into the *lachrymal*, the *frontal*, and the *nasal* nerves.

The *lachrymal nerve* proceeds along the external part of the orbit, gives off the spheno-maxillary branch, which unites with a branch of the superior maxillary nerve ; and the molar branch, which unites with a branch of the facial nerve ; it furnishes also several branches to the lachrymal gland, and to the superior eyelid.

The *frontal nerve* is found in the upper part of the orbit, where it divides into two filaments. The *internal frontal*, which is distributed to the frontal sinus, the corrugator supercilii, and frontalis muscles, and the subcutaneous cellular tissue of the forehead.

The *external frontal filament* passes through the supra orbitary foramen, and is distributed to the frontalis muscles, and to the integuments extending over the summit of the head.

The *nasal nerve* passes under the superior oblique muscle ; it frequently receives a filament from the superior cervical ganglion, and furnishes a very delicate filament to the lenticular ganglion, and also, two or three *ciliary filaments :* it at length divides into two branches; the *internal nasal*, which reënters the cranium by the anterior internal orbitary foramen, and from thence again passes down through one of the perforations of the cribriform plate of the ethmoid bone, to be distributed to the septum narium and the nasal fossæ. The *external branch* passes out of the orbit, beneath the pulley of the superior oblique muscle, and is distributed to the lachrymal passages and dorsum of the nose.

2. THE SUPERIOR MAXILLARY NERVE, OR SECOND BRANCH OF THE FIFTH PAIR.

The *superior maxillary nerve* is extended from the ganglion of the fifth pair ; it enters through the foramen rotundum of the sphenoid bone into the spheno-maxillary fossa, where it receives filaments from the spheno-palatine ganglion ; it then passes through the infra-orbitar canal, and terminates on the cheek. It furnishes, 1st, the *orbital branch*, which passes into the orbit by the spheno-maxillary fissure, and there divides into the *molar* and *temporal filaments*. 2d. The *posterior* and *superior dental branches*, which enter the passages in the maxillary tuberosity, and, dividing into many filaments, are distributed to the roots of the three last molar teeth, and to the gums. 3d. The *anterior dental branch*, which descends into the anterior dental canal, and divides into filaments, which are distributed to the incisor, the canine, and the two small molar teeth. 4th. The *infra-orbitar branches*, which form the termination of the superior maxillary nerve ; these pass out by the infra-orbitar foramen, and uniting with filaments from the facial, nasal, and buccal branches, are distributed to the muscles and integuments of the cheek.

3. THE INFERIOR MAXILLARY NERVE, OR THIRD BRANCH OF THE FIFTH PAIR.

The *inferior maxillary nerve* passes through the foramen ovale of the sphenoid bone, and is distributed to the lower jaw, and the muscles situated between it and the os hyoides ; it furnishes the following branches, viz.—

1st. *Two deep temporal nerves*, which are distributed to the inner part of the temporal muscle.

2d. The *masseteric nerves*, which are distributed to the articulation of the jaw and the masseter muscle.

3d. The *buccal nerve*, which passes between the pterygoid muscles, and divides into six or seven filaments which are distributed to the temporal, buccinator, and levator anguli oris muscles, to the angle of the mouth, and finally to the integuments.

4th. The *pterygoid nerves*, two very delicate filaments which are directed downwards, and terminate in the internal pterygoid muscles.

5th. The *lingual* or *gustatory nerve*, of considerable size, and which receives the filament called the *corda tympani*, which extends from the spheno-palatine ganglion. The lingual nerve afterwards descends between the pterygoidei muscles, and furnishes in its passage a filament to the internal pterygoid muscle ; several to the tonsils and to the superior constrictor of the pharynx ; two or three to the back part of the gums, and to the submaxillary gland ; several filaments are distributed to the sublingual gland, and to the mucous membrane of the mouth ; lastly, it divides into numerous filaments which penetrate the muscular tissue of the tongue, and ascending towards the superior surface terminate in the numerous papillæ ; in consequence of which, this branch is considered as the principal nerve of the organ of taste.

6th. The *inferior dental nerve*, which enters the dental canal, and is divided into branches which are distributed to the teeth and to the cancelli of the bone : some filaments, named the *mental nerves*, pass out of the anterior maxillary foramen, and are distributed to the lower lip and chin.

The *auricular* or *superficial temporal nerve*, proceeds backwards and outwards between the condyle of the jaw and the auditory canal ; it communicates with the facial nerve, giving off branches to the temporo-maxillary articulation, and to the pavilion and integuments of the ear ; it is ultimately distributed to the integuments of the temples and forehead.

Fig. 234.

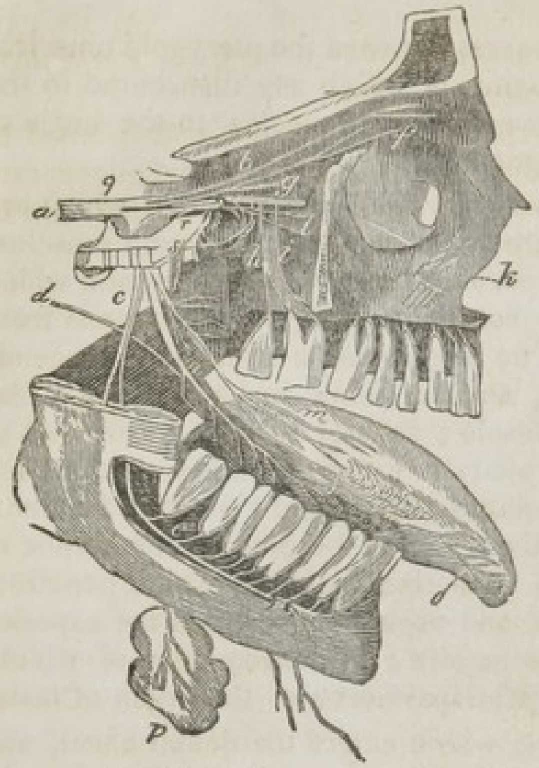


Fig. 234, exhibits the trifacial nerve and the distribution of its three principal branches.

a, the trunk of the trifacial nerve.

q, the Gasserian ganglion.

b, the frontal.

f, the lachrymal.

g, the nasal nerves of the ophthalmic branch.

r, the superior maxillary branch.

l, the malar.

i, the anterior dental.

h, the posterior dental.

k, the infra orbitar nerves.

c, the inferior maxillary branch.

s, the two deep temporal.

t, the masseteric.

n, *o*, the lingual.

e, the inferior dental.

p, the sublingual nerves.

SIXTH PAIR OF NERVES.

The *sixth pair of nerves* are very small; they are attached to the sides of the corpora pyramidalia, each proceeds to the line which separates the pons Varolii from the medulla oblongata; here the filaments unite and proceed along the basilar groove through the cavernous sinus, pass through the foramen lacerum orbitale, and are distributed to the external rectus muscle of the eye.

While in the cavernous sinus, the sixth nerve is placed between the ophthalmic nerve and the carotid artery, upon the surface of the latter of which, two or three filaments are extended to the great sympathetic nerve.

SEVENTH PAIR OF NERVES, OR FACIAL NERVES.

The *facial nerve* is the *portio dura* of the old anatomists; it appears beneath the posterior and external part of the pons Varolii, from the line between the corpora olivaria and restiformia; it enters the internal auditory foramen with the acoustic nerve, then leaves the latter to proceed into the acqueduct of Fallopius, passing out of the cranium by the stylo-mastoid foramen. On a level with the hiatus Fallopii, it receives a filament of the Vidian nerve, which enters the cavity of the tympanum, under the name of *corda tympani*.

The facial nerve also furnishes filaments to the muscles of the tympanum, the pavilion, and the integuments of the ear. On its exit from the stylo-mastoid foramen, it gives off the *posterior auricular*, the *stylo-hyoid*, and the *sub-mastoid branches*.

The facial nerve then enters the parotid gland, and is distributed to the muscles and the integuments of the face. These branches separate and reunite at different places, so as to form a plexus on the side of the face, which has been called the *pes anserinus*.

Fig. 235.

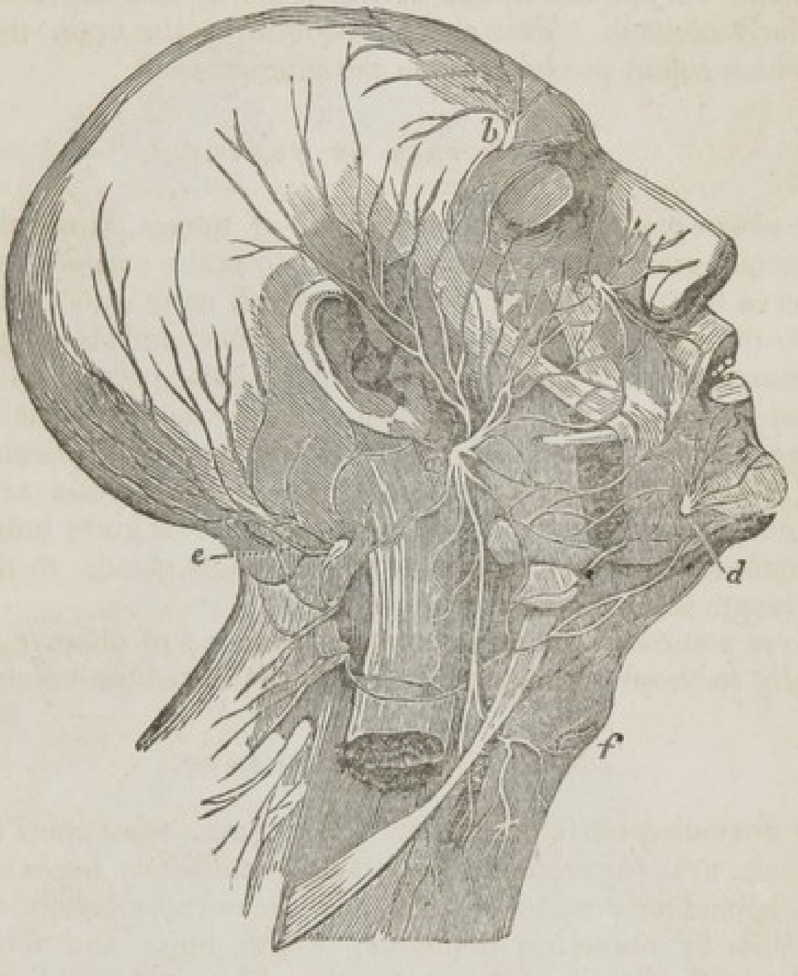


Fig. 235, exhibits the superficial nerves of the face and neck : the parotid gland is removed to show the divisions of the facial nerve which passes through it.

a, the divisions of the facial nerve, termed the pes anserinus.

b, the supra orbitary nerve.

c, the infra orbitary nerve.

d, the mental nerves.

e, the first cervical nerve.

f, descending branches communicating with the hypo-glossal and cervical nerves.

EIGHTH PAIR, OR AUDITORY NERVES.

The *auditory nerve* is the portio mollis of the old anatomists. It is attached over the restiform body, from the substance of a small gray band, which unites it to the floor of the fourth ventricle. We may observe also a small band which seems to unite this part of the auditory nerve, and furnishes it with a commissure. This nerve accompanies the facial, so long as it is contained in the skull and internal auditory canal; but at the bottom of this canal it divides into branches, which are distributed to the cochlea, the vestibule, and the semicircular canals. In the description of the organ of hearing, these will be particularly noticed. This nerve transmits to the brain the impressions which sound produces upon the internal ear.

NINTH PAIR OF NERVES.

The *glosso-pharyngeal*, or *ninth pair of nerves,* is attached in the line which separates the corpora olivaria from the corpora restiformia; each nerve has three or four filaments, which unite into a single cord, which is directed through the foramen lacerum, and is separted from the pneumo-gastric nerve by the internal jugular vein. After its exit from the cranium, it sends a filament to the auditory canal, receives a filament from the facial, and another from the pneumo-gastric nerve; several filaments are distributed to the carotid artery, and others communicate with the cervical ganglia. It gives branches also to the muscles of the pharynx, to the mucous glands, to the fauces, and at length terminates in the tongue.

It gives motion to the muscles of the tongue and pharnyx, but more especially to those necessary for the articulation of the voice.

TENTH PAIR OF NERVES.

The *pneumo-gastric nerves*, or *par vagum*, sometimes called the eighth pair, are connected to the brain, immediately beneath the preceding, behind the corpora olivaria, near the corpora restiformia. Each commences by numerous filaments, which unite and form two or three fasciculi, placed under each other; but on passing out of the cranium through the foramen lacerum posterius, they form a round cord, which descends with the great sympathetic, on the lateral part of the neck, on the outer side of the primitive carotid, and posterior to the jugular vein; it passes into the chest behind the subclavian vein, and accompanies the œsophagus to the stomach. It presents a multitude of variations in its secondary divisions, so that we seldom find it alike in two subjects; but it constantly furnishes —

1st. The *pharyngeal nerve* which is distributed to the pharynx, and forms the pharyngeal plexus.

2d. The *superior laryngeal nerve*, which is distributed to the muscles of the larynx, the thyroid gland, and the mucous membrane of the larynx and pharynx.

3d. The *cardiac nerves.* On the right side of the pneumo-gastric nerve supplies two or three filaments, descending with itself to the stomach, and uniting with the cardiac filaments of the cervical ganglion ; on the left side it furnishes only one filament, which terminates in the cardiac plexus.

4th. The *recurrent* or *inferior laryngeal nerves.* These differ on the right and left sides ; the left turns round the arch of the aorta ; the right passes round the subclavian artery : both ascend on the side of the trachea, and terminate at the layrnx.

Fig. 236.

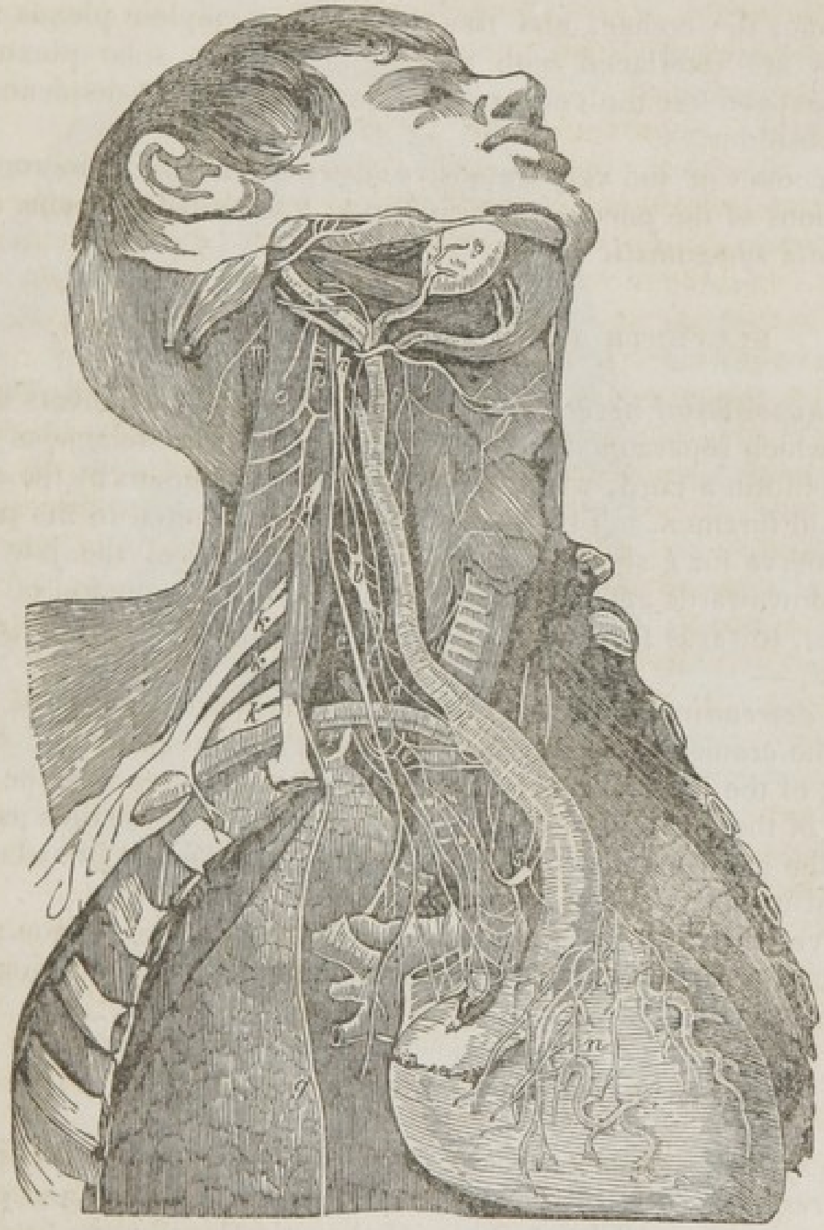


Fig. 236, exhibits the general course of the deep-seated nerves of the neck and thorax.

a, the superior cervical ganglion of the great sympathetic nerve.

b, the middle cervical ganglion.

c, the pneumo-gastric nerve.

d, *d*, the recurrent, or inferior laryngeal nerve.
l, the pharyngeal nerve.
t, the superior laryngeal nerve.
s, the cardiac plexus.
n, the coronary nerves.
k, *k*, *k*, the cervical nerves, forming the brachial plexus.
o, *p*, the cervical plexus.
i, the commencement of the phrenic nerve from the fourth cervical nerve. *g*, its course over the lungs to the diaphragm.

The pneumo-gastric nerve gives filaments to the œsophagus and stomach; it also unites by numerous radiations with the hepatic, the splenic, the cœliac, and the right gastro-epiploic plexus: other filaments are interlaced with the meshes of the solar plexus, and several expand on the vena portæ, the pancreas, the duodenum, and the gall bladder.

On account of the very extensive distribution, and numerous communications of the pneumo-gastric nerve, it is called by some authors the *middle sympathetic nerve*.

ELEVENTH PAIR, OR HYPOGLOSSAL NERVES.

The *hypoglossal nerve* is connected by several filaments with the fissure which separates the olivary and pyramidal eminences; these filaments form a cord, which passes out of the cranium by the anterior condyloid foramen. The hypoglossal is then united to the pneumogastric nerve for a short distance, but at the angle of the jaw it is directed downwards and forwards, curving under the tendon of the digastricus, towards the tongue. From the convexity of the curve it gives off, —

The *descending cervical branch*. In the former mode of enumerating the cranial nerves, it was termed the *descendens noni*; it passes in front of the internal jugular vein, and communicates with the internal branch of the cervical plexus. The hypoglossal nerve then passes between the mylo-hyoideus and hyoglossus; it furnishes branches to the adjacent muscles, and is finally distributed to the tongue.

It gives the power of motion to the muscles of the tongue; principally, however, to those concerned in the process of mastication and deglutition.

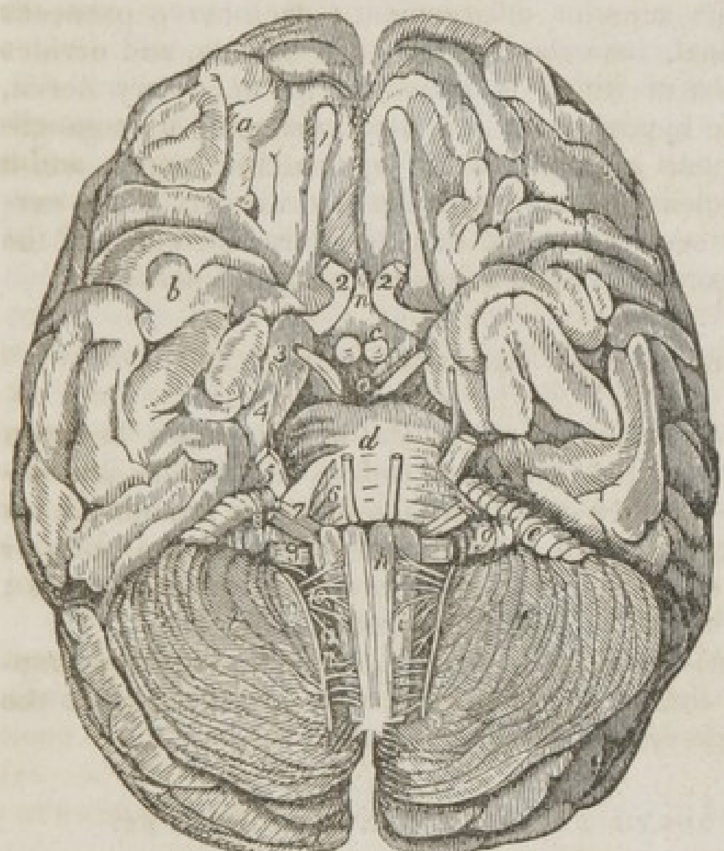
TWELFTH PAIR, OR ACCESSORY NERVE OF WILLIS.

The *spinal accessory nerve* (called by Sir CHARLES BELL the *superior respiratory of the trunk*) is singular in its origin and progress. It commences at the lateral parts of the spinal cord; the first point of union with the medulla spinalis is about the sixth vertebra of the cervical region; it ascends between the ligamentum denticulatum and posterior roots of the cervical nerves, receiving from the latter new filaments, which increase its size; it then passes through the great occipital foramen, and makes its exit by the foramen lacerum posterius with the pneumo-gastric, to which it sends a filament ; it then leaves the latter and adheres to the hypoglossal, from which it again separates, passes through the sterno-cleido-mastoideus muscle, and terminates in the trapezius. Fig. 236, *m*.

Recent investigations have decidedly proved, that the spinal accessory nerve, both in its commencement and disposition, conforms to the spinal nerves, and is never deprived of a posterior root, as some have imagined.

This nerve gives the power of motion to the sterno-cleido-mastoideus, and to the trapezius.

Fig. 237.



This figure was before given to show the basis of the brain, etc. It is again introduced to exhibit the commencement of the cerebral nerves. They are numbered, as they have been described, according to the most modern arrangement.

1, the olfactory nerve, having several roots behind, and a bulbous extremity before.

2, 2, the optic nerves united before, *n*, the infundibulum.

3, the common motor nerve.

4, the patheticus.

5, the trigeminus.

6, the abducens, or external motor nerve.

7, the facial nerve, or portio dura.

8, the auditory nerve, or portio mollis.

9, the glosso-pharyngeal nerve.

10, the pneumo-gastric nerve.

11, the hypoglossal nerve.

12, the spinal accessory.

SPINAL NERVES.

The *spinal nerves* are divided into four orders, viz. the *cervical*, the *dorsal*, the *lumbar*, and the *sacral*.

The nerves of the spinal cord, which have been previously enumerated, commence by two species of roots. Each of these roots is formed by a number of distinct filaments, but in their passage through the intervertebral foramina they unite; the posterior root, at their union, forms a ganglion. See Fig. 220.

The 1st order of spinal nerves are the cervical, nine pairs.

The 2d order, the dorsal nerves, twelve pairs.

The 3d order, the lumbar nerves, five pairs.

The 4th order, the sacral nerves, six pairs.

FIRST PAIR OF CERVICAL NERVES.

The *first pair of cervical nerves* commences at the sides of the spinal cord, beneath its superior enlargement; each nerve proceeds from the vertebral canal, between the atlas and dentata, and divides into two parts: the first of which is joined to the accessory nerve, and by branches of the hypoglossal; it is also connected by a gangliform root, with the upper ganglion of the sympathetic nerve, and it gives filaments to muscles connected with the anterior part of the cervical vertebræ. The second part of this nerve is distributed to the extensors of the head and neck, and forms the *occipital nerve.*

SECOND PAIR OF CERVICAL NERVES.

The *anterior branch* of this pair of cervical nerves passes between the transverse processes of the two first vertebræ, and divides into numerous filaments, one of which unites with the first pair; another joins the superior cervical ganglion; a third is distributed to the anterior rectus of the head; a fourth contributes to form a cervical plexus; and a fifth communicates with the pneumo-gastric nerves.

The *posterior branch* is reflected upwards, under the obliquus capitis inferior, traverses the great complexus, and is distributed to the occipito-frontalis muscle and to the integuments.

THIRD AND FOURTH PAIRS OF CERVICAL NERVES.

The *third* and *fourth cervical nerves* proceed in similar directions; the anterior part sending off branches to form the cervical plexus; while the posterior supplies the muscles and integuments of the back part of the neck.

CERVICAL PLEXUS.

The *cervical plexus* is situated on the lateral part of the neck, on a level with the second, third, and fourth vertebræ, and is formed by the anterior branches of the second, third, and fourth cervical nerves, which communicate and form arches, the convexities of which send off filaments, which again unite, and communicate superiorly with the first pair; inferiorly, with the brachial plexus. The cervical furnishes very many ascending and descending branches.

1st. The *internal descending branch*, formed by two filaments of the second and third pair, which uniting descends on the sterno-cleido-mastoideus muscle, and communicates with the hypoglossal nerve.

2d. The *phrenic nerve*, or the internal respiratory nerve, is principally composed of a branch of the fifth pair, but receives a filament from the fourth, and two or three from the brachial plexus ; it descends upon the anterior part of the neck, between the anterior rectus and anterior scalenus muscles, communicating with the inferior cervical ganglion, and passing into the thorax between the subclavian artery and subclavian vein ; it enters the anterior mediastinum, then descends between the pleura and the lateral parts of the pericardium, and terminates in numerous filaments which ramify on the superior surface of the diaphragm. See Fig. 236, *i*, *g*.

3d. The *external descending branches* of the cervical plexus are distributed in numerous filaments to the muscles and integuments of the mastoid, auricular, and scapular regions. Some are superficial, others deep. The superficial descend to the clavicle and acromion process, supply the superficial muscles in their course, and terminate in the pectoral and deltoid muscles, and in the integuments. The deep branches descend behind the clavicle, supply the deep muscles on the side of the neck, and those connected to the scapula. One of these branches, remarkable for its length, and of the same size of the phrenic, is named the *external respiratory nerve.* This nerve proceeds from the back part of the plexus, chiefly from the fourth cervical. It has also filaments connecting it to the third and second and to the phrenic. It descends behind the scaleni muscles, and beneath the trapezius and levator anguli scapulæ, and is almost exclusively distributed to the serratus magnus muscle.

4th. The *superficial ascending branches* are derived principally from the third pair ; they are distributed to the sterno-cleido-mastoideus, the platysma myoides, the skin of the neck, and the inferior maxillary region, and communicate with the facial nerve.

FOURTH, FIFTH, SIXTH, AND SEVENTH PAIRS OF CERVICAL NERVES.

The *posterior branches* of these nerves descend obliquely outwards, traverse the splenius and trapezius, and are distributed to the muscles and integuments of the back part of the neck.

The *anterior branches* furnish filaments which communicate with the cervical ganglia, and some others which are distributed to the scaleni muscles ; they then communicate and form the brachial plexus. It may be observed, that a filament of the fourth contributes to the formation of the phrenic nerve.

BRACHIAL OR AXILLARY PLEXUS.

The *brachial plexus* consists of an interlacement of the anterior branches of the last four cervical nerves and the first dorsal. The brachial plexus extends from the lateral and inferior part of the neck to the axilla, where it divides into several branches, which are distributed to the thorax, shoulder and arm. It is situated between the scaleni muscles, above the subclavian artery.

THORACIC BRANCHES.

The *anterior thoracic branch* is chiefly derived from the seventh cervical nerve ; it descends behind the clavicle, and divides into numerous filaments, some of which surround the axillary artery, others descend on the chest, and are distributed to the pectoral muscles.

The *posterior thoracic branch* is furnished by the sixth and seventh cervical nerve ; it descends on the sides of the thorax, and is distributed to the serratus magnus.

The *supra-scapular branch* is supplied by the 5th nerve ; it descends obliquely backwards towards the upper edge of the scapula, passes under the ligament which converts the coracoid notch into a foramen, and after giving a branch to the subscapularis muscle, it passes into the infra-spinatus fossa, where its ramifications are lost in the infra-spinatus and teres major muscles.

The *sub-scapular branches* commence at variable points of the brachial plexus ; they descend behind the axillary vessels, and are distributed to the muscles under the scapula, and in the teres major and minor.

NERVES OF THE ARM.

INTERNAL CUTANEOUS NERVE.

The *internal cutaneous nerve* is the smallest of the branches which terminate the brachial plexus, from the lower part of which it proceeds ; namely, from the last cervical and the first dorsal ; it descends along the internal surface of the arm, under the brachial aponeurosis, near the basilic vein, and divides at the internal condyle of the os brachii into two branches. The *external branch* passes along the border of the biceps towards the wrist, where it is distributed to the integuments. The *internal branch* descends on the brachialis internus, supplies the integuments of the back part of the fore-arm, and finally terminates at the back of the hand and the little finger.

EXTERNAL CUTANEOUS NERVE, OR MUSCULO-CUTANEOUS.

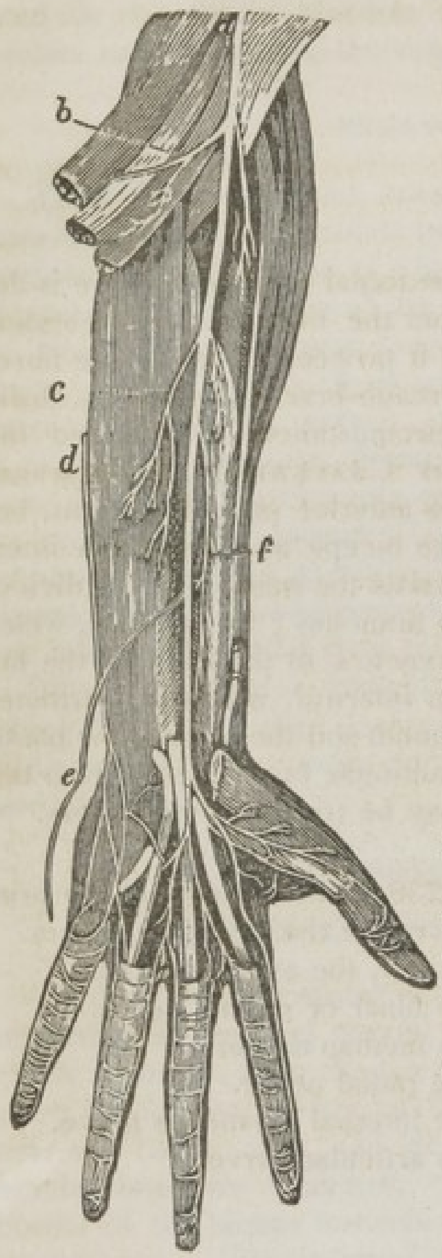
Fig. 238.

The external cutaneous nerve is derived from the fifth and sixth cervical nerves; it proceeds through the fibres of the coraco-brachialis muscle, (from which circumstance it is named the *perforans* CASSERII,) and descends along the anterior part of the arm, between the biceps and brachialis internus, towards the wrist, where it divides into two branches; an *external*, which sends branches to the back of the fingers; an *internal*, which is distributed to the thumb and the palm of the hand; and a multitude of filaments from this nerve may be traced to the fingers.

Fig. 238, exhibits some of the principal nerves of the front of the arm.
a, *b*, *c*, *d*, the axillary plexus.
e, the ulnar or cubital nerve.
f, the median nerve.
g, the radial nerve.
h, the internal cutaneous nerve.
i, the articular nerve.

THE MEDIAN NERVE.

Fig. 239.



The *median nerve* is the largest of the brachial plexus; it is principally formed by the two lower cervical and the first dorsal nerves. Descending behind the internal part of the biceps, on the inner side of the brachial artery, and dipping between the brachialis internus and ponator teres, it descends along the fore-arm, between the superficial and deep-seated flexor muscles. It then proceeds under the annular ligament of the carpus, and divides in the hand into digital filaments, which are distributed to the fingers. Before this division, however, it furnishes considerable branches to the muscles of the fore-arm.

Fig. 239, exhibits the distribution of the principal branches of the median nerve on the fore-arm.

a, the trunk of the median nerve.

b, a branch given to the supinator muscles.

c, a branch to the interosseous ligament, and to the flexor profundus muscle.

d, the ulnar nerve cut off.

e, the palmar branch given to the integuments of the hand.

f, a branch to the pronator muscles.

ULNAR NERVE.

The *ulnar nerve* proceeds from the last cervical and first dorsal nerves, and descends along the internal border of the triceps, supplying this muscle and the upper part of the fore-arm with numerous filaments; then passing between the inner condyle of the humerus and the olecranon, gives many branches to the flexor carpi ulnaris, and descends along the anterior and internal part of the fore-arm, dividing near the wrist into two branches, the *palmar* and the *dorsal*. The former is directed on the outer part of the tendon of the flexor carpi ulnaris, on the side of the os pisiforme, and divides into the deep, the superficial, the external, and the internal branches, which are distributed to the fingers. The latter, or dorsal, gains the internal part of the back of the hand, and divides into internal branches, which are extended to the corresponding surface of the middle, the ring finger, and the little finger.

Fig. 240.

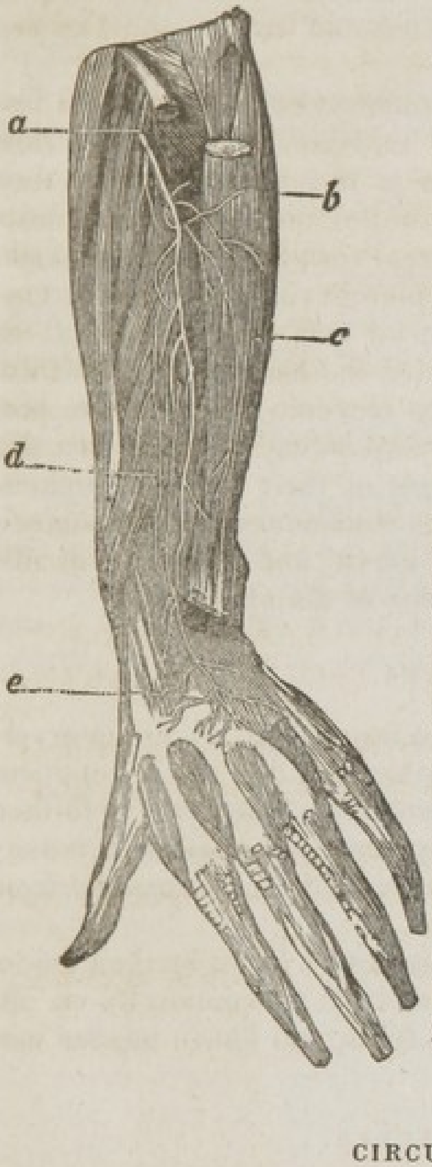


Fig. 240, exhibits the distribution of the principal branches of the ulnar nerve.

a, the ulnar nerve perforating the heads of the flexor muscles.

b, *c*, branches distributed to the common extensor of the fingers.

d, a branch distributed to the interosseous ligament.

e, a branch distributed to the wrist and the back of the hand.

RADIAL NERVE.

The *radial* or *muscular spiral nerve*, has the same derivation as the preceding; it descends between the middle and the short portions of the triceps muscle, turns round the os brachii to the external part of the arm, and at the elbow joint divides into two branches; the *anterior* which descends between the two supinator muscles, and is distributed to the thumb, and the inner side and back of the fore finger, and the outer side of the middle finger. Its *posterior* branch is divided into filaments, which are distributed to the superficial muscles of the fore-arm.

CIRCUMFLEX NERVE.

The *circumflex*, or *articular nerve*, is usually formed by the two last cervical and the first dorsal nerve; it descends in front of the subscapularis muscle, to which it gives a branch, and turns backwards, between the superior part of the os brachii and the long portion of the triceps; it is ultimately distributed to the internal surface of the deltoid muscle, near its insertion in the os brachii.

DORSAL NERVES.

The *dorsal nerves*, or those which are transmitted by the intervertebral foramina of the dorsal region, like the cervical nerves, proceed from the lateral parts of the spinal marrow, by two distinct roots, an anterior or small, and a posterior or large, separated by the ligamentum dentulatum. Beyond the intervertebral foramen, the double roots are united into a single trunk, and a small gray and hard ganglion is formed by the posterior roots. These nerves divide into dorsal and intercostal branches.

The *dorsal branches* pass backwards between the transverse processes of the dorsal vertebræ, and are distributed to the muscles and integuments of the back and loins.

The *intercostal branches*, near their commencement, receive a filament from each thoracic ganglion, pass outwards between the ribs, covered by the pleura, as far as the angle of these bones, where they are found between the two strata of intercostal muscles. The anterior branch of the second follows the internal surface of the second rib, and sends off a brachial filament, which pierces the external intercostal muscle, and descends along the posterior and internal part of the arm; and is lost at the elbow : this is named the nerve of Wrisberg. The anterior branches of the fourth to the eleventh dorsal nerve, proceed along the inferior margin of the corresponding ribs, and are distributed to the muscles and the integuments of their different regions. The anterior branch of the twelfth, at its commencement, communicates by a filament with the first lumbar nerve, and is afterwards distributed to the muscles and the integuments of the abdomen.

LUMBAR NERVES.

The *lumbar nerves*, or those which are transmitted by the intervertebral foramina of the lumbar vertebræ, consist of five pair ; commencing by two broad fasciculi of filaments, which the older writers termed *cauda equina*, from the resemblance they bear to the tail of a horse ; especially when the nervous fibres are unravelled, and separated from each other.

The anterior branches of the five lumbar nerves form, by their union, the *lumbar plexus*, which is situated behind the psoas muscle, on the lateral parts of the bodies of the second, third, and fourth lumbar vertebræ.

FIRST LUMBAR NERVE.

The *posterior branch* of this nerve is distributed to the multifidus spinæ, traverses the sacro-spinalis muscle, and passing under the aponeuroses of the abdominal muscles, finally ramifies in the integuments of the upper part of the hip.

The *anterior branch* receives a communicating filament from the lumbar ganglia, and from the twelfth dorsal nerve, and terminates in the lumbar plexus.

SECOND LUMBAR NERVE.

The *posterior branch* of this nerve takes nearly the same course as the former, and is expanded by a great number of subdivisions on the upper and back part of the thigh.

The *anterior branch* has extensive communications with the lumbar ganglia, the anterior branches of the first and second pairs of the lumbar region, and with the lumbo-abdominal plexus.

THIRD LUMBAR NERVE.

The *posterior branch* is distributed precisely in the same manner as the former.

The *anterior branch* communicates with the second and the fourth lumbar nerves, giving contributions as the preceding.

FOURTH AND FIFTH LUMBAR NERVES.

The *posterior* and *anterior branches* have a similar distribution to those just described ; some filaments, however, of the latter, are continued into the pelvis, to unite with the sciatic plexus.

LUMBO-ABDOMINAL, OR LUMBAR PLEXUS.

This plexus is formed by the union of the *anterior branches* of the five lumbar nerves ; it is situated on the lateral parts of the bodies of the second, third, and fourth lumbar vertebræ, behind the psoas magnus. It terminates in the *musculo-cutaneous*, the *genito-crural*, the *crural*, the *obturator*, and the *lumbo-sacral nerves*.

MUSCULO-CUTANEOUS BRANCHES.

These branches are commonly three in number ; 1st, the *superior*, proceeding from the first lumbar nerve, descends on the quadratus lumborum as far as the crest of the ilium, pierces the transversalis muscle, and, ramifying in the muscles and integuments of the abdomen, and extending to the abdominal ring, is distributed to the groin, the pudic region, the scrotum in the male, and the labia pudendi in the female. 2d, the *middle branch* descends on the outer margin of the psoas muscle, perforates the transversalis, and is distributed to the cellular tissue of the abdomen ; one filament is transmitted to the superior part of the scrotum. 3d, the *inferior branch*, extending from the second lumbar nerve, and passing out of the pelvis, between the superior and the inferior spinous processes of the ilium, is distributed to the posterior superior part of the thigh. An internal filament pierces the fascia lata, and descends to the external part of the knee.

GENITO-CRURAL NERVE.

This nerve proceeds from the first lumbar nerve ; it descends in the substance of the psoas muscle, and afterwards divides into an *internal branch*, which accompanies the spermatic cord ; and an *external*, which, at the crural arch, is distributed in a multitude of filaments in the subcutaneous cellular tissue.

CRURAL NERVE.

This nerve commences at the first four lumbar nerves ; it passes out of the abdomen under the crural arch, on the outer side of the femoral artery, and then divides into deep-seated and superficial branches.

1st. The *superficial branches* perforate the fascia lata, and are distributed in the integuments of the anterior and inner part of the thigh, descending as far as the superior part of the leg.

2d. The *deep-seated branches* divide into numerous filaments, which are distributed to the iliacus, the sartorius, and the triceps extensor cruris muscles. The internal branches supply the muscles on the corresponding part of the thigh ; one of these, more conspicuous than the other branches, termed the *internal saphena nerve*, accompanies the vena saphena in all its divisions to the great toe.

Fig. 241.

Fig. 241, exhibits the principal nerves of the front of the thigh.

a, a branch of the first lumbar nerve.

b, a branch of the second lumbar nerve.

c, the crural nerve, with its divisions into the branches which supply the front of the thigh.

d, a branch to the triceps extensor cruris muscle

e, *e*, the saphena nerve, sent from the crural nerve to the inner part of the leg.

f, the external cutaneous nerve.

g, the femoral artery.

h, the anterior obturator nerve.

OBTURATOR NERVE.

This nerve issues principally from the second, third, and sometimes from the fourth, lumbar nerves ; it descends on the inner margin of the psoas muscle, gives a branch to the obturator muscles, traverses the obturator foramen, and between the pectineus and first adductor, divides into two branches. 1st. Its *anterior branch*, distributed to the little adductor and vastus internus. 2d. Its *posterior branch*, to the great adductor and external obturator muscles.

LUMBO-SACRAL NERVE.

This nerve is derived from the fourth and fifth lumbar nerves ; it descends into the pelvis, and unites with the sciatic plexus. In its course it furnishes a single branch, which is the *glutæal nerve*.

GLUTÆAL NERVE.

This nerve derives some roots from the sciatic plexus ; it passes out of the sciatic notch, and divides into a multitude of branches, which are distributed to the glutæi muscles, the perineum, and the subcutaneous cellular tissue at the back of the thigh.

SACRAL NERVES.

The *sacral nerves* issue from the sacral canal ; they consist of five or six pairs, derived from the inferior part of the spinal cord. Their posterior branches supply the various muscles in their vicinity ; while the anterior branches of the first four sacral, with those of the fifth lumbar, form the SACRAL OR SCIATIC PLEXUS. These branches, again uniting, form a large nerve, termed the *sciatic nerve.* It also furnishes the *hæmorrhoidal*, the *vesical*, the *uterine*, and the *vaginal nerve* (which are small and interlacing with each other); and the *inferior glutæal* and *pudic*, which are distributed to those parts the several names indicate.

SCIATIC NERVE.

The *sciatic nerve* terminates the plexus of the same name, and is the largest of all the nerves of the body ; it passes out of the pelvis by the sciatic notch, between the pyramidalis and superior gemellus, and descends along the posterior part of the thigh as far as the ham, where it divides into two branches, termed the popliteal. As the sciatic nerve proceeds down the leg, it furnishes filaments to the adjacent muscles, and to the integuments.

EXTERNAL POPLITEAL NERVE.

This nerve has also the name of *fibular*, or *peroneal nerve ;* it descends behind the external condyle of the femur, and passes between the fibula and the peroneus longus muscle, and divides into the musculo-cutaneous, and the anterior tibial. The *musculo-cutaneous*, or *external fibular nerve*, descends between the peroneus longus, and the extensor digitorum pedis, and afterwards between this latter and the peroneus brevis. Towards the middle of the leg it becomes superficial, and divides near the foot into filaments, which are distributed to the back of the foot and to the toes.

The *anterior tibial nerve* descends in front of the interosseous ligament, ramifies in the extensor brevis digitorum pedis, and gives filaments to the first two toes.

INTERNAL POPLITEAL NERVE.

This nerve is larger than the preceding, and descends into the ham, passing behind the articulation, and between the heads of the gastrocnemii and the popliteus muscles, then between the latter and the soleus muscle ; there it passes through the arched aperture which that muscle presents, and takes the name of the *tibial nerve*. This nerve descends between the soleus and tibialis posticus posteriorly, and the flexor longus digitorum pedis anteriorly, and is closely connected with the posterior tibial artery ; — beneath the os calcis it divides into the *external* and *internal plantar nerves*. The tibial nerve furnishes, above the external condyle of the femur, the *external saphena nerve*. In the ham it supplies filaments to the muscles of the superior part of the leg, and to the articulation of the knee ; to the interosseous ligament, and to the anterior muscles of the leg. Near the inner malleolus, it sends a filament to the sole of the foot.

Fig. 242.

The *internal plantar branch* proceeds directly forwards above the adductor proprius pollicis pedis, and is distributed to the internal part of the foot and to the toes.

The *external plantar branch* is directed forwards and outwards, and is distributed to the external border of the foot, and to the interosseous muscles.

Fig. 242, exhibits the principal nerves of the back part of the thigh.

a, the sciatic nerve, passing out of the pelvis.

b, the posterior superior cutaneous nerve.

c, the trunk of the sciatic nerve, sending branches to the muscles of the back part of the thigh.

d, the division of this nerve into, —

e, the tibial nerve, and, —

f, the fibular nerve.

CHAP. III.

GANGLIONIC DEPARTMENT OF THE NERVOUS SYSTEM.

It has been before remarked in this work, that in the infancy of anatomy the term "ganglion" was used to denote a swelling in the thecæ of tendons, and even at the present day it is not unfrequently employed in the same sense. It was subsequently applied to the knotted appearance presented by certain nerves ; but of late years a considerable latitude has been given to its signification by Gall and Spurzheim, who include within its comprehension, the several masses of cineritious substance inclosed within the medulla and brain, and which, according to their theory, are considered " ganglia of increase " to the formative fibres of the cerebral hemispheres. ☞ The term " formative fibres " will be explained at the termination of the article on the nervous system.

Nervous *ganglia* may be divided into two orders. 1. Those observable on the posterior roots of the cerebro-spinal nerves, including that of the fifth nerve ; 2. The ganglia of the sympathetic.

Fig. 243.

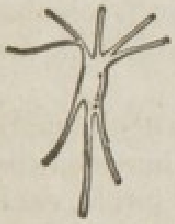


Fig. 244.

The *ganglia* are small nervous centres, (see Fig. 243 and 244,) which some anatomists have designated by the appellation of " diminutive brains." They extend from the cranium to the pelvis, mostly lying along the vertebral column, and presenting a series connected by nervous filaments, each ganglion being considered by most physiologists as a speceal centre of nervous influence.

The forms of the ganglia are very irregular ; in general they are somewhat round ; occasionally they are elongated ; in other instances they are of a semilunar form, as that which bears this name. In general all their forms, as I have just noticed, are remarkably irregular.

Each ganglion transmits nerves upwards and downwards to the ganglia which are contiguous ; and other nerves to the cerebral or spinal nerves. The greater part, however, of the nervous filaments radiating from the ganglia are interwoven, in the form of a net-work or plexus ; the most remarkable of which is the solar plexus, which is formed by the innumerable nerves proceeding from the semilunar, the hypogastric, and the cardiac ganglia. The filaments of the ganglia, as it were, exchange their connexions and their direction, and form angles and meshes so intricate, that it is not possible to distinguish any thing more than a mass of nerves.

The ganglia are amply supplied with blood-vessels which penetrate them on all sides, ramifying on their surface and uniting in their interior.

The cerebro-spinal department of the nervous system is the immediate agent of the will, whilst the *ganglionic department* presides altogether out of the influence of the will of the individual. Thus, for example, the heart contracts without our possessing the power of accelerating or retarding its movements, in any sudden way, according to our will ; the stomach, in like manner, acts on the aliments, and digests them without our being able to exercise any control over its operations ; and for this reason, these organs are under the direction of the ganglionic department of the nervous system.

PARTICULAR GANGLIA.

GANGLIA OF THE HEAD.

LENTICULAR GANGLION.

The *lenticular ganglion* is situated on the external side of the optic nerve, near its entry into the orbit ; its form is oblong and very small. Posteriorly, it receives a filament from the nasal branch of the ophthalmic, and one from the third nerve ; anteriorly, it furnishes the ciliary nerves.

The *ciliary nerves* are very delicate, and are divided into two fasciculi ; the superior fasciculus is formed of six filaments, which extend to the globe of the eye above the optic nerve. The inferior fasciculus is composed of eight or ten nervous filaments, which proceed on the outer and inferior part of the optic nerve.

These nerves, consisting of from twelve to seventeen, pass obliquely through the sclerotica, and proceed in a parallel direction between the latter membrane and the choroid, and, reaching the ciliary circle, each filament subdivides and is extended to the ciliary ligament and the iris.

SPHENO-PALATINE GANGLION.

This ganglion, denominated also the *ganglion* of Meckel, is a small, triangular, reddish body ; it is not very readily discovered, being concealed in the adipose cellular tissue of the pterygo-maxillary fissure. This ganglion furnishes the following branches :

The *ascending branches*, two in number, which pass upwards, and join the superior maxillary, or second branch of the fifth pair, previously to its entrance into the infra-orbitar canal.

The *spheno-palatine nerves*, varying in number from three to five ; they pass into the nasal fossa by the spheno-palatine foramen. Two or three filaments ramify on the concave surface of the superior turbinated bone, and in the corresponding meatus ; some extend to the middle turbinated bone, and others are distributed to the posterior part of the septum narium. The most considerable filament, termed the *naso-palatine*, is directed to the superior part of the septum, and terminates in the naso-palatine ganglion.

The *palatine nerves* are, 1st, the *great* or *inferior palatine*, which furnishes a filament to the middle and inferior turbinated bones ; it afterwards enters the posterior palatine canal, and before its exit gives another filament to the nasal fossæ, which is lost on the ascending process of the superior maxillary bone. Other filaments are distributed to the velum palati, the arch of the palate, the alveoli, and the gums.

2d. The *middle palatine nerves*, which are distributed to the amygdalæ and to the velum palati.

3d. The *lesser palatine nerves*, which are situated between the external pterygoid muscle and the superior maxillary bone ; they are destined for the tonsils and the mucous follicles of the membrane of the palate.

4th. The *Vidian nerve* leaves the spheno-palatine ganglion and enters the pterygoid canal, giving filaments to the adjacent parts; then divides into two branches, 1st, the *inferior* or *carotid branch*, which descends into the carotid canal, and unites with the superior cervical ganglion. 2d. The *superior branch*, which takes rather a complicated course, enters the cranium between the petrous portion of the temporal and the sphenoid bones, and is directed backwards and outwards on the superior surface of the former bone, where it is lodged in a small groove covered by the inferior maxillary nerve and the dura mater; it then passes with a small artery into the hiatus FALLOPII, and, on arriving at the aqueduct of FALLOPIUS, is found in oppositionwith the facial nerve. It then penetrates the cavity of the tympanum, where it is denominated the *corda tympani;* above the tensor tympani it enlarges, and is directed downwards and forwards, passes out of the glenoid, or Glasserian fissure, and is attached to the lingual branch of the inferior maxillary nerve. Opposite the submaxillary gland it separates from it to proceed to the ganglion of the same name.

Fig. 245.

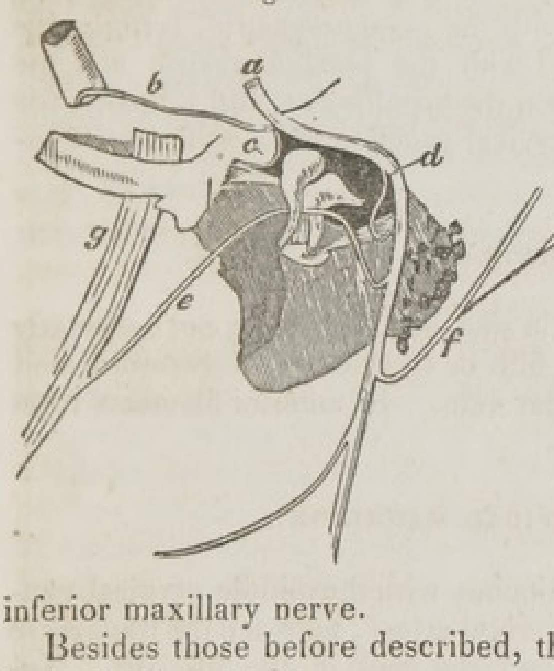


Fig. 245, exhibits the course of the corda tympani, on the left side.

a, the facial nerve in the aqueduct of FALLOPIUS.

b, the Vidian nerve, communicating with the facial in the aqueduct of FALLOPIUS.

c, a filament of the facial given to the laxator tympani.

d, a filament given to the muscle of the stapes.

e, the corda tympani, separating from the facial, passing through the cavity of the tympanum, and uniting with, *g*, the inferior maxillary nerve.

Besides those before described, the following ganglia are met with in the head, namely —

The *cavernous ganglion*, situated on the outer side of the internal carotid artery in the cavernous sinus.

The *naso-palatine ganglion*, situated in the anterior palatine foramen.

The *submaxillary ganglion*, occurring on a level with the submaxillary gland, and apparently formed by the superior filament of the Vidian nerve.

GANGLIA OF THE NECK.

SUPERIOR, OR GREAT CERVICAL GANGLION. Fig. 236, *a*.

This ganglion is found under the angle of the inferior maxilla, and is remarkable for its size and the regularity of its occurrence ; it is of a reddish gray color, and is intimately united to the pneumo-gastric and hypo-glossal nerves. It lies on the rectus anticus muscle, concealed by the jugular vein and carotid artery. A number of nervous filaments issue from it, which are distinguished into superior, inferior, external, and anterior.

The *superior* or *ascending filaments* ascend into the carotid canal, and unite with the superior filament of the Vidian nerve, with the sixth pair in the cavernous sinus, with a filament from the glosso-pharyngeal, and by other filaments with the ophthalmic and nasal branches.

The *inferior* or *descending filaments* pass in front of the anterior recti and longus colli muscles, covered by the carotid artery, the jugular vein, the pneumo-gastric, and the hypoglossal nerves, and terminate on a level with the fifth or sixth vertebra in the middle cervical ganglion. Filaments from the superior ganglion unite with the external laryngeal nerve, and others which enter the thorax concur in forming the cardiac plexus. The external, internal, and anterior filaments, communicate with nerves in their vicinity ; thus the first unites with the cervical nerves, the second with the pneumo-gastric, forming the pharyngeal plexus ; and the third with the pneumo-gastric and the facial nerves, forming a plexus upon the primitive carotid : finally, the latter filaments of the superior cervical ganglion unite to form the superior cardiac nerve.

MIDDLE CERVICAL GANGLION. Fig. 236, *b*.

This ganglion varies extremely in size, and, indeed, is not constantly found ; it is situated opposite the fifth or sixth cervical vertebra, and behind the carotid artery and jugular vein. Its anterior filaments form the middle cardiac nerves.

INFERIOR CERVICAL GANGLION.

This ganglion is frequently continuous with the middle cervical ganglion ; it is situated behind the vertebral artery, between the transverse process of the seventh vertebra, and the neck of the first rib. Numerous filaments issue from this ganglion, which unite with the cervical nerves, the first thoracic ganglion, and the inferior cardiac nerves.

CARDIAC NERVES. Fig. 236, *n*.

These nerves are particularly destined to supply the heart : there are three on each side, which terminate in the cardiac plexus.

The *superior cardiac nerves*, on the right side, are formed by five or six filaments which proceed from the superior cervical ganglion ; they descend on the side of the trachea, penetrate the thorax behind the subclavian vein, and receive filaments from the inferior cervical ganglion and the recurrent nerve of the pneumo-gastric. Those of the left side are situated between the primitive carotid and the subclavian arteries, and proceed on the aorta to unite with the inferior cardiac nerves.

The *middle cardiac nerves*, on the right side, proceed by five or six filaments from the middle cervical ganglion ; these descend near the primitive carotid, uniting with the recurrent, and terminating in the cardiac plexus. That of the left side receives its principal filament from the inferior cervical ganglion, and descends behind the subclavian artery and the arch of the aorta.

The *inferior cardiac nerves*, on the right side, descend from the inferior cervical ganglion, and proceed on the anterior part of the arch of the aorta, as far as the cardiac plexus.

The middle, and the inferior cardiac nerves, on the left side, are united into a single trunk.

CARDIAC PLEXUS, OR GANGLION. Fig. 236, *s*.

The *cardiac plexus* is situated behind the arch of the aorta, and consists of a central point of union of the cardiac nerves, a great number of which issue from it, and others are connected with it in every direction : some ramify on the aorta ; others terminate in the pulmonary plexus ; several are distributed to the pulmonary artery ; and a considerable nerve interlaces its filaments in the direction of the posterior coronary artery, forming the *coronary plexus*. Filaments also proceed in the direction of the anterior coronary artery, and are therefore denominated the *anterior coronary plexus*.

THORACIC GANGLIA.

These ganglia are smaller than the cervical ganglia ; — there are twelve on each side, disposed in the same line in front of the head of each rib. Their form and size resemble grains of barley ; they communicate by vertical filaments with each other, and furnish also external and internal filaments ; the former unite with each of the branches of the dorsal nerves, at the point of their exit from their foramina ; the latter concur in the formation of the splanchnic nerves.

SPLANCHNIC NERVES.

There are two splanchnic nerves on each side, distinguished into the great and small.

GREAT SPLANCHNIC NERVE.

This nerve is connected with the internal part of the sixth, seventh, eighth, ninth, and sometimes the tenth thoracic ganglia, by filaments which descend on the sides of the vertebral column, and unite into a single trunk, on a level with the eleventh dorsal vertebra ; this nervous cord enters the abdomen, passes behind the stomach, and terminates in the semilunar ganglion.

SMALL SPLANCHNIC NERVE.

This nerve is formed of two branches from the tenth and the enth thoracic ganglia ; these branches unite into a small cord on the twelfth dorsal vertebra, enter the abdomen, and, communicating with the former, terminate in the *renal ganglion.*

GANGLIA OF THE ABDOMEN.

SEMILUNAR GANGLIA AND SOLAR PLEXUS.

The *semilunar ganglia* are two in number, situated on each side of the aorta, on a level with the cœliac artery ; they are larger than any other ganglia, and have a form somewhat corresponding to the name. The superior and external extremity of each ganglion receives the great splanchnic nerves ; by the inferior they form a communication with each other. The two semilunar ganglia are surrounded by a multitude of other smaller ganglia, communicating with them by short filaments, which issue from their circumference ; and the secondary ganglia also are united to each other by very numerous filaments, which form areolæ. It is this remarkable assemblage of ganglia, and interlacing of nervous filaments, that constitutes the SOLAR PLEXUS.

The plexus just named, appears to be particularly destined for the aorta, being distributed to all its divisions, and following all its immediate branches with a corresponding number of secondary plexuses, such as, —

1. The *sub-diaphragmatic plexus*, which is composed of a small number of filaments, which unite with the phrenic nerve and are distributed to the diaphragm.

2. The *cœliac plexus* is merely a prolongation of the solar plexus, upon the triple division of the cœliac artery ; — it is composed of several ganglia, varying in form and size.

3. The *hepatic plexus* is associated with the hepatic artery and the vena portæ ; — it follows their principal divisions.

4. The *splenic plexus* follows the course of the splenic artery, and is distributed to the spleen.

5. The *superior mesenteric plexus* descends with the superior mesenteric artery, and forms a web of great extent, the filaments of which are distributed to the lymphatic glands of the mesentery, and follow the ramifications of the artery, so as to cover the whole surface of the small intestines. This plexus also furnishes nerves to the ascending colon and cœcum.

The *inferior mesenteric plexus* accompanies the inferior mesenteric artery, enters the iliac mesocolon, and is distributed to the adjacent parts.

7. The *renal plexus* commences by several ganglia, situated on the renal artery, and is distributed to the substance of the kidney.

8. The *surrenal plexus* is found at the commencement of the capsular artery, and supplies the part which the name implies.

9. The *spermatic plexus* descends from the renal, and follows the direction of the spermatic artery, to the testicle in the male, and to the ovarium and the Fallopian tube in the female.

THE LUMBAR GANGLIA.

These ganglia are situated on the anterior and lateral parts of the bodies of the lumbar vertebræ : they are commonly five in number on each side, and have communicating nervous branches, and external and internal filaments, which contribute to supply the adjacent organs, and are united with the sacral ganglia.

THE SACRAL GANGLIA.

There are three or four of these ganglia found on each side of the anterior foramina of the sacrum ; they communicate with the lumbar ganglia, and contribute to form the hypogastric plexus.

HYPOGASTRIC PLEXUS.

This plexus is composed of numerous filaments from the vesical, uterine, vaginal, and hæmorrhoidal nerves of the sciatic plexus. The hypogastric plexus distributes its ramifications to the organs of generation (within the pelvis,) to the os coccygis, and to the rectum.

Fig. 246.

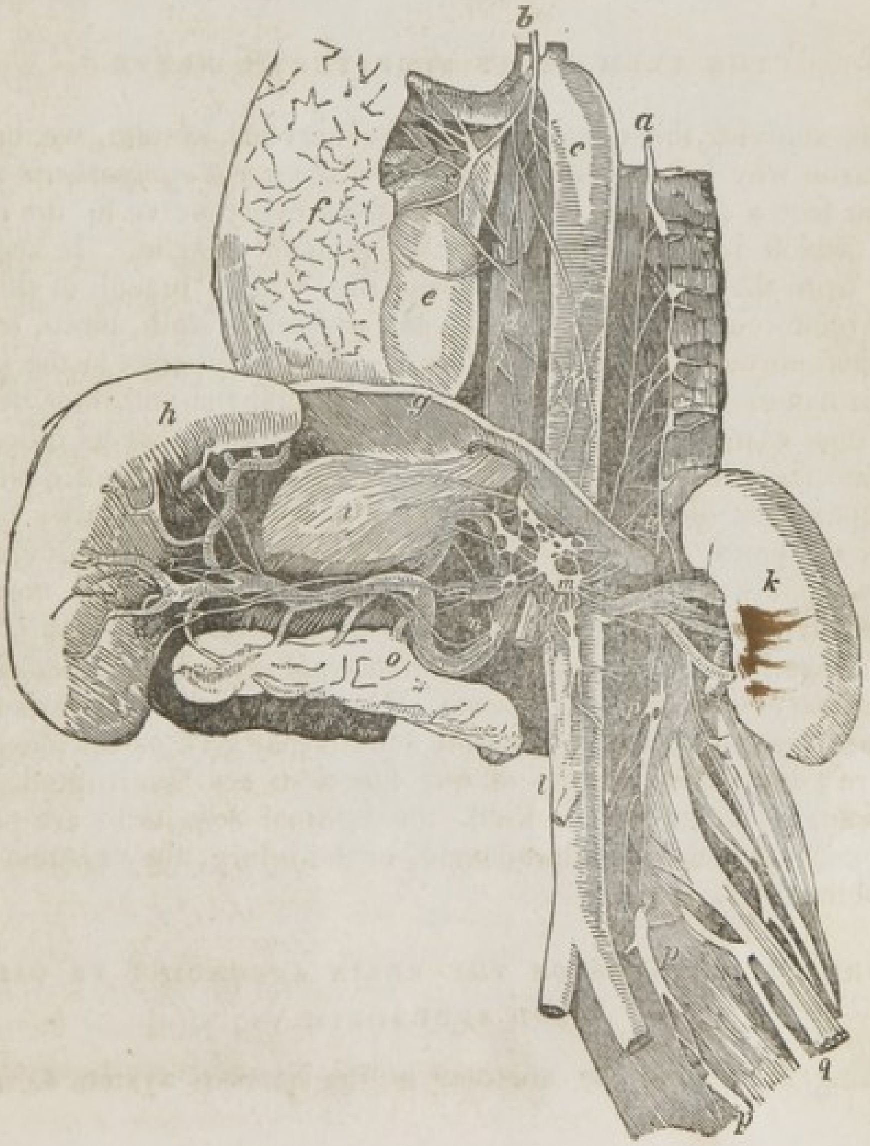


Fig. 246, exhibits some of the principal nervous ganglia and plexuses of the thorax and abdomen, on the left side, and the pneumo-gastric nerve, on the same side.

a, *a*, thoracic ganglia.

b, the pneumo-gastric nerve.

c, a branch of the former, called the inferior laryngeal or recurrent, curving round the arch of the aorta.

d, the œsophageal plexus.

e, the pericardium. *f*, the lungs.

r, the pulmonary plexus.

g, the diaphragm. *h*, the spleen.

i, the stomach.

The two last-named organs are turned to the opposite side to show the distribution of the nerves.

k, the kidney. *l*, the abdominal aorta.

m, the semilunar ganglion, and solar plexus ; the latter radiating to all the divisions of the aorta.

n, the splenic plexus. *o*, the pancreas.

p, *p*, *p*, the lumbar ganglia.

q, the obturator nerve.

THE TERM GREAT SYMPATHETIC NERVE.

After studying this department of the nervous system, we can see the reason why it is usually denominated the *great sympathetic nerve*. It is in fact a collection of filaments from every nerve in the animal fabric, which join each other at the adjacent ganglia. It seems to spring from the sixth nerve, and from the Vidian branch of the fifth, and is reinforced by filaments from the seventh, eighth, ninth, and all the spinal nerves, to the lumbar region, and terminates in the pelvis.

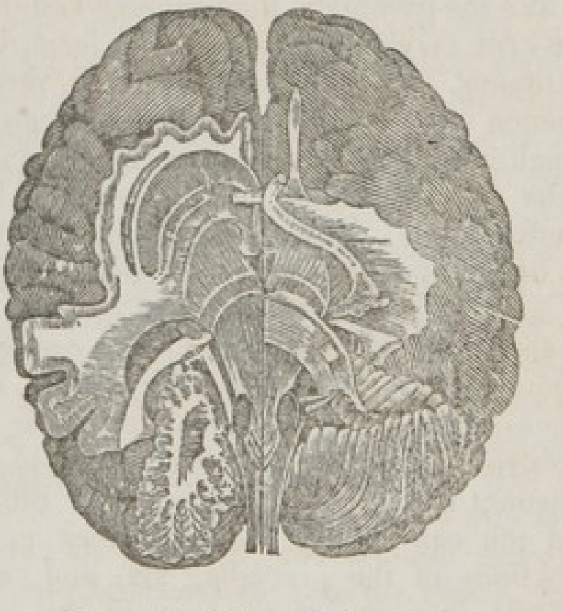
This name, which has been given to the ganglia and their nervous radiations, expresses the conviction of anatomists, that its office is to associate the affections of different parts. And we cannot doubt that this department directs and controls the actions, and endows organic life, or the parts within, with its due sensibilities ; the visceral sensations are always involuntary ; they are generally vague, confused, and usually more or less fugitive, and do not, for any length of time, become fixed in the mind. If our internal organs act according to the ordinary laws of organization, the sensations which arise from them are agreeable, and the healthy actions may give us the most vivid pleasure ; but if the actions of our functions are interrupted, if our organs are wounded or diseased, the internal sensations are painful, and according to the disordered state, or the injury, they assume a different character.

FORMATIVE FIBRES OF THE BRAIN ACCORDING TO GALL AND SPURZHEIM.

Having completed the anatomy of the nervous system as usually described in elementary treatises on the subject, it may not be considered superfluous to give briefly the views of Drs. GALL and SPURZHEIM, relative to the manner in which the cerebral hemispheres are formed. The following appears to be the simplest exposition, and is selected from recent writers. The cerebral hemispheres are considered by the above anatomists as resulting from an expansion of the fibres of the medualla; hence they are termed *primitive* or *formative* fasciculi. The fibres of the anterior pyramids may be traced upwards to the margin of the pons, where they become somewhat constricted. From the inner border of each, fibres pass across the middle sulcus, and mutually change place, or decussate, those of the right side passing to the left, and *vice versâ*. If an incision, a line or two in depth, be made through the pons, so that one lateral half of it may be turned outwards, the fibres of the pyramid will be observed to pass into a quantity of gray substance lodged in the interior of the nodus encephali. In this situation the fibres diverge and separate, and are also considerably increased; at the upper margin of the pons they become continuous with the crus cerebri. Here an additional increase is derived from their passage through the gray substance lodged in the interior of the crus, after which they proceed through the inferior cerebral ganglion (*thalamus nervi optici*), and in the next place through the superior one (*corpus striatum*), being successively increased and rendered still more divergent, until they finally reach the anterior and middle lobes, where they are evolved into their inferior, external, and anterior convolutions. The corpus olivare contains within itself a small ganglion; its fibres pass without any decussation, into the gray substance lodged in the cerebral protuberance, where, like the pyramids, they receive additions, after which they pass into the crus cerebri, of which they form the posterior and inner part. Continuing their ascent, they pass through the optic thalamus, and thence into the corpus striatum, receiving additions as they radiate through each, and finally, are continued upwards into the convolutions at the summit of the hemisphere, and backwards into those of the posterior lobe. Previously to entering the optic thalamus, some fibres of the corpus olivare have been observed to turn inwards, so as to give to the tubercula quadrigemina their medullary investment, and also to unite with those of the opposite side to form the valve of Vieussens. The *diverging* fibres, thus traced up through their successive steps of increase, terminate in the gray substance of the convolutions; but another order of fibres may be observed quite distinct from these, and taking a different direction. These are called the *converging fibres*, as they commence at the peripheral terminations of the preceding set, and pass from without inwards to the middle line, so as to connect the lateral parts, and bring them into relation with one another; on which account they are called *commissures*. The anterior and posterior commissures are formed in this way, as is also the corpus callosum; though the greater number of the fibres which compose the latter are transverse, those towards its extremities are oblique. This is owing to the manner in which the converging fibres of the anterior lobe are constrained to pass from before backwards, and those of the posterior lobe from behind forwards, in order to gain the corresponding borders of the corpus callosum. By this arrangement a greater number of fibres are collected to its extremities, which render them thicker (particularly the posterior one) than any other part of its extent. Some of the inferior fibres thus traced from without inwards, instead of uniting with the corresponding set along the middle line, become reflected downwards from the under surface of the corpus callosum to the fornix, the fibres of which are stretched from behind forwards in such a way, that whilst its body is in a manner unattached, the extremities are identified with the parts just referred to.

The formative fibres of the cerebellum are derived from the posterior pyramids, or corpora restiformia ; they pass upwards and outwards, and soon meet the corpus rhomboideum, which is considered as the ganglion of the cerebellum ; the fibres are supposed to proceed through the gray substance of which it is composed, though it is difficult to demonstrate the fact ; after which they pass outwards, diverging into the lobes of the cerebellum. The converging fibres, by their union, form the crura cerebelli, and the fibres of the crus, expanding as they pass downwards and inwards, constitute by their junction the pons Varolii, which brings the lateral lobes of the cerebellum into relation, and forms their commissure. The processus a cerebello ad testes bring the lobes of the cerebellum into intimate connexion with the cerebral hemispheres.

Fig. 246.*



Formative Fibres of the Brain.

ART. VIII.

CHAP. I.

PARTICULAR ORGANS OF SENSATION.

THE EYE AND ITS APPENDAGES.

THE eye and its appendages consist of the globe of the eye, the eyebrow, the eyelids, the ciliæ, the Meibomian, and the lachrymal glands.

EYEBROWS.

The eyebrows are covered with short stiff hairs, generally of the same color as the hair of the head. The skin, in which the bulbs of the hair are implanted, is placed upon a thick layer of adipose cellular tissue. The frontal, the corrugator supercilii, and the orbicularis palpebrarum muscles move them in the various expressions of the face.

The projection of the eyebrow guards the eye against external violence; the hairs, on account of their oblique direction, and the oily matter with which they are covered, prevent the perspiration from flowing towards, or irritating the eye; they direct it towards the temple, and the root of the nose.

EYELIDS. (PALPEBRÆ.)

The eyelids are those movable veils which cover the anterior part of the globe of the eye.

The *upper eyelid* is possessed of great mobility; it is chiefly by it that the eye is closed, for the motion of the lower eyelid is very limited.

The two eyelids are united at their extremities, forming two angles, of which the inner is more open than the outer. The edges of the eyelids are supported by fibro-cartilages, named the *tarsal cartilages*, which keep the eyelids always extended and accommodated to the form of the globe of the eye.

The posterior edges of the cartilages are so shaped as to form a triangular groove for the tears, when the eyelids are shut, and as the outer angle of the eyelids is higher than the inner, the tears are directed towards the puncta lachrymalia, which are situated at the inner angle.

The eyelids cover the eye during sleep, and preserve it from the injurious effects of extraneous particles flying about in the air ; they defend it from sudden shocks by an instantaneous closure ; and by their repeated motions (nictitation) diffuse the lachrymal fluid over the surface, and preserve it in that polished state which is necessary for perfect vision. The eyelids also by their partial closure, moderate the effects of too brilliant a light, by admitting only so much as will not offend the eye.

The *eyelashes*, or *ciliæ*, are strong hairs, most commonly of the same color as the hair of the head, and are arranged in double or triple rows on the edges of the eyelids ; those of the upper eyelid are longer than those of the lower, and are curved upwards ; those of the under eyelid are directed downwards.

These hairs act as a shade to the eye, moderate the intensity of the light, and prevent dust and other extraneous substances from falling into the eye.

The *Meibomian glands*, or *ciliary follicles*, are small glandular bodies situated in grooves, between the tarsal cartilages and the tunica conjunctiva ; they are arranged in two vertical lines ; these follicles communicate with each other, and those nearest the edges of the eyelid open by minute orifices behind the ciliæ.

A sebaceous matter exudes through the orifices of these glands, and which may be seen in the form of minute cylinders on pressing the tarsal cartilages.

The *tunica conjunctiva*, or *tunica adnata*, is a very thin transparent mucous membrane, which lines the posterior surface of the eyelids, and is continued over the fore part of the globe of the eye. It becomes thin and transparent on the cornea, so much so, that some anatomists have doubted whether it extends over the entire of its surface.

On the inner angle of the eye, the tunica conjunctivia forms a small crescent-shaped fold, which has some resemblance to the third eyelid of birds, and is therefore named by some anatomists the *membrana nictitans.**

The *caruncula lachrymalis* is a small membranous elevation, situated in the inner angle of the eye ; it is formed by a fold of the tunica conjunctiva, in the substance of which are mucous follicles, and the bulbs of some very minute hairs.

The rose color of this small body indicates the energy of the general system, and its paleness, on the contrary, denotes a state of debility and sickness.†

THE GLOBE OF THE EYE IN GENERAL.

The eye is composed of two distinct portions of a sphere united to

* This loose fold of the conjunctiva has not the office nor the muscular apparatus of the nictitating membrane, and is consequently very erroneously named.

† A description of the lachrymal apparatus is given in the article on the *organs of secretion*.

each other; the anterior segment, which forms about the fifth part of the globe, has the smallest diameter. See Fig. 247.

1. THE SCLEROTICA.

The *sclerotica*, (*cornea opaca*) is a strong, opaque, fibrous substance, which preserves the globular figure of the eye; it is an envelope which defends its more delicate internal structure, and serves as a point of insertion for those muscles which move the eye. It forms about four-fifths of the external investment of the eye, extending from the entrance of the optic nerve to the border of the cornea. The external surface is in relation with the conjunctiva, the expansions of the muscles, and the vessels and nerves of the orbit. It has on its internal face the choroid membrane. Posteriorly it is pierced by the optic nerve, and this aperture is divided by a number of septa, so as to constitute a cribriform plate through which the pulp of the nerve passes. Anteriorly it receives the cornea which is inserted into it somewhat like a watch-glass into its case.

2. THE CORNEA.

The *cornea* (*cornea pellucida*) forms the anterior transparent portion of the globe of the eye; it is not perfectly circular, the transverse diameter being a little longer than the vertical. The cornea is incased in an aperture of the sclerotica, and presents the appearance of a segment of a small sphere added to a larger. Its anterior surface, which is convex, is in contact with the conjunctiva; the posterior is concave, and is lined by the membrane of the aqueous humor. Its degree of convexity varies in different individuals, and at the different periods of life.

The cornea is thicker than the sclerotica, and is composed of several distinct laminæ superimposed on each other; it does not appear to contain either blood-vessels or nerves. When the eye is removed from its socket, and compressed between the fingers, a serous fluid exudes from between the laminæ of the cornea.

Part of the light which reaches the cornea is reflected from its finely polished surface, and thus contributes to the brilliancy of the eye; but its principal office is to cause the rays to converge to the axis of the eye.

THE CHOROID MEMBRANE.

The *choroid*, or the second membrane, is of a dark brown color, soft, cellular, and vascular; it is situated on the inner surface of the sclerotica; its outer surface is connected to the sclerotica by vessels and nerves; its inner surfaceis merely contiguous to the retina without adhering to it.

The choroid membrane is chiefly composed of minute arteries* and veins, united by fine cellular tissue ; it is so exceedingly vascular, that after a successful injection of its blood-vessels, it assumes a uniform red color. These vessels form two laminæ, which may be separated from each other. The inner lamina was first successfully injected by RUYSCH, and his son subsequently named it *tunica Ruyschiana.*

The *pigmentum nigrum* is a dark brown substance, covering the outer and inner surface of the choroid membrane ; on the latter surface this substance is more abundant, and is in immediate contact with the retina. Its office is, apparently, to absorb the rays of light immediately after they have impinged on the sensible surface of the retina.†

Persons termed *Albinoes* have no pigmentum nigrum, therefore the iris and pupil appear of a red color, and their vision is very imperfect, that is, they cannot view objects in a strong light ; even during the day time they can scarcely see sufficiently to go about.

THE CILIARY CICRLE OR LIGAMENT.

Towards the margin of the cornea, the choroid adheres firmly to the sclerotica, constituting what is termed the *ligamentum ciliare ;* within, it has the appearance of folds, which are called the *ciliary processes ;* they indent the hyaloid membrane, where it splits to form the Petitian canal. The intervals of these processes are covered by the pigmentum nigrum.

The *ciliary processes* are sixty or seventy in number, arranged in a radiated manner around the lens, on the fore part of the vitreous humor. Each extends inwards and backwards from the ciliary ligament as far as the border of the lens. The anterior edge of each process is connected to the ciliary ligament and iris, the posterior to the vitreous humor ; and the internal is loose, and forms the circumference of the posterior chamber of the eye.

THE IRIS.

The iris is a delicate circular membrane, floating in the aqueous humor, and suspended vertically behind the cornea, so as to divide

* The ciliary arteries have been described. The veins have a peculiar arrangement, being disposed in whirls, and are therefore denominated *vasa vorticosa*, and open into the ophthalmic vein.

† Mr. G. H. Fielding, in a communication delivered at Oxford, before a meeting of the British Association, stated his opinion, that this substance does not at all possess the properties of a pigment ; that its colors are not, as it has been supposed to be, the result of any secreted matter ; that it consists of layers separable from the Ruyschiana : that it possesses *elasticity*, and above all, circulation ; he thinks, therefore, that we are warranted in coming to the conclusion, that it is a *membrane* and not a *pigment*.

To this membrane he has given the name of MEMBRANA VERSICOLOR, from the great variety of color it has in different animals. He supposes that it receives the impression of images through the transparent retina.

the space between this and the lens into two chambers, an anterior and posterior; the former is the larger of the two. These chambers communicate through the central aperture in the iris, the *pupil*.

The iris is so named from its being of different colors;* it is a kind of circular curtain placed in the anterior part of the eye, to regulate the quantity of light passing to the back part of the eye.

The *outer circumference* is attached to the ciliary circle; its *inner circumference* forms the limits of the pupil.

The iris floats in the aqueous humor, and is of a very contractile nature, so that when the eye is exposed to a strong light, or when we look upon a near object, the diameter of the pupil is diminished; and *vice versâ*.

Upon the back part of the iris there is a dark-colored secretion, resembling the pigmentum nigrum. This surface is called the *uvea*.

The iris is composed of two laminæ, intimately united near the pupil. Some anatomists of great merit state that these laminæ are two sets of muscular fibres, the one concentric, round the pupil, composed of circular fibres contracting the pupil in the manner of a *sphincter*; the other radiated, and having by its muscular action the power of contracting the iris, and consequently enlarging the pupil.

The ciliary arteries, which supply the opposite sides of the iris, freely unite with each other: and the smaller vessels of the iris form a circle round the pupil.

The iris is supplied with nerves by filaments from the ciliary nerves.

The motions of the iris are involuntary, and depend on the quantity of light falling on the retina; for when the retina loses its sensibility, the iris does not move, but remains dilated.

The pupil in the fœtus is closed by a delicate but vascular membrane, termed the *membrana pupillaris*, which is either ruptured at, or a short time previous to birth.

THE RETINA.

The *retina* (*tunica nervea*) is called the third membrane of the eye; it is a soft, thin, semitransparent, nervous expansion, extending from the optic nerve to the crystalline lens, embracing the vitreous body, and lining the choroid membrane, without adhering to either of these two parts.

At the posterior part of the retina, and exactly in the axis of vision, there is a circular foramen surrounded by a bright yellow border. This was discovered by SOEMMERING, and is named the *foramen centrale*, or more frequently the *foramen of* SOEMMERING; it is about one thirty-third of an inch in diameter, but its office is not perfectly understood. BLUMENBACH supposed that it might serve as a

* The color of the iris in general corresponds with that of the hair, being blue or gray where the hair is light, and brown or black where the hair and complexion are of a dark color.

kind of pupil, through which concentric rays might be absorbed by the choroid, when the eye was in danger by a very strong light.

The retina is divisible into three layers ; viz., serous, nervous, and vascular. The external or serous is extremely delicate, and is the one discovered by Dr. JACOB, and is now known as *Jacob's membrane*

The retina is the seat of vision, therefore the primary part of the eye, to which all the other parts, within the orbit are subservient ; nevertheless, that part of the retina, which lies over the entrance of the optic nerve, is insensible to light.

For the perfect functions of the retina, it requires the light within a certain degree of intensity : a very feeble light is not felt by the retina ; too strong a light hurts it, and renders it for some time unfit for action.

Fig. 247.

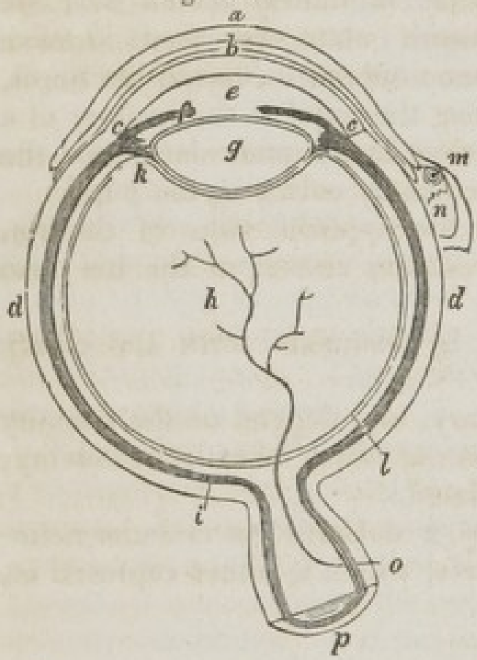


Fig. 247. A diagram of the eye.
a, the eyelid.
b, the tunica conjunctiva, lining the eyelids, and reflected over the anterior part of the eye.
c, *c*, the cornea.
d, *d*, the sclerotica.
e, the aqueous humor.
f, the iris.
g, the crystalline lens.
h, the vitreous humor.
i, the choroid tunic, with its pigmentum nigrum.
k, the ciliary processes.
l, the retina.
m, the punctum lachrymale.
n, the caruncula lachrymalis.
o, the central artery of the retina.
p, the optic nerve.

THE AQUEOUS HUMOR.

The aqueous humor is as clear as the purest water, but its specific gravity is somewhat greater ; it is about five grains in weight, and consists of water impregnated with albumen, gelatin, and muriate of soda.

The aqueous humor is situated between the cornea and crystalline lens, and, being confined in this space, forms a meniscus, which assists in collecting and transmitting the rays of light to the inner part of the eye.

The light only which passes the pupil can be of use in vision ; that which falls on the iris is reflected, returns through the cornea, and exhibits the color of the iris.

The *membrane of the aqueous humor* is extremely thin, and perfectly transparent, lining all the anterior chamber of the eye, but not extending to the posterior chamber. The first of these chambers is about two lines, the latter about half a line in depth. This membrane secretes the aqueous humor in the first instance, and reproduces it when evacuated by accident or during operations.

THE CRYSTALLINE LENS.

The crystalline lens is a transparent body, placed between the aqueous humor and the vitreous body, lying behind the iris, surrounded by the ciliary processes. It is a double convex lens, of which the anterior surface is flatter than the posterior, the diameter of which is four lines, and its thickness about two ; its axis corresponds to the centre of the pupil.

The lens appears to be composed of several distinct layers, an exterior, very soft and easily removed, and the interior forming a more solid nucleus, made up of a great number of concentric superimposed laminæ ; and each of these laminæ is composed of very fine fibres, like those of spun glass.

If the lens be dried, it may also be divided into three segments of a sphere, in the centre of which there exists a small transparent globule.

In its chemical composition it differs very little from the aqueous humor, only in having a larger proportion of gelatin and albumen, and in being free from saline matters.

The *membrane*, or *capsule*, of the lens is also perfectly pellucid, and adheres very slightly to the lens, so that when the capsule is punctured, upon making gentle pressure on the eye, the lens starts out. The capsule receives a minute branch of the central artery of the retina, and ramifications of the vessels of the ciliary processes. It incloses a small quantity of fluid which is termed *liquor Morgagni*.

The crystalline lens is retained in its situation by numerous delicate transparent filaments, which pass from the ciliary processes to the circumference of the capsule of the lens.

The office of the lens is not only to assemble the rays of light upon a certain part of the retina, but to increase the intensity of the light, which is directed towards the back of the eye. It may also be added, that the light, which passes near the circumference of the crystalline lens, is probably refracted in a different manner from that which passes through the centre ; so that its peculiar structure is supposed to have the effect of correcting that aberration which is always produced by the sphericity of ordinary lenses.

THE VITREOUS BODY.

The *vitreous body*, or *humor*, is so called from its resemblance to melted glass : it is a perfectly transparent tremulous mass, occupying the globe of the eye, from the entrance of the optic nerve to the surface of the crystalline lens, or about the posterior two-thirds of the globe. It is invested, in nearly its whole extent, by the retina, but to which it is not adherent ; so that its connexion with the other parts of the eye is merely by the central artery of the optic nerve, which passes through it, to the posterior part of the capsule of the lens.

The vitreous body is composed of a fluid or humor contained in cells, formed of the hyaloid membrane.

The chemical properties of the fluid of the vitreous body are similar to those of the aqueous humor.

The *hyaloid membrane*, which contains the vitreous humor, is excessively thin and transparent, and constitutes an innumerable mass of *cellules* which communicate with each other, so that, by making a puncture in the hyaloid membrane, the whole humor will escape.

Fig. 248.

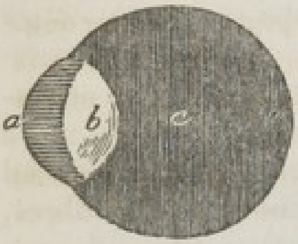


Fig. 248, the refracting media of the eye.
a, the aqueous humor.
b, the crystalline lens.
c, the vitreous humor.

Fig. 249.

The *Petitian canal* is named after PETIT, who discovered it. This canal, Fig. 249, is formed merely by, *b*, the laminæ of the vitreous humor which passes before and behind, *a*, the lens, and becomes identified with its capsule; thus, leaving at, *c*, its margin, a somewhat triangular space, which may be demonstrated by inflation : although, strictly speaking, it does not exist in its natural state, for the laminæ are in perfect contact, the canal being formed artificially, by blowing air between the posterior surface of the capsule of the lens, and the hyaloid membrane on which the lens rests.

The anterior lamina of the canal of PETIT presents radiated striæ and contractions, corresponding to the ciliary process, forming a curious and beautiful appearance.

The vitreous body possesses a less refractive power than the crystalline, therefore, after the rays are collected by the latter, the vitreous body continues their convergence, increases the field of vision, and assists in bringing the rays to an accurate focus on the retina.

CHAP. II.

THE EAR AND ITS APPENDAGES.

THERE are a number of organs in the apparatus of hearing, which, by their physical properties and functions, concur in collecting and transmitting sounds, and there is a nerve for the purpose of receiving and conveying the impressions of sonorous vibrations to the sensorium.

The organ of hearing is divisible into three parts, viz, the external ear, or auricula, the tympanum, and the labyrinth.

THE EXTERNAL EAR.

The *external ear* comprehends the *pinna* or *auricle*, and the *meatus auditorius externus.*

The *auricle* consists of the *pavilion*, or *ala*, which is by much the greater part of it, and the *lobus*, which is the most dependent portion.

The exterior of the ear presents the following remarkable prominences and depressions, viz :—

Fig. 250.

1. *h*, *h*, Fig. 250, the *helix*, a rim of nearly a semicircular shape surrounding its upper edge ; and continued to, *l*, the lobe of the ear.

2. *a*, the *anti-helix*, an inner semicircular eminence, which is situated within the former, and is formed superiorly of two ridges uniting together below —

s, the *scapha*, the depression which separates the two roots of the anti-helix.

3. *t*, the *tragus*, a small eminence situated over the meatus externus, and connected to the under and fore part of the helix.

4. *a*, *t*, the *anti-tragus*, is another eminence situated behind, nearly opposite to the tragus, and at the inferior extremity of the anti-helix.

5. *c*, the *concha*, is a large cavity under the anti-helix, and leading to the meatus auditorius.

6. *l*, the *lobe of the ear*, is the inferior soft part of the ear, and is composed of cellular tissue, with a small quantity of fat. This is the part which it has been customary, in many countries, to perforate for the purpose of suspending rings and other ornaments.

The office of the auricle of the external ear is to collect the sonorous radiations, and to direct them towards the auditory passage.

FIBRO-CARTILAGE OF THE EAR.

Fig. 251.

The fibro-cartilage of the ear, Fig. 251, constitutes its basis, determining the form of that part : in its consistence and elasticity, it is analogous to those of the nose.

All the eminences and depressions just described are formed by it, as may be seen in the annexed figure — *h*, *h*, the cartilage of the helix ; *a*, the anti-helix ; *s*, the scapha ; *t*, the tragus ; *a*, *t*, the anti-tragus ; *c*, the concha. These fibro-cartilages are covered by a dermal layer, having a great number of sebaceous follicles disposed through it. The inner surface of, *t*, the tragus, is furnished with hairs, which appear destined to prevent small particles, which float in the atmosphere, from entering the auditory passage.

There are ligaments which serve to fix the fibro-cartilage to the side of the head, called the *superior*, the *anterior*, and the *posterior ligaments* ; they are more cellular than fibrous, and are intermingled with the muscular fibres of the auricle.

The principal muscles of the ear have been already described, and those that remain, which belong to the cartilage, are of small size ; one or more of them are sometimes absent ; at other times, CLOQUET states, he could meet with none ; indeed, so insignificant are these muscles that I am not aware that, in any person, they possess the power of moving the part they are attached to. The following, however, is an enumeration of them.

1. The *transversus auris*, extending from the convexity of the concha, to the prominence which the groove of the helix forms posteriorly.

2. The *tragicus*, is of a triangular form, and almost entirely covers the outer surface of the tragus.

3. The *anti-tragicus* occupies the interval which separates the anti-tragus from the anti-helix.

4. The *helicis major* covers, for a few lines, the helix above the tragus.

5. The *helicis minor* is situated beneath and behind the preceding, on the prominence of the helix.

The muscles of the external ear, no doubt, are calculated to expand the different hollows of which the surface is formed. Among savage tribes the ear is prominent and movable, like the ears of animals ; their hearing is more acute than that of civilized nations ; and it is probable, that the motion of the external ear assists them in discriminating the nature of different sounds.

THE AUDITORY CANAL.

This canal extends from the concha of the ear to the membrane of the tympanum ; it is composed of bone and cartilage, lined by a very fine skin, and defended by a peculiar acrid sebaceous substance, the *cerumen*, or the wax, furnished by the *cerumenous glands* ; this canal is also fenced by a number of hairs. It takes a direction first forwards, upwards, and inwards, then downwards and inwards. It is therefore curved, or concave downwards, and about an inch in length.

THE INTERNAL EAR.

The internal ear consists of the cavity of the tympanum, the vestibule, the cochlea, and the parts communicating with them.

The *tympanum* is a narrow chamber which opens into the posterior fauces through the *Eustachian tube*, and is continued backwards into the cells of the mastoid process of the temporal bone.

The *Eustachian tube* descends obliquely forwards and inwards, and terminates in a trumpet-shaped mouth, behind the posterior nares, on a level with the inferior spongy bone. It is small and osseous posteriorly ; anteriorly it is large, and formed externally of membrane, and internally of fibro-cartilage. It is lined by mucous membrane. Through this tube, the air can pass from the fauces into the tympanum, to support the latter on its internal surface.

The *membrana tympani* is extended over the circular opening, at the bottom of the external meatus.

The *foramen ovale*, or *fenestra ovalis*, is an aperture of a shape which the name implies ; it forms a communication between the tympanum and vestibule.

The *foramen rotundum*, or *fenestra rotunda*, is of smaller dimensions than the preceding foramen, and forms a communication between the inner scala of the cochlea and the tympanum.

The *promontorium* is an eminence formed by the outer side of the vestibule, and by the corresponding scala of the cochlea.

THE BONES CONTAINED IN THE CAVITY OF THE TYMPANUM, OR THE OSSICULA AUDITUS.

A series of very small bones* extends from the membrana tympani to the fenestra ovalis, and consequently to the labyrinth. These convey to the deepest parts of the internal ear the changes which supervene in the membrane of the tympanum. They are named the *malleus*, the *incus*, the *os orbiculare*, and the *stapes*, and there are muscles appropriated to put them into motion.

Fig. 252.

The *malleus*, Fig. 252, which is described as having a head, a neck, a handle, and a process.

The handle of the malleus is attached to the membrana tympani, being situated between the layers of it.

Fig. 253.

The *incus*, Fig. 253, consists of a body and two crura. It is articulated to the malleus, and is fixed by a ligament to the sides of the mastoid cells.

Fig. 254.

The *os orbiculare*, Fig. 254, is articulated to the long process of the incus.

Fig. 255.

The *stapes*, Fig. 255, is distinguished into a head, crura, and base. This bone is placed horizontally, with its base resting against the fenestra ovalis, and its head articulated with the os orbiculare.

* The annexed figures of the bones, as well as those which follow with the muscles attached to them, are magnified to twice the natural size.

There are three muscles by which this series of bones is moved :—

Fig. 256.

1. The *laxator tympani*, Fig. 256, *a*, is attached to the upper part of the edge of the tympanum, near to the part to which the membrane of the tympanum adheres, and is extended to the handle of the malleus.

2. The *tensor tympani*, *c*, is attached to the upper part of the Eustachian tube, and to the handle of the malleus below its process.

3. The *extensor mallei*, *b*, or the *musculus processus minoris* of Valsalva, is figured by Sir C. Bell ; but it is not acknowledged by Cloquet and some other anatomists to be of the nature of a muscle.

Fig. 257.

4. The *stapedius*, Fig. 257, *a*, is the smallest muscle, and is attached near the mastoid cells, and into the head of, *b*, the stapes.

THE LABYRINTH.

Fig. 258.*

The *labyrinth*, so called from its sinuosities and windings, is situated between the tympanum and the meatus auditorius internus ; it is formed of several cavities, which are designated by the names of, *a*, the vestibule, *b*, the cochlea, and, *c*, *c*, *c*, the semicircular canals.

The *vestibule*, named from its forming an entry to the cochlea and semicircular canals, is a cavity of an irregular form, containing several apertures, which communicate with the neighboring parts, which we must again notice, viz.: —

1st. *d*, the *fenestra ovalis*, or *foramen ovale*, which communicates with the tympanum, and upon which is placed the base of the stapes. 2d. Superiorly, the two anterior orifices of the superior vertical and horizontal semicircular canals. 3d. Posteriorly, the two separate openings of the semicircular canals, and one opening common to the two vertical canals. 4th. On the inner side is a number of small perforations for the transmission of blood-vessels and branches of the auditory nerve. 5th. Near the common orifice of the vertical canals we find the opening of the aqueduct of the vestibulum, extremely small, extending from this cavity to the posterior surface of the petrous portion of the temporal bone.

* To obtain the exact form of the exterior of these parts, we may pour melted lead into the external meatus of the temporal bone, the bone may be afterwards easily removed, and we have a metallic cast of these delicate parts.

THE COCHLEA.

The *cochlea*, Fig. 259, is situated on the inner side of the vestibulum, in the anterior part of the petrous portion of the temporal bone: it is an osseous, shell-like cavity, formed by two conical canals, twisted in a spiral direction. See Fig. 258, *b*.

Fig. 259.

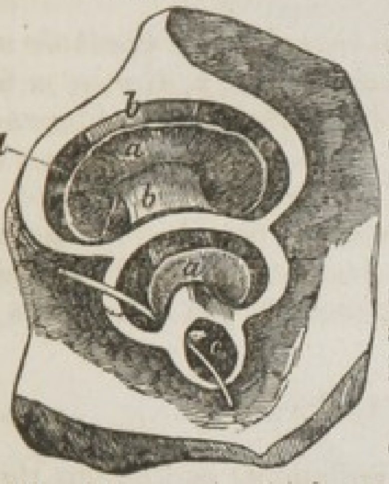


Fig. 259, represents a section of that part of the petrous portion of the temporal bone which contains the cochlea.

1st. *b*, *b*, the *modiolus*, an osseous conical pillar in the centre of the cochlea, terminating in a small cavity, *c*, called the *infundibulum*.

2d. *a*, *a*, the *lamina spiralis*, formed round, *b*, *b*, the modiolus, takes two turns and a half, and terminates by a hook at *c*, in the infundibulum.

3d. The *spiral septum*, dividing the cavity of the cochlea into two smaller ones.

4th. The *gyri*, which are the spiral cavities formed by the septum.

5th. The *aqueduct*, an extremely narrow passage opening, superiorly, into the cavity of the tympanum, near the foramen rotundum; inferiorly, in the posterior petrous portion of the temporal bone.

THE SEMICIRCULAR CANALS.

The form of the three canals, Fig. 258, *c*, *c*, *c*, is indicated by the name; they are situated in the substance of the petrous portion of the temporal bone, and open into the vestibulum by five orifices.

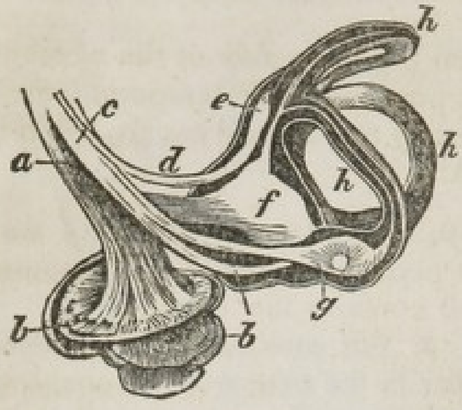
The cavities of the internal ear are lined by a very delicate membrane; and each of the semicircular canals contains a membranous tube, opening into a common sac, which occupies a portion of, *d*, the vestibulum, and contains a small quantity of a peculiar fluid. The vestibulum also is lined by another membranous sac, filled with a limpid fluid, called the *liquor of* COTUNNIUS; it sends a prolongation of its membrane into the aqueduct of the vestibulum, and this prolongation terminates in a small cul-de-sac under the dura mater.

The membrane of the vestibule appears to introduce itself into the cochlea by the orifice of the external scala, lines all its cavities, is continued into the aqueduct of the cochlea, and terminates by a cul-de-sac under the dura mater.

THE ACOUSTIC, OR AUDITORY NERVE.

The acoustic nerve proceeds parallel to the facial, so long as it is contained within the skull; it then introduces itself with it into the internal auditory canal, and divides into two branches: —

Fig. 260.



1. The *branch of the cochlea*, Fig. 260,* *a*, on arriving at the base of the cochlea divides into a great number of very slender filaments, which enter into apertures of the cochlea, and spread out their ramifications on, *b*, *b*, the lamina spiralis, in a very dense net-work.

2. The *branch of the vestibule and semicircular canals*, *e*, *d*, *g*, is at first united to the preceding, but afterwards separates from it, and forms an enlargement, from which proceed filaments, which are distributed to, *f*, the vestibule, and to, *h*, *h*, *h*, the semicircular canals. At the entrance of the posterior vertical canal, we observe, at *g*, the increased size of the nerve in the ampulla, or enlargement of the extremities of the canals.

MECHANISM OF HEARING.

The external ear collects the sonorous radiations, and directs them towards the auditory passage ; and this tube transmits sound in the same manner as any other canal, partly by the air it contains, and partly by its parietes, until it arrives at the membrane of the tympanum ; this membrane vibrates under the influence of the sonorous undulations which the meatus conducts to it. The series of little bones, next, has a peculiar action upon the membrane of the fenestra ovalis, so that the liquor of COTUNNIUS receives vibrations which are impressed on the acoustic nerve.

The gyri of the cochlea receive the vibrations principally by the membranes of the fenestra ovalis ; the vestibule, by the series of bones; the semicircular canals, by the sides of the tympanum ; but the assistance which is given to hearing by the several parts of the internal ear is totally unknown.

It is, however, certain that impressions are received and transmitted to the brain by the auditory nerve ; and the brain perceives them with more or less facility and exactness in different individuals.

* The three last figures are considerably enlarged views.

Fig. 261.

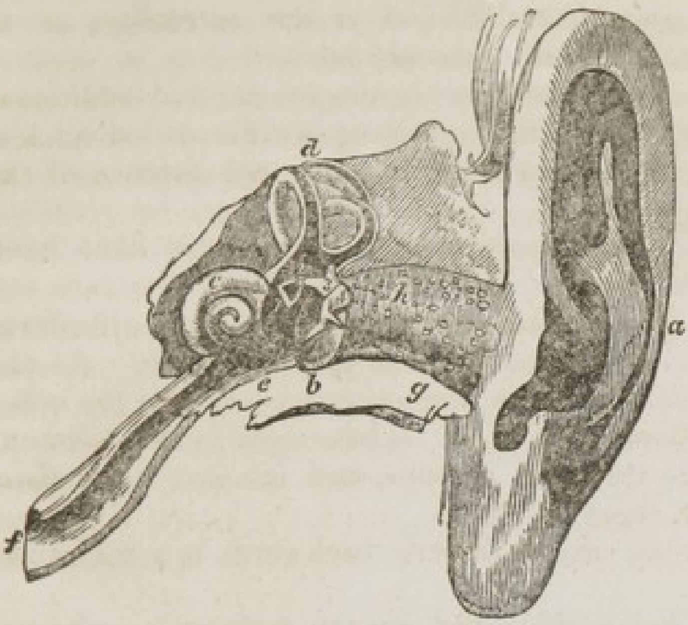


Fig. 261, exhibits the organ of hearing, of the natural size.

a, the external ear.

b, the tympanum, exposed by opening the vestibule.

c, the cochlea.

d, the three semicircular canals laid open.

e, the osseous part of the Eustachian tube.

f, the membranous extremity of the Eustachian tube, opening into the fauces.

g, the petrous portion of the temporal bone.

h, the meatus auditorius externus, on which is seen the cerumenous glands.

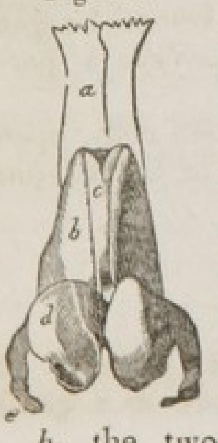
1, the stapes ; 2, the os orbiculare : 3, the incus ; 4, the malleus ; a series of bones which transmits the vibrations of the tympanum.

CHAP. III.

THE NOSE, OR ORGAN OF SMELL.

THE external part of the organ of smelling, or the nose, properly so called, is composed superiorly of bones, and inferiorly of cartilages ; it has a partial covering from muscles, and a general one from the common integuments.

Fig. 262.



The osseous part of the nose has already been described ; the ossa nasi, Fig 262, *a*, forms the bridge.

The fore part of the nose contains five cartilages, of a regular figure, and some smaller pieces, which are more irregular.

The *middle cartilage*, *c*, is the most considerable, and supports the rest ; it constitutes the cartilaginous part of the septum narium, and is united to the anterior edge of the nasal lamilla of the ethmoid bone, to the anterior edge of the vomer, and to the fore part of the spinous process of the superior maxillary bones.

b, the two superior *lateral cartilages* are placed somewhat anteriorly, so that by their union they form the centre of the nose; *d*, the two inferior, laterally, and at the extremity, so as to form the tip of the nose; and, *e*, the alæ nasi.

Between the anterior and posterior cartilages, we find additional cartilages, the number, size, and figure varying in different individuals.

The elasticity of the cartilages contributes to the defence of the nose against external injuries.

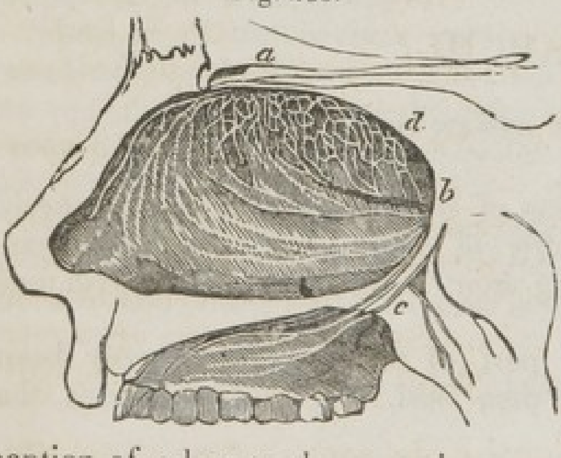
The muscles which move the cartilages of the nose have been described.

The internal cavities of the nose extend upwards to the cribriform plate of the ethmoid, and to the body of the sphenoid bone. At the inner side, they are bounded by the septum narium, and on the outer side, by the turbinated bones, which, as we have seen in the skeleton, project considerably into the nasal cavities, and increase the surface of the membrane of the organ of smell.

The floor of the nostrils passes directly backwards in a horizontal direction to the throat.

The nose is lined by a thick and spongy mucous membrane, termed the *membrana pituitaria* of SCHNEIDER, or the *Schneiderian membrane*; which secretes a mucus that defends the nerves from the current of air which is respired; by this means they are preserved moist, and rendered fit for the impression of effluvia. This membrane adheres to the periosteum, to the sinuses, to the lacrymal sacs, Eustachian tubes, pharynx, and palate, and is intended to stop any foreign body which may be mixed with the air. The pituitary membrane is extremely vascular, and over the whole of it are distributed filaments of, —

Fig. 263.



b, Fig. 263, the fifth pair of nerves, which endue the membrane with ordinary sensibility. The distribution of the first nerve, *a*, *d*, the olfactory, is more limited. The latter perforates the cribriform plate of the ethmoid bone, and spreads in numerous filaments over the septum narium, and surface of the upper turbinated bones; this nerve is the essential organ of smell, and conveys a perception of odors to the sensorium.

The maxillary and sphenoid sinuses, and the ethmoid cells, open into the nasal cavity, and are lined by a continuation of the mucous membrane just described.

MECHANISM OF SMELL.

A great many substances in nature emit certain particles of extreme tenuity, which are carried by the air, often to a great distance; these particles constitute odors; the organ of smelling is destined to perceive and appreciate them; thus an important relation is established between animals and other bodies. The mechanism by which we smell is extremely simple: it is only necessary that the odoriferous particles should be detained upon the pituitary membrane, particularly in the parts where it receives the filaments of the olfactory nerve. The nose also contributes to the general purposes of respiration and the modulation of the voice, and receives the superabundant fluid from the external surface of the eyes.

CHAP. IV.

THE TONGUE, OR ORGAN OF TASTE.

The *tongue* is a muscular organ, possessing great mobility, and is the principal organ of taste; but this is not its only use, for it is the chief instrument of speech and contributes to the acts of sucking, mastication, and deglutition.

The *muscular portion of the tongue* forms the greater part of its substance, and is composed of the fibres of the stylo-glossi, the hyo-glossi, and the genio-glossi muscles, which have already been described: beneath and on each side also, are two parallel fasciculi of fibres, which are named the lingual muscles. All these muscles, however, have their fibres interwoven in a most inextricable manner. In the upper part of the tongue, there are interposed small adipose globules.

At the centre of this fleshy tissue there is a fibro-cartilaginous septum, which gives attachment to the muscular fibres.

The *mucous membrane*, which lines the whole interior of the mouth, passes to the under surface of the tongue, forming in the centre a fold which is named the *frænum linguæ*. The same membrane then extends on each side, beneath the tongue, ascends upon its edges, passes over its upper surface, and forms three folds near the epiglottis.

On the upper surface of the tongue the mucous membrane presents a very different appearance to that on its inferior surface; there it assumes a distinct epidermis, under which is a tissue formed of numberless vessels and nerves, which constitute a network, surrounding the papillæ and mucous follicles, and which give to the tongue the red color peculiar to it. The upper surface is rendered rough and uneven by the existence of a very great number of projections differing in their form. These are the *papillæ*, which may be distinguished into three kinds.

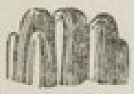
1. The *enticular papillæ* vary in number from nine to fifteen ; they are observed only at the posterior part of the tongue, arranged in oblique lines, like the letter v, and meeting at a considerable depression, termed the *foramen cæcum* of Morgagni, by whom it was first described.

The lenticular papillæ are generally spherical or oval ; they are not like the other papillæ, organs of taste, but are simply mucous follicles, which open upon the tongue by very small orifices.

Fig. 264.

2. The *fungiform papillæ*, Fig. 264, of a whitish appearance, are disseminated irregularly near the edges of the tongue ; they present a rounded flattened head, supported by a narrrow pedicle.

Fig. 265.



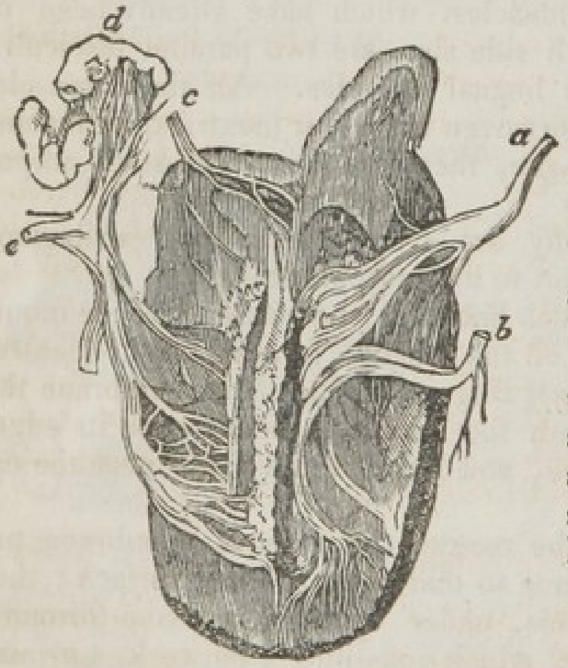
3. The *conical papillæ*, Fig. 265, or *papillæ mediæ*. — These are by much the most numerous, and occupy almost the whole upper surface of the tongue, becoming gradually shorter at the sides, and longer and more abundant at the apex, where the sensation of taste is most acute.

These papillæ resemble small cones, attached to the tongue by their base, and free at their summit ; they are placed close to each other, but at many parts leave irregular intervals in the form of clefts.

Fig. 266.

The *filiform papillæ*, Fig. 266, are observed at the edges of the tongue ; they assume a shred-like appearance, and are of a similar fabric to the last.

Fig. 267.



The nerves of the tongue, as we may observe in the annexed figure, are very abundant, and are furnished by, *b*, *e*, the inferior maxillary ; *c*, the glosso-pharyngeal ; and, *a*, the hypoglossal nerves.

Behind the fringes formed under the tongue, we perceive an amygdaloid granular mass, amply supplied by blood-vessels, and by filaments of the lingual nerve.

TASTE.

Although the tongue is the principal organ of taste, the lips, the internal surface of the cheeks, the palate, and even the teeth, are sensible to the impression of sapid bodies.

To excite a sensation of taste, a substance must be in a liquid state ; to promote this object, when a solid is placed in the mouth, the saliva is observed to flow abundantly, and its sapid qualities are perceived in proportion as it dissolves ; and there are many substances which we cannot perfectly taste, unless their fumes ascend into the cavity of the nostrils ; indeed, sensations of taste are not perfect, until the mouth is closed, and the tongue pressed against the palate, by which means the sapid body is brought more immediately into contact with the surface of the tongue, and perhaps forced into the nervous membrane, at the same time that the fumes are driven through the posterior fauces into the nasal cavities.

The choice of food entirely depends on the taste ; joined to smell, it enables us to distinguish between substances which are hurtful, and those that are nutritious.

CHAP. V.

THE SKIN.

The skin is a dense membrane of variable thickness, according to the part which it covers ; it is very flexible, and envelopes the whole body ; at the circumference of the apertures, as at the nose, the mouth, etc. it is continuous with the mucous membrane which lines those cavities.

The skin is composed of three very distinct layers ; the *dermis*, or *chorion*, the *rete mucosum*, and the *epidermis*, or *cuticle*.

The *external surface* of the skin is covered by a vast number of small projections, resembling papillæ, and it is furrowed by a multitude of wrinkles, some of which are occasioned by the action of muscles, as in the forehead, the hand, and the sole of the foot ; others are produced by the flexure of joints, or by the rows of papillæ, as we observe at the extremities of the fingers.

This surface of the skin presents a multitude of pores, very visible by the aid of a microscope ; it has been questioned whether these pores are the terminations of exhalent vessels, out of which the drops of sweat issue ; but they may be considered as perforations made by the excretory ducts of sebaceous follicles, or by the hairs.

I. THE DERMIS.

The *dermis* is the thickest layer of the skin, and is formed of fibres, interwoven in an inextricable manner, and is so plentifully furnished with blood-vessels and nerves, that the smallest puncture cannot be made, in any part of it, without occasioning pain and a discharge of blood.

The dermis is strong and elastic, and forms the most substantial part of the skin ; indeed, it is that part, in quadrupeds, of which leather is made.

The outer part is very compact, the inner more loose, and it gradually degenerates into the common cellular tissue.

The dermis is covered in all its regions with more or less distinct prominences, and irregular depressions, which appear through the epidermis. The asperities are named the papillæ, and are divided by a series of small depressions, to the number of four or five in the extent of a line. On the points of the toes, and on the tips of the fingers, the papillæ generally take a somewhat spiral and parallel direction.

Blood-vessels twine in the subcutaneous cellular tissue, and project an infinitude of small branches, which penetrate into the remotest areolæ of the dermis, unite in a variety of ways, cross the external surface, and finally give rise to that capillary net, which I shall describe in speaking of the rete mucosum.

The nerves are distributed nearly in the same order as the blood-vessels ; there is a subcutaneous stratum of the nervous system from which pass all the filaments which penetrate the dermis. These filaments frequently unite and insinuate themselves into the internal areolæ, and undoubtedly terminate in giving origin to the papillæ. In the hand, and at the points of the fingers, where the papillæ are remarkably conspicuous, there is a larger proportion of subcutaneous nerves than in any other part of the body ; and it cannot be doubted that the soles of the feet, the palms of the hands, and the tips of the fingers, are gifted with much more sensibility than any other parts.

2. THE RETE MUCOSUM.

This tissue lies immediately under the dermis, and is the chief cause of that variety of color which characterizes the natives of different climates, and different people of the same climate ; being white, or rather of a light gray in the European, brown in the Asiatic, and black in the African. And, on account of the thinness and transparency of the dermis, the color of the rete mucosum appears through it.

The rete mucosum then may be conceived as a general capillary system, enveloping the cutaneous organ, and forming, in common with the papillæ, a stratum interposed between the dermis and the epidermis. In different subjects it has a different hue, forming the *complexion* of the individual, and there is every intermediate color from the swarthy hue of the negro, to the fairest skin of the European. Hence, the complexion depends on the substance which exists in the very minute vessels of the skin.

It is likewise the cause of the difference of color, in different parts of the body of the same person, and is composed, according to GAULTIER, of four distinct layers ; the first counting from within outwards, is formed of blood-vessels arranged like granulations, on the asperities of the dermis : the second is whitish, and applied upon the former, in the irregularities of the dermis, and there are numerous prolongations of this layer which penetrate into the substance of the dermis ; the third layer is composed of minute convex bodies, containing the coloring matter of the skin; the fourth layer is white, of extreme tenuity, perforated by the hairs, and adherent to the epidermis.

3. THE EPIDERMIS.

The *epidermis*, or *cuticle*, is the most superficial layer, and is separated from the dermis by the rete mucosum. It presents all the wrinkles and furrows which have been mentioned in the description of the outer surface of the dermis; it is thin, and transparent, and formed of numerous scales in close apposition with one another. The inner surface is very firmly attached to the dermis: on removing it by maceration, we observe a multiplicity of small prolongations, which appear to be nothing more than processes, which line the passages through which hairs grow and the sebaceous follicles open.

A great number of sebaceous follicles are seated under the skin, and open by small ducts on its surface; Mr. CHEVALIER* counted one hundred and forty in the space of a quarter of an inch, which will make one hundred and twenty millions, on the surface of the whole body. These follicles, or glands, secrete an oily fluid which serves to lubricate the skin, and defend it from the inclemency of the weather, or from the effects of friction.

Immense multitudes of perforations have been supposed to exist in the epidermis, for the purpose of allowing the perspirable matter to escape from the body. But are there any in reality? A microscope of high powers will not detect them; we can only discern those apertures which belong to the hairs, and the sebaceous follicles. The serum, produced by a blister, will not exude from within, nor will water or other fluids penetrate from without. How then is the office of perspiration carried on through the cuticle? Instead of porosity, this appearance results from an infinite number of velaminæ, regularly arranged, of exquisite tenuity, presenting a follicular appearance, and separated from each other by filaments crossing in a thousand different directions. The terminal vessels of the cutaneous apparatus transmit the perspiration through this tissue, without the inconvenience of perforated pores. Perspiration then is a secretion produced by the action of the sudatory vessels, and not an exudation, and the skin constitutes one wide and diffused perspiratory gland; a subtile fluid is separated from the circulation by it, from the invisible vapor of perfect health and ease, to the profuse and colliquative sweat of a languishing hectic. The skin, therefore, seems the natural and appropriate recipient of the capillary vessels, of the cutaneous secretion, which it transmits through that exquisitely fine gauze of the epidermis. Perspiration liberates from the blood superfluous animal gas, and water; and by its copious evaporation in summer, and its partial suppression in winter, it regulates the temperature of our bodies, and thus the skin acts as the safety-valve of life and health.

* Lectures on the General Structure of the Human Body, delivered at the Royal College of Surgeons. — p. 186.

Exhalents, absorbent vessels, and hairs pass through the epidermis, but no blood-vessels have been traced in it, either by the eye or by the assistance of glasses ; it possesses, therefore, none of the properties of life : it wears away and is renewed continually, and its thickness lessens or augments, as it is needed ; it becomes hard and thick on the hands of the laborer, and soft and delicate on the hands of those who are occupied in lighter employments.

THE SENSE OF TOUCH.

This is the fifth sense, and must be included in the description of the skin. None of the vertebrata inferior to man are endowed with the special organ of touch ; and although the general surface is in most animals an organ of sense, the distinct faculty of touch is entirely wanting, or exists in a very modified degree. It is in the sense of touch, says CUVIER, that we excel every other animal. Why ? Because this sense is quite different from the others ; this is consequent to them, and rectifies their errors : we feel, because we have seen, heard, tasted, or smelt the objects. Touch is voluntary, and reflection is necessary to exercise it, while the other four require none. Light, sound, etc. may strike their respective organs unnoticed ; but we touch nothing without a preliminary act of the intellectual functions.

Sensibility to cold and various stimuli does not prove that the lower grades of animals have the sense of touch ; our own species inherits this *common sensibility*, which we maintain essential to all other organized structures ; but, in addition to this, we possess the special sense of TOUCH, which enables us to ascertain the properties of bodies, for almost all the physical properties of bodies are capable of acting on the organs of touch ; form, dimensions, locomotion, and vibration, are all appreciated by the organ of touch.

The whole cuticular surface may be said to have a modified sense of touch, and this kind of feeling is likewise shared by the mucous membrane of the eyes, nose, and mouth, the larynx, rectum, and the external genital organs. But the hand only can be truly designated as the organ of touch ; the hand is expressly constructed for the purpose of examining the qualities of objects ; the tips of the fingers especially have practically the finest discrimination of the tangible qualities of bodies. This delicacy of touch in the fingers has given man a great advantage over the animals : his touch is so delicate that it has been considered the source of his intelligence. This sense is capable of arriving at a very great degree of perfection, as is seen in many professions ; and MAGENDIE observes, that, "for medical men, a very delicate sense of touch is absolutely necessary." This property then, of the nervous system, as before mentioned, which depends on the extreme pulpy distribution of the posterior roots of the spinal nerves, can be assigned only to man.

THE HAIR.

Hair exists on almost all parts of the surface of the body and limbs, except the palm of the hand and the sole of the foot.

The *head* is that part wherein the hair is most abundant; it occupies the whole space corresponding with the occipital, the parietal, the squamous portion of the temporal, and the upper part of the frontal bones. It seems to be provided as a protection against mechanical injuries of the head. The hair on the face and other parts is, in general, much less, though still in great quantity.

The difference in the nature of the hair considerably influences its length; lank hair is generally the longest. The more it curls the shorter it is, as exemplified in the African, and even in Europeans.

The color of the hair varies considerably, according to the different countries, latitudes, and climates. Naturalists have considered the color of the hair, as well as that of the skin, as forming one of the characteristic distinctions of the human races.

The *eyebrows* form arches to shade the eyes, and their motions are intended to protect them from the too powerful impression of luminous beams. Their actions also are very expressive of the passions and mental emotions, which affect the individual. Painters have paid much more attention than anatomists to the varied position of the eyebrows.

The *eyelashes* have a similar use; they moderate the light, and likewise guard the eye from substances floating in the atmosphere.

The *hair on the chin and upper lip* is the peculiar attribute of the male, and appears towards the period of virility when the animal powers increase.

The *hair on the trunk* varies most astonishingly; some men are almost completely hairy, whilst others are not at all so. Generally speaking, the fore part of the body possesses much more than the back part: in men it is particularly met with along the median line of the chest.

In both sexes a considerable quantity shades the genital organs.

The *hair on the limbs*, in man, is abundant on the whole surface: the proportion is the same in all, but its length and fineness vary considerably. In some it consists of a mere down; in others it is coarse and thick, giving to the limbs a hairy aspect.

ORGANIZATION OF THE HAIR.

The hair may vary in respect to form, length, and fineness, but its organization is the same in all. It generally arises from the subcutaneous cellular tissue: every individual hair originates in a bulb, or root, and each bulb has two capsules, containing an oily fluid between them, which gives color to the hair; a deficiency of this is supposed to occasion a change of the color, and the whiteness we observe in advanced life.

In general the color of the hair has some relation to the rete mucosum ; as in the negro, the hair corresponds with the tint of the skin, and in a person with light or with dark colored hair, there is a florid or a dark complexion.

The hairs, in passing from the skin, are supposed to carry with them a sheath of the epidermis, which is thin, but hard, and so transparent, as to allow the color of the hair to appear through it. With the aid of a good glass we may observe canals for containing their nourishing fluid, termed the medulla, which constitutes the coloring matter of the hair. The chemical properties of the hair appear to be of the same nature as the epidermis, cartilage, and the nails.

The hair serves in general for ornament, to retain animal heat, or to protect the different parts on or near which it is situated.

THE NAILS.

The fingers are provided, at their extremities, with a hard, transparent, and flexible kind of plate, of a similar nature to that of horn.

The upper part of the nail, which is concealed, forms nearly a sixth part of its whole extent: its surface adheres strongly to the epidermis, which, to fix it, is disposed in the following manner : — after having covered the portion of the finger, corresponding to the last joint, it is reflected over the concave border, where the skin ends, and the nail begins to emerge ; the epidermis having formed a kind of ridge, is again reflected, insinuates itself between the skin and the nail, and adheres to the concave surface without being confounded with it ; for it is easily removed by maceration or with the dissecting knife. Thus the nail is placed in a folding of the skin ; there is, however, a cuticular covering to it, which appears to be derived from a lamina of the epidermis.

The nails strengthen and defend the ends of the fingers and toes ; they afford a support to the ends of the fingers in grasping bodies, and they are particularly useful in taking hold of minute objects.

CHAP. VI.

MUSCULAR SENSATION.

To the sensitive department of the fifth pair, and the compound spinal nerves, is assigned muscular sensation. This is the SIXTH SENSE. All our conceptions of weight and resistance, and motion in general, are derived from our muscles. The muscular system, then, may be considered a distinct organ of sense as well as motion ; each motion of the invisible muscles is accompanied with a certain feeling, which may indeed be complex, as arising from various muscles, but which is considered by the mind as one, and it is this pecular feeling, attending the action of the muscular fibres, which we distinguish from every other sensation. To exemplify this, I might refer to the state of the muscles in cramp of the limbs, and in rheumatic affections ; in such morbid conditions their structure becomes painfully sensible. But let us call to mind the phenomenon which every one must have experienced, I mean the feeling of fatigue ; this is a muscular sensation : a sensation of which the muscles are the organs, as much so as the eye, and the ear, are the organs of sight and hearing. Every bodily effort depends on muscular contraction ; and long and frequent contractions, that is, continued exercise, occasion a peculiar uneasiness which demands repose. Powerful and protracted exertions produce painful sensations to the muscular sense : a more moderate degree of exercise is attended with agreeable sensations. With a healthy state of body, there is a muscular pleasure in exertion. Thus the child, who is not playful, is not healthy. There is a muscular gratification, if I may so express myself, in every limb, in the games and pastimes of the school-boy.

Dr. Brown, without being aware that there was a peculiar set of nerves appropriated to muscular sensation, observes, that "Nature in the other animals, whose sources of general pleasure are more limited, has converted their muscular system into an organ of delight. It is not in search of richer pasture that the horse gallops over the field, or the goat leaps from rock to rock ; it is for the luxury of the exercise itself. It is this appearance of active life which spreads a charm over every little group, with which the Deity animates the scenery of nature." We may, therefore, consider that the muscular system is not merely the living machinery of motion, but that it is also truly an *organ of sense*.

The muscular sensation commences in infancy ; there is a feeling of danger when the child is first tossed in the nurse's arms, and afterwards, when it essays to walk, there is evidently an apprehension of falling. Sir C. Bell* has shown that we have a muscular sense, and that without it we could have no guidance of our frame ; that we could not command our muscles in standing, far less in walking, leaping, or running, had we not a perception of the condition of the muscles.

Without a sense of muscular action or consciousness of the effort made, the proper sense of touch could hardly be an inlet to knowledge. The property of the hand in ascertaining the size, the weight, the form, the hardness and softness, the roughness or smoothness of objects, results from the combined perception — through the sensibility of the proper organ of touch, and the motion of the hand, arm, and fingers. But the *motion* of the fingers is especially necessary to the sense of touch ; they bend, extend, or expand like palpa, with the advantage of embracing the object, and feeling on all its surfaces ; sensible to its solidity and to its resistance when grasped ; moving

* Bridgewater Treatise. On the Hand, its Mechanism, and vital Endowments. — p. 189.

round it and gliding over its surface, and, therefore, feeling every asperity.

The same author has given an admirable description of the pleasures arising from the muscular sense.

"The exercise of the muscular frame is the source of much of the knowledge which is usually supposed to be obtained through the organs of sense; and to this source, also, we must trace some of our own chief enjoyments. We may, indeed, affirm that it is benevolently provided that vigorous circulation, and, therefore, the healthful condition both of the mind and the body, shall result from muscular exertion and the alternation of activity and repose.

"The pleasure which arises from the activity of the body is also attended by gratification from the exercise of a species of power — as in mere dexterity, successful pursuit in the field, or the accomplishment of some work of art. This activity is followed by weariness and a desire for rest, and although unattended with any describable pleasure or local sensation, there is diffused through every part of the frame, after fatigue and whilst the active powers are sinking into repose, a feeling almost voluptuous. To this succeeds the impatience of rest, and thus we are urged to the alternations which are necessary to health, and invited on from stage to stage of our existence.

"We owe other enjoyments to the muscular sense. It would appear that in modern times we know comparatively little of the pleasures arising from motion. The Greeks, and even the Romans, studied elegance of attitude and movement. Their apparel admitted of it, and their exercises and games must have led to it. Their dances were not the result of mere exuberance of spirits and activity; they studied harmony in the motion of the body and limbs, and majesty of gait. Their dances consisted more of the unfolding of the arms, than the play of the feet: 'their arms sublime that floated on the air.' The Pyrrhic dances were elegant movements, joined to the attitudes of combat, and performed in correct coincidence with the expression of the music. The spectators in their theatres must have had very different associations from ours, to account for the national enthusiasm arising from music, and their rage excited by a mere error in time.

"This reminds us that the diversions in music in some degree belong to the muscular sense. A man will put down his staff in regulated time, and the sound of his steps will fall into a measure, in his common walk. A boy striking the railing in mere wantonness will do it with a regular succession of blows. This disposition of the muscular frame to put itself into motion, with an accordance of time, is the source of much that is pleasing in music, and aids the effect of melody. There is thus established the closest connexion between the enjoyments of the sense of hearing, and the exercise of the MUSCULAR SENSE."

CHAP. VII.

VISCERAL SENSATION.

I HAVE elsewhere stated that the ganglionic department of the nervous system belongs to organic life. The whole series of actions resulting from this department are *instinctive*. And we are conscious that the nerves of the ganglia are the seat of certain sensations. This is the SEVENTH or VISCERAL SENSE. The ganglionic nerves, throughout the whole animal kingdom, preside over the organic or vegetative functions, so as to control and direct their operation; but their sensation or perception, in man, is connected frequently with certain affections of the mind. MAGENDIE said, "The passions were the triumph of the viscera over the intellect." It is, however, with great diffidence that I proceed to a description of this ganglionic or visceral sensation, although I am convinced of its existence.

1st. In the viscera of the chest; — strong mental emotion, as anger, first exalts, and then exhausts the powers of the heart: and extreme grief, says BICHAT, has been known so to debilitate the circulatory powers, as to render them incapable of returning to their usual condition. DESAULT, the late chief surgeon of the *Hôtel Dieu*, has remarked, that diseases of the heart, and aneurisms of the aorta, were augmented in number during the Revolution, in proportion to the evils which it produced. The united testimony of mankind concurs in referring all the finer feelings (sensations) to the heart; and this view of the subject of visceral sensation, I imagine must be confirmed by our own individual experience and perceptions.*

Of this species of sensation is profound sorrow; it is felt in the lungs; hence, the sense of oppression, anxiety, suffocation, and involuntary sighs, which visibly agitate the pulmonary organs.

2d. The abdominal organs possess similar visceral sensation. The stomach is affected by any kind of trouble: frequently it will cause a painful sensation in that organ, and an interruption of the digestive process: and the sad forebodings and darker affections of the mind have a sensible effect on the digestive organs.

It has been very judiciously observed by HALLER, that the sensations we experience in parts receiving nerves from the ganglions have a peculiar character; that they do not resemble those experienced in such parts as are supplied with cerebral nerves. BROUSSAIS ascribes the pleasure and pain which accompany the exercise of the intellectual faculties, as having the same seat as the pleasure and pain of the passions; for the sensorium cannot feel without a corresponding feeling in the viscera.

* Dr. SPURZHEIM denies that the feelings depend on the viscera of the thorax or abdomen. "The influence of the abdominal and thoracic viscera, or the manifestations of the mind, is only mediate; their functions contribute to the organic constitution of the brain as well as of the body in general, but they are not the seat of the affective faculties."

Are not hunger and thirst also instinctive and visceral sensations? Are they not important indications to the individual of the wants of the animal economy, and do they not incite the animal to acts which contribute and are essential to self-preservation? And the solicitation for food and drink must be obeyed, or alienation of the mind or death of the body must ensue.

Hunger is characterized by a peculiar sensation in the region of the stomach; there is a sense of drawing and oppression in that part, and when the cravings of hunger are not appeased, it amounts to severe pain in the stomach, and a general feebleness of the whole frame.

It might be easily proved that all the abdominal viscera are capable of transmitting impressions to the brain, without the intervention of any external cause; and examples might be multiplied, were it necessary, to establish the theory of *visceral sensation*, without referring to the morbid states to which the internal organs are liable.

The ganglionic visceral feelings are instinctive, and constitute a separate department of sense; the impressions conveyed by this department of the nervous system, to the common sensorium, being totally dissimilar to those which result from any other order of nerves.*

* There are several species of sensation resulting from the ganglionic department, which, in an elementary work of this kind, cannot be discussed even in the most transitory manner, but which may be compressed in the generic term, *visceral sensation*, every species of which is instinctive: namely, sensations determined by the viscera, and which solicit the nervous centre to execute acts necessary for the exercise of their functions.

ART. IX.

ORGANS OF DIGESTION.

THE MOUTH.

The *mouth* is circumscribed laterally by the cheeks, anteriorly by the lips, posteriorly by the velum palati, above by the arch of the palate, and below by the tongue. The cavity of the mouth, and the organs which it contains, are lined by a common mucous membrane.

This membrane forms a fold opposite the symphysis of the chin, which is named the *frænum of the under lip*. The mucous membrane passes into each alveolus, a prolongation of which adheres to the roots of the teeth, and indeed lines the cavities into which they are inserted. Beneath the tongue we find another fold, called the *frænum of the tongue*. This membrane is then continued over the epiglottis into the larynx and pharynx.

About the middle of the lining of the cheeks we observe the *orifice of the parotid duct*, and in other parts a great number of mucous follicles.

The *lips* are principally composed of muscles which have been described; they are covered outwardly by the common integuments, and lined within by the membrane of the mouth.

The lips possess a small proportion of adipose tissue; but there is a considerable quantity generally found in the cheeks, which give shape to the face.

THE PALATE.

The *palate*, or roof of the mouth, represents a kind of parabolic arch; a white depressed line extends from the anterior to the posterior part of the palate, in the median line of the body.

On the arch of the palate, the common mucous membrane is much more dense and thick than on the other parts of the mouth, and is interspersed with small perforations, which are the orifices of mucous follicles, situated between it and the osseous part of the palate.

The *gums* are continuous with the membrane of the palate, and are formed of a similar kind of compact red tissue, the intimate structure of which it is difficult to explain: they are, however, prolonged into the alveolar cavities, and send into the root of each tooth a bulbous process, named the pulp of the tooth.

The *velum palati, or soft palate*, is a soft, broad, mobile partition, situated at the extremity of the palate, and separating the mouth from the palate. Its upper edge is adherent to the arch of the os palati;

its lower edge is extended over the root of the tongue. It presents, at its middle part, a prolongation, termed the *uvula*; which forms the inferior edge of the palate into a double arch.

The velum palati acts like a valve, in preventing what we swallow from passing into the nose.

The *pillars* of the velum palati are united above, but diverge below, and are separated by a triangular space in which the tonsils are lodged.

The *tonsils* are of a light red color, somewhat of the size and figure of almonds; they are full of cells which communicate with each other, and have large irregular openings which convey a transparent mucous into the throat: they are situated between the anterior and the posterior pillars of the soft palate, and close by the sides of the base of the tongue.

THE PHARYNX.

The *pharynx* is a funnel-shaped musculo-membranous canal, situated behind the tongue; it extends from the base of the skull to near the middle of the neck; it rests on the vertebral column, and on its sides is in contact with the common and internal carotid arteries, the internal jugular veins, and the pneumo-gastric nerves. It is connected with those different parts by a cellular tissue of a very extensile character, and destitute of adipose substance.

Anteriorly, on a level with the nasal fossa and mouth, the cavity of the pharynx is open; opposite the commencement of the trachea, it contracts, and terminates in the œsophagus.

The pharynx has several openings by which it communicates with the neighboring cavities; two of these, called the *posterior nares*, lead upwards and forwards; two others, called the *Eustachian tubes*, proceed laterally to the ears; one passes forward, termed the *fauces*, or upper part of the throat, to the mouth; one downwards, through the larynx and trachea, to the lungs; and another, which is a continuation of the pharynx, leads directly downwards by the œsophagus to the stomach.

The muscles of which it is composed are the six constrictors, which have been described; their fibres, which differ in their obliquity, form planes crossing each other in different directions. See Fig. 120.

A *mucous membrane* lines the whole cavity of the pharynx, which has a very deep red tint. It is smooth, or presents only a few inequalities, arising from the presence of the mucous follicles.

The pharynx receives the aliments from the mouth, and, by the action of its muscles, conveys them to the œsophagus. It also receives the air we inspire, and assists in the modulation of the voice.

THE ŒSOPHAGUS.

The *œsophagus*, or *gullet*, is a musculo-membranous canal, extending from the lower part of the pharynx to the upper orifice of the stomach.

It is situated between the trachea and the vertebræ, and in the neck it deviates a little to the left; in the thorax it proceeds behind the base of the heart, and between the layers of the posterior mediastinum, from which it receives a covering. On entering the thorax, it passes downwards upon the right side of the aorta. It then perforates the diaphragm, and after a very short course, arrives at the stomach.

It is connected to the adjacent parts by a loose and extensile cellular tissue, which contains a number of lymphatic glands.

Its outer surface is smooth in its whole extent, and of a red color above, but becoming paler as it descends: its inner surface is whiter than that of the pharynx, and presents longitudinal folds.

The œsophagus, like the pharynx, is composed of a muscular coat, and a mucous membrane.

The *muscular coat* consists of two strata; the external of which has thick, strong, longitudinal fibres, somewhat fasciculated; the internal is formed of circular or transverse fibres and is thinner than the former.

The longitudinal fibres diverge toward the stomach, and may be traced over its cardiac extremity, while the circular fibres entirely disappear where the œsophagus terminates.

The outer stratum of fibres is fitted for shortening and relaxing, and the inner for contracting the canal, during deglutition.

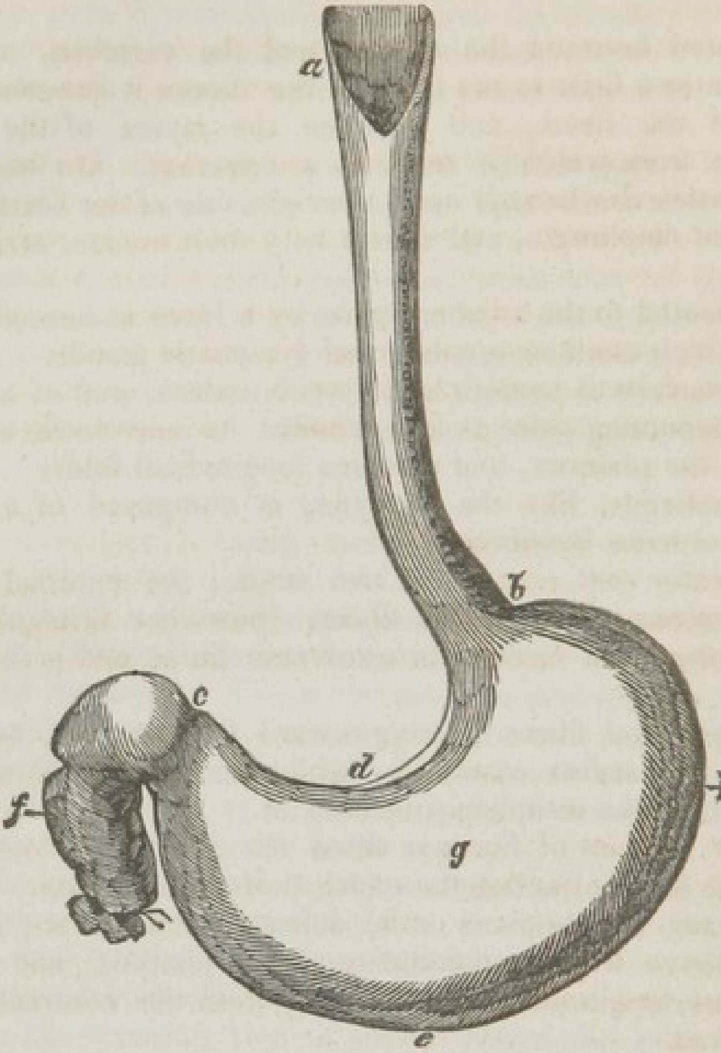
The *mucous membrane* is soft, delicate, and white; it appears continuous above with the membrane of the pharynx, and is formed into numerous longitudinal folds, arising from the contraction of its muscular fibres.

Between the muscular and mucous coats there is a dense and compact cellular tissue, to which the older anatomists gave the name of the *nervous coat:* it is merely the connecting medium of the two former.

The *mucous follicles* of the œsophagus are thinly distributed; they are furnished with numerous foramina, which supply a mucus for lubricating the passage and facilitating deglutition.

The office of the œsophagus is to convey the food from the pharynx into the stomach; for the aliment does not descend into the stomach by its own weight, as we are able to swallow solids or fluids with the head more dependent than the stomach; and, indeed, we see animals feeding in this position, namely, with the head lower than the body: it is, therefore, from a successive dilatation and contraction of the muscular fibres of the canal, that the contents are urged on to the stomach.

Fig. 268.



THE STOMACH.

The *stomach* (*ventriculus*), Fig. 268, is the principal organ of digestion ; it is a conoid, elongated, musculo-membranous reservoir : continuous on the one hand with, *a*, *b*, the œsophagus, on the other with, *f*, the duodenum. It is situated beneath the diaphragm, between the liver and the spleen, occupying at the upper part of the abdomen, the epigastrium and a portion of the left hypochondrium. The stomach is destined to receive the food from the œsophagus, and afterwards to convert it into chyme, before transmitting it to the intestines.

The dimensions of this organ vary according to the quantity of aliment it contains ; it is much larger in those individuals who eat much, than in other persons.

The *cardiac*, or *large extremity*, *h*, is situated in the left hypochondriac region, approaches the spleen, and is considerably higher than the small extremity.

The *upper surface*, *g*, is turned towards the diaphragm, the *under*, towards the intestines ; but when we examine the abdomen after death, unless the stomach is considerably distended, it falls on the spine, so that the superior surface becomes anterior, and the inferior surface posterior.

The *large curvature*, *e*, is situated obliquely forwards and downwards; the *small curvature*, *d*, is opposite to the large one, and towards the spine.

The *left* or *cardiac aperture*, of the stomach, is the termination of, *b*, the œsophagus.

The *right aperture*, or the *pylorus*, *c*, terminates the stomach to the right, and communicates with *f*, the duodenum: it consists of a duplicature of the two inner tunics, which project into the passage, dividing the stomach, and intestines; it contains circular muscular fibres, called the *sphincter pylori;* or, I should rather describe it, as a solid fibrous ring, interposed between the peritonæal and mucous surface of the pylorus.

THE ORGANIZATION OF THE STOMACH.

The stomach is formed of three membranes, a serous, a muscular, and a mucous; these are connected together by cellular tissue, and supplied with vessels and nerves.

The *serous membrane* is merely the peritoneal covering, and, in this situation, has a transparent, smooth, and white appearance; it is externally lubricated by a serous fluid. It is united to the muscular membrane by a cellular tissue.

The *muscular membrane*, or tunic, is composed of pale fibres, disposed in three different directions. 1st. Some of these fibres, which are more *longitudinal*, are superficial; others, which are extended over the surface, are more irregularly distributed. The 2d plane of fibres lies immediately under the former; these fibres are *circular*, and run parallel to each other. In the 3d series the fibres are *oblique*, and may be observed in broad fasciculi upon the extremities of the stomach.

A layer of dense cellular tissue unites the muscular to the mucous tissue. This layer has been very improperly named by the old anatomists, the *nervous coat.*

The *mucous membrane*, or tunic, forms the inner surface of the stomach; it is of a pale pink color, and marbled appearance, crowded with villosities which seem to constitute a downy and colored tissue, continually covered with an abundant, viscid, inodorous fluid. When the stomach is empty, this membrane, from the contraction of the muscular fibres, presents numerous wrinkles, which are termed the *rugæ* of the stomach.

This surface has a velvet-like appearance, and when injected and examined with a powerful lens, we find it formed of fine, short, prominent *villi*, which are crowded with an infinity of small vessels, whose office is to furnish that particular fluid, called the *gastric juice*, which is the principal agent of digestion.

There is also a number of orifices on the mucous membrane; these are the openings of the mucous follicles, which are distributed in very regular order.

OFFICE OF THE STOMACH.

It is the office of the stomach to receive the food after it is prepared by mastication, likewise liquid nutriment or other fluids, and to secrete the gastric juice, and subsequently to transmit the digested mass to the small intestines. In the stomach, the food is converted into *chyme* by the solvent power of the gastric fluid, which gradually acts on the ingesta, from the superficies to the centre of the mass, and as soon as a portion of it is reduced to a homogeneous consistence, it passes into the duodenum, without waiting till the same change has pervaded the whole.

The stomach is amply furnished with nerves from each nervous department ; — hence, its great sensibility to all kinds of stimuli, and its disturbance by mental causes ; — hence, also, the surprising sympathy existing between it and most functions of the system, so that the healthy condition of the stomach actually depends upon the tranquillity of the mind.

THE INTESTINAL CANAL.

The *intestinal canal* extends from the pylorus to the anus, and in the human subject varies from thirty to thirty-five feet in length. It is coiled on itself, so as to form folds or convolutions, and is divisible into two parts, differing in size and situation, as well as external conformation ; the division between them being moreover marked by a peculiar valvular structure, which prevents a reflux of the ingesta after they have passed beyond it. The part of the canal, between the pylorus and the valve just referred to, is called the small intestine, the remainder thence onward to the anus, the large intestine.

THE SMALL INTESTINE.

The term *small intestines* is calculated to give us a false idea of the nature of the smaller portion of the alimentary canal, the small intestines being only one continued cylindrical tube ; but, on account of the situations of its various parts, or other circumstances which will subsequently be adverted to, it is convenient to distinguish it into three disvisions ; namely, the *duodenum*, the *jejunum*, and the *ilium*.

THE DUODENUM.

This portion of the intestine differs, however, so materially from the others, as scarcely to admit of the above arrangement ; for it is not invested with a serous membrane, the peritoneum being only partially applied upon it in a small extent, nor is it supported by the mesentery, and its volume is so large, that it frequently equals the stomach in size ; for this reason, and others which will be presently noticed, it has obtained the name of ventriculus succenturiatus.

The *duodenum* is so named on account of its length being commonly estimated at twelve fingers' breadth ; it is that portion of the intestinal canal, which immediately succeeds to the stomach ; it occupies the middle part of the abdomen, where it is concealed by the transverse mesocolon and the stomach.

The duodenum commences at the valve of the pylorus, where it is covered in the greater part of its extent by the peritoneum ; here we often observe it tinged yellow by the transudation of bile from the gall bladder. The intestine we are speaking of proceeds horizontally backwards, and to the right, to near the neck of the gall bladder ; then descends vertically to the left, as far as the third lumbar vertebra, and terminates by being directed upwards and forwards, towards the extremity of the mesentery, above the superior mesenteric vessels.

Fig. 269.

The duodenum, consequently, forms a kind of semicircle, having its convexity to the left, and embracing the pancreas in its concavity.

The *inner surface* of the duodenum, like that of the stomach, is covered by a mucous membrane, upon which we may observe a number of folds, more or less, surrounding the intestine, and very close to each other ; these are the *valvulæ conniventes.* Fig. 269, represents the inner surface of a portion of the small intestine. These valves are formed by plaitings of the mucous membrane only, and they project three or four lines into its cavity.

In the interior of the duodenum we observe a small tubercle, at the point of which are seen the united or separate orifices of the ductus communis choledochus and the pancreatic ducts.

THE JEJUNUM AND ILIUM, PROPERLY CALLED THE SMALL INTESTINE.

The *small intestine* is continuous with the duodenum, without any distinct line of demarkation to distinguish it. The small intestine is the longest portion of the digestive canal, its length being about twenty-six feet, or five times that of the whole body. It forms a number of curves, of which the concavities are connected with the mesentery, while the convexities are free and floating, and folded upon each other in different directions a number of times, forming what are termed *convolutions.*

Fig. 270, a portion of the mesentery and small intestine removed from the body, and suspended by, *a*, *a*, two threads attached to the mesentery ; *b*, *b*, *b*, the convolutions of the intestine attached to it ; *c*, one of the mesenteric glands.

The small intestine commences under the superior mesenteric vessels, and terminates in the cœcum. Anatomists usually divided

Fig. 270.

it into two portions, although it is impossible to assign distinct limits to each of them. The upper portion is named the *jejunum*, from its being commonly more empty than the other part of the intestine; the other is called the *ilium*, from its position in the fossæ of that name. The jejunum occupies the upper part of the umbilical region; the ilium extends as far as the hypogastric and iliac regions. An examination of the small intestine, however, shows no natural division of this kind, so that the limits of the two portions are quite arbitrary.

Its whole *outer surface* is perfectly smooth, and contained between the two laminæ of the mesentery; its *inner surface* has the same structure and appearance as the duodenum; the villi of the small intestine are larger than those of the stomach; there are about four thousand to the space of a square inch, and their length is about one fourth of a line; but the valvulæ conniventes are gradually less conspicuous as they are examined towards the cœcum.

The *muscular membrane* is interposed between the two others; its fibres are pale, and not very apparent; the superficial layer is longitudinal, and the deep fibres are curved in the transverse direction of the intestine; not passing entirely round it, but like the longitudinal are interrupted from space to space, and seem composed of shorter fibres, whose extremities pass between each other. The longitudinal fibres shorten the canal, and the circular fibres diminish its calibre; together they produce an undulating movement of the intestine, termed the *peristaltic motion*.

THE LARGE INTESTINE. See Fig. 272.

The *large*, like the small, intestine forms one continued alimentary canal, the former extending from the termination of the ilium to the anus. The large intestine, however, is distinguished not only by its size, but by its outer surface presenting irregular enlargements and depressions, interrupted in three places by longitudinal bands of muscular fibres. One of these depressions is anterior; the other two are posterior; the annexed figure shows its form and its course better than any verbal description. Its length is that of the body, or about six feet. Its volume is generally triple that of the small intestine, and it also differs from it in having papillæ of fat, called *appendices pinguedinosæ*, attached externally to it.

Like the small intestine, it is distinguished into three portions, termed the *cœcum*, the *colon*, and the *rectum*.

The *cœcum* is only three or four inches in length, and nearly the same in diameter ; it consists of that part of the intestine which is under the extremity of the ilium. It is situated in the right iliac region, resting on the cavity of the corresponding os ilium. The inferior part forms a closed sac, the mouth of which is directed towards the colon.

At the left extremity of the cœcum there is a process of about the same length, and of the same nature with itself, but the diameter is not larger than that of a writing quill, — termed the *appendix cœci vermiformis.* It is hollow in its whole extent, and communicates with the cœcum. It is constantly filled with mucus, but its uses are entirely unknown. We must again recur to the union of the small intestine with the large ; at the opening of the former into the latter is situated the *ilio-cœcal valve*, or the *valve of Bauhin ;* this, however, is merely a projecting of the intestinum ilium into the cœcum, so that the folding of its extremity does not prevent the fæces from passing downwards, but, by the pressure of the edges against the sides, and the contraction of its muscular fibres, it offers a resistance, under most circumstances, to a retrograde movement of the contents of the intestine.

Fig. 271.

Fig. 271, exhibits the insertion of the small into the large intestine ; the drawing from which this was taken was inflated, dried, and a large opening cut into it to show the valve.

a, the intestinum ilium,

b, its valvular opening into the cavity of the colon.

c, the caput cœci.

d, the appendix cœci vermiformis.

e, a portion of the colon.

The *colon* forms the most considerable portion of the large intestine ; it nearly encircles the small intestine, and is a continuation of the cœcum, or that portion of the intestine which is extended from the right iliac region to the left. The colon commences at the cœcum, and terminates in the rectum.

The colon ascends in the right lumbar region, over the kidney of that side, and is here termed the *ascending colon.*

From the kidney it proceeds forwards, and crosses the abdomen in the epigastric and hypochondriack regions, beneath the stomach and above the small intestine ; it is here called the *transverse arch of the colon.*

On the right side the arch is situated under the liver and gall bladder, the latter of which, after death, usually stains it with bile. In the hypochondrium it turns backward under the spleen, and descends in the left lumbar region in front of the kidney, to which it is closely connected ; in this situation it is called the *descending colon*.

In the iliac region it forms a double curve, compared in shape to the Greek letter ς, and hence termed the *sigmoid flexure of the colon*. It is surrounded in nearly its whole circumference by the peritoneum, which fixes it above and behind, by means of an extended and loose fold, termed the *iliac mesocolon*.

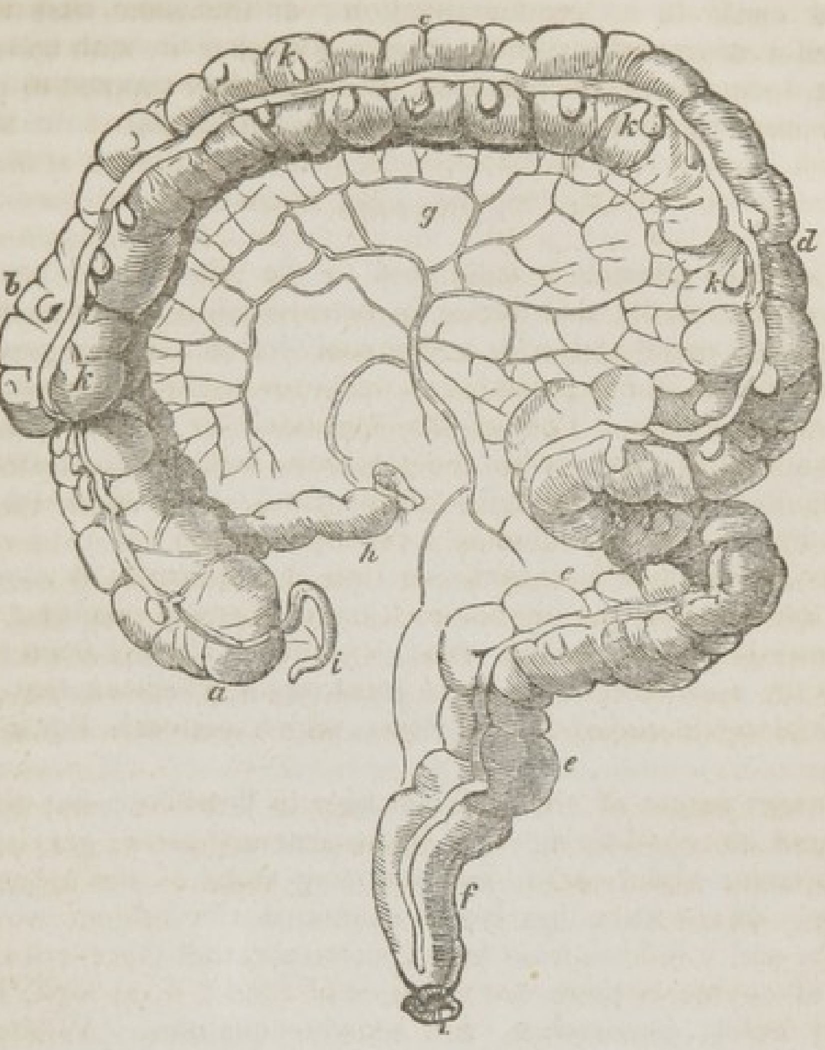
The *rectum* has its name from being nearly a right line, extending from the last lumbar vertebræ to the anus ; it is, however, accomodated to the curve of the sacrum. The rectum is smaller than the cœcum or colon, but is capable of great dilatation, and does not present those intersections and muscular bands which we find in the other portions of the large intestines. At the anus it contracts into a narrow orifice, the sides of which are compressed into close, longitudinal folds, by the sphincter ani and the two levatores ani.

The structure of the large intestine is the same as that of the small intestine ; but it is less muscular. The villi of the inner part are smaller, the mucous glands or follicles are very apparent, and there are no valvulæ conniventes. The most characteristic distinction, in the general appearance of the large intestine, is the intersected and cellular divisions throughout its whole extent. These cells retain the matter, and prevent its too rapid descent into the rectum, and thus allow time for the lymphatic vessels to collect the fluid from the digestive canal.

Fig. 272, exhibits the sacculated appearance and course of the large intestine.

a, the caput coli.
b, the ascending colon.
c, the transverse arch of the colon.
d, the descending colon.
e, the sigmoid flexure of the colon.
f, the rectum.
g, the mesocolon.
h, the termination of the ilium.
i, the appendix cœci vermiformis.
k, *k*, *k*, *k*, appendices pinguedinosæ.

Fig. 272.



THE MESENTERY.

The *mesentery* is formed by the peritoneum,* which advances from the parietes of the abdomen, and includes the intestines in a duplicature of it. The mesentery is situated in the middle of the intestines, commencing at the last turn of the duodenum, and proceeding obliquely downwards and towards the right side, along the vertebræ of the loins, to the first, second, and third of which it is chiefly connected.

Its anterior edge is more extensive than the posterior, as it corresponds to the convolutions of the intestines, which are prevented by it from being entangled in the various motions of the body.

That part, which connects the small intestine to the spine, retains the name of mesentery; the other, which belongs to the colon, the *mesocolon;* a portion, also, which is continuous with the latter, and is connected with the rectum, is called the *mesorectum*.

* The peritoneum is a serous membrane investing the inner surface of the abdomen, and prolonged under the form of an envelope over most of the viscera contained in it. See Article XVI.

The office of the mesentery is to suspend, connect, and retain the intestinal canal in its proper situation; at the same time allowing it a certain degree of motion; it also furnishes it with an exterior covering, lodges numerous glands, and affords a support to the vessels and nerves which are distributed to the intestines.

DIGESTION.

Our food in general is submitted to the mechanical process of division by the teeth; and during its mastication it becomes intimately mixed and combined with a chemical solvent, which prepares it for the process it has shortly to undergo in the stomach. This solvent is the saliva. The glands appointed to produce this fluid seem to act in sympathy with the stomach, being with it simultaneously excited by the stimulus of the food, "or even (says Dr. PARIS) by the contemplation of a favorite meal."

When the aliment is introduced into the stomach, it appears to remain there a short period before it undergoes any change; but the solvent energy of the peculiar fluid, which has already been referred to under the appellation of *gastric juice*, soon produces that change upon the aliments called the digestion, which converts the food into CHYME.

The exact nature of chyme is not easy to describe; but physiologists agree in considering it a homogeneous paste, grayish, of a sweetish taste, slightly acid, and retaining some of the properties of the food. MAGENDIE has lately examined the subject with great precision, and it follows from his experiments, that there are as many species of chyme as there are varieties of food; if, at least, we may judge by color, consistence, and sensible qualities. Whatever be the nature of the alimentary substance, introduced into the stomach, the chyme will possess the invariable property of an acid, reddening litmus paper, and it always has a sharp odor and taste. As the parts of the food are digested, that is, converted into chyme, they pass out of the stomach into the duodenum, there to undergo further changes. In this process the pylorus must, as its name implies, be endowed with a peculiar sensibility and vigilance, by which it is enabled to distinguish between the crude and chymified portion, so as to admit the latter, while it usually opposes the exit of the former. Sometimes the pylorus seems so far to resist the egress of the contents of the stomach as to occasion an inverted action, and to expel the food by vomiting.

If a liquid holding nutritive matter is taken into the stomach, it is either coagulated by the gastric fluid, or its watery part is absorbed, and the solid matter deposited in the stomach; in both cases the product is afterwards chymified in the manner already described. Part of the liquid passes through the pylorus into the intestines, to be absorbed with the chyle, or to be rejected with the fæces; and a large portion of the liquids is conveyed directly from the stomach into the circulation.

Many anatomists have considered the duodenum as a subordinate stomach; for, immediately the chyme has arrived at this part of the alimentary canal, it becomes converted into a more highly animalized product, termed CHYLE, or the milk-like fluid which is imbibed by the lacteals. Chyle has been frequently chemically examined, but it presents a difference in composition, according to the nature of the aliment from which it has been elaborated. If the animal has eaten substances of a fatty nature, the chyle will be found milky white, a little heavier than water, with a strong and peculiar odor, and a saline and sensibly alkaline taste; but if the food should not have contained fat, it will be opaline and almost transparent. Very soon after chyle is extracted from the living animal, it becomes firm, by coagulation: it then gradually separates into three distinct parts; the one solid, which remains at the bottom of the vessel, the second liquid, and a third that forms a very thin layer at the surface. The more solid part seems to be an intermediate substance between albumen and fibrin, for it unites several properties common to both. The liquid part of the chyle resembles the serum of the blood; the other part which appears on its surface is a fatty substance, which imparts to the fluid the appearance of milk. The comparison, however, which has been made between chyle and milk has no real foundation; for the former contains nothing which exactly agrees with the constituents of the latter.

The lacteal vessels which absorb this fluid have been already described; they commence in the very extended valvular apparatus of the mucous membrane of the intestine, by thousands and tens of thousands of orifices which imbibe the chyle.*.

The function, consequently, of the small intestine is to separate the nutritious matter from the feculent, and to convey the latter into the colon. In its progress, the nutritive principles of the aliment having been absorbed into the circulation, the residue is urged forward by the action termed the *peristaltic motion*; the ingesta losing, as it proceeds towards the cœcum, any portion of the chyle which may have escaped the lacteals in the first portion of the small intestine. The remainder of the contents accumulates to a certain extent in the colon, and acquires the peculiar fetor which distinguishes the fæces. In its passage in this part of the digestive canal, it is considerably retarded by the cells or compartments into which the large intestine is divided. But the principal function of the large intestine is to imbibe the remaining fluid in proportion to the wants of the system;

*It is probable that the mesenteric glands through which they pass produce an important change in the chyle; but the nature of this change is wholly unknown; it is certain that these glands secrete a fluid, which may be compressed from them with the fingers; hence, some physiologists have supposed that they add a fluid to the chyle in order to purify it; while others, again, have contended that their use is to produce a more intimate union of the aliments which compose it. The chyle is, at length, poured into the thoracic duct, together with the lymph which is brought from all parts of the system, by the absorbent vessels, and together they furnish new materials to repair the waste which the body is perpetually undergoing.

another office obviously performed by this portion of the alimentary canal is to carry out of the system the waste, incident to the changes of the economy, which is not removed by the kidneys. The fecal matter as it passes along the colon gradually becomes more solid, and at length, when it enters the rectum, it forms a mass of considerable bulk, which distends its parietes, and then creates a sensation of uneasiness, which announces the necessity for relief.

ART. X.

ORGANS OF RESPIRATION.

THE LUNGS.

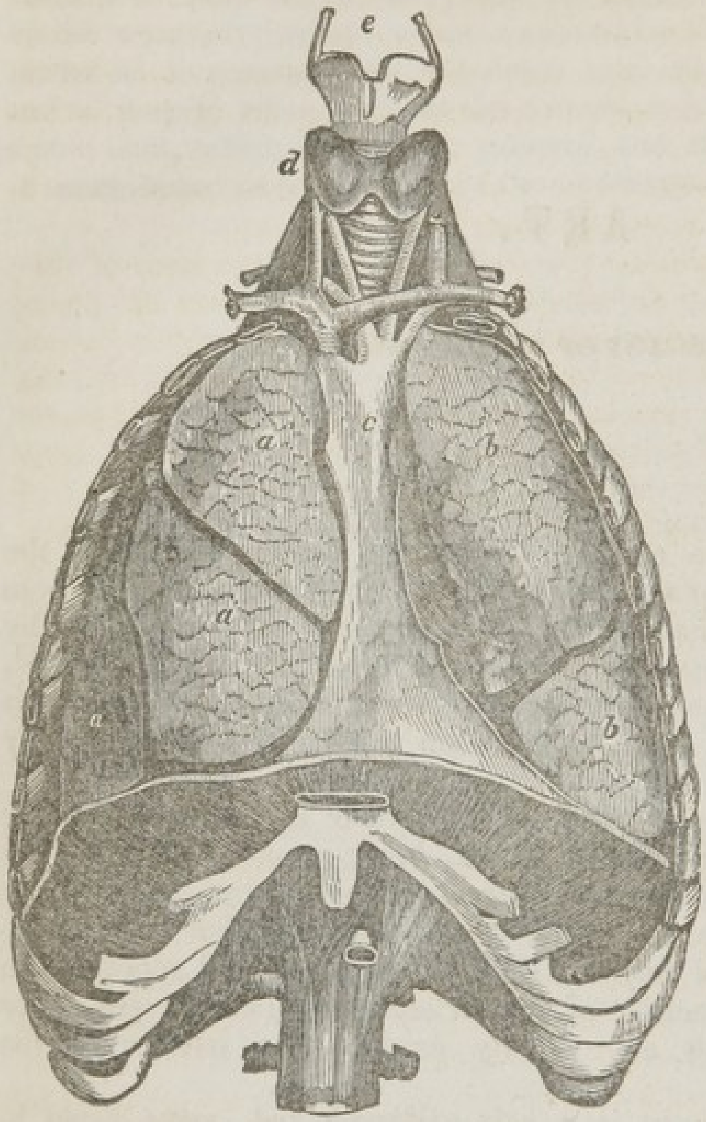
THE *lungs* are two cellular, or spongy organs, occupying the greater part of the cavity of the thorax: they are separated from each other by the mediastina and the heart, and are surrounded by membranes which are named pleuræ, with which they are in contact, so that no air can intervene between them, unless an opening is made into the bag of the pleura, when the lungs would instantly collapse.

In *figure* they are somewhat conical, their shape corresponding exactly with the cavity of the thorax, being rounded towards the ribs, and irregularly depressed towards the mediastinum and heart. In all instances, the volume of the lungs is in proportion to the capacity of the thorax, and they are compressed or dilated according to the expansion or contraction of the parietes; nor (in a healthy state of these organs) does any vacuity exist in the interior of the chest.

The *color* of the lungs is a pale yellowish red, more florid in children, and of a deeper and purple hue in age; but the lung is always more colored on the side on which a dead body has lain; but this deeper tinge is owing merely to the blood, from its own gravity, falling to the most dependent part of the lung. The general color of the lungs is also interrupted by small black spots, irregularly dispersed on their surface, and more or less numerous, some of which are entirely superficial, others penetrate more or less deeply into the tissue of the lungs. These spots do not appear till the age of ten or twelve years.

The specific gravity of the lungs is much less than that of the other organs; when in their natural state, they swim in water, and this lightness depends upon a large quantity of air penetrating their whole tissue. In infants, who have never breathed, the lungs generally sink if immersed in water. The absolute weight, however, of the lungs varies in different individuals, depending on the greater or less quantity of blood remaining in them at the moment of death.

Fig. 273.



In this figure (273) the ribs are sawn through at the sides, and the anterior parietes of the thorax removed, in order to exhibit the natural situation of the lungs.

a, *a*, *a*, the three lobes of the right lung.

b, *b*, the two lobes of the left lung.

c, the anterior mediastinum.

d, the thyroid gland, situated on the trachea.

e, the thyroid cartilage.

ORGANIZATION OF THE LUNGS.

Each of the lungs is divided into sections, called *lobes*, varying in depth in different bodies. The right lung contains *three* lobes, the left *two;* each of which lobes is subdivided into *lobules*, which are of different sizes and of irregular angular forms ; distinct at the exterior, and separated from each other by whitish grooves of cellular tissue. Each of these lobules is again divided into air-cells, the intricate structure and figure of which are unknown.

The pulmonary lobules, therefore, are formed of a spongy tissue, the *areolæ* of which are so small as to require a powerful lens distinctly to observe them : these areolæ communicate with each other, and are surrounded by a thin layer of cellular tissue, which separates them from the adjoining lobules.

One of the branches of the air-tubes (bronchi), and the pulmonary artery, are distributed to the lobule, and the latter then terminates in the radicles of the pulmonary veins. This is proved by injecting colored water into the pulmonary artery, when the injected matter immediately passes into the pulmonary veins ; but, at the same time, a small portion enters the bronchi : this circumstance establishes the fact of the intimate connexion between the organs of respiration and circulation.

The outer surface is covered by a glossy serous membrane, named the *pleura*,* which will be subsequently described.

The lungs are very elastic, and constantly kept in a state of distension by the pressure of the atmosphere : this is proved by puncturing the parietes of the thorax, when they instantly collapse. During inspiration the intercostal muscles raise and draw out the ribs, and the diaphragm descends ; the enlargement of the thoracic cavity follows of necessity the greater distention of the lungs, from the diminished resistance of the air gravitating in the bronchi and pulmonary areolæ. The diaphragm and muscles of respiration ceasing to act, the substance of the lungs, from its elasticity, recovers its former dimensions, and expels the additional volume of air just admitted, and the respiratory muscles follow the shrinking substance of the lungs, offering from their relaxation no resistance to the atmosphere pressing on the surface of the chest and abdomen. Thus expiration is produced : thus the lungs are continually expanding to admit the atmospheric air, or contracting to expel it, from the hour of birth to the latest moment of our existence. This alternation occurs in an adult at rest about twenty times in a minute, — once to about three pulsations of the heart, — this will give twenty-eight thousand eight hundred inspirations in twenty-four hours.

The mean quantity of air that enters the lungs at each inspiration is forty cubic inches ; and the ordinary quantity of air contained in the lungs is two hundred and eighty.† Thus, supposing twenty inspirations in a minute, the quantity of air that would enter and pass out in this time would be eight hundred inches, which make forty-eight thousand in the hour, and in twenty-four hours is one million one hundred and fifty-two thousand cubic inches.

Inspiration and expiration are intended to renew, in part, the mass of air contained in the lungs : it may be here remarked, that the portion of air expired is not exactly that which was inspired immediately before, but a portion only of the quantity which the lungs contained after inspiration.

The office of the lungs is to produce certain atmospheric changes in the blood, which are essential for the support of life.

The air in its passage to the lungs, by passing through the mouth or the nose, the pharynx, the trachea, and the bronchi, becomes of a similar temperature with the body, and is charged with the vapor which it carries from the air passages ; and in this state, rarefied and humid, it arrives in the pulmonary lobules, to mix with that which the lungs contained before.

* See Article XVI.

† Dr. Thompson.

PHYSICAL AND CHEMICAL CHANGES WHICH TAKE PLACE IN RESPIRATION.

The air, in its exit from the lungs, partakes of the temperature of the body ; there escapes with it a great quantity of aqueous vapor, called *pulmonary transpiration*, and its chemical composition is very different from the inspired air.

The atmospheric air we breathe contains 0·21 of oxygen, and a trace of carbonic acid ; the air which passes out of the lungs contains 0·14 or 0·15 of oxygen, and 0·6 to 0·7 of carbonic acid : generally, the quantity of carbonic acid is less than the quantity of oxygen which has disappeared.

The quantity of oxygen consumed by an adult, according to LAVOISIER and Sir H. DAVY, is thirty-two cubic inches in a minute, which gives, for twenty-four hours, forty-six thousand and thirty-seven inches.

We may, therefore, easily calculate the quantity of carbonic acid that passes out of the lungs in the same time, since it nearly represents the volume of oxygen that has disappeared. THOMPSON values it at forty thousand cubic inches, though, he says, it is probably a little less : now this quantity of carbonic acid represents twelve ounces of solid carbon.

If we are attentive to our respiration, we shall find the degree of alteration that the air undergoes in our lungs, by a feeling which inclines us to renew it ; if the breathing is suspended for many seconds, there is anxiety and fear, and, as it were, an instinctive warning of the importance of respiration.

The changes of the quality of the air during respiration have been described, in which time the blood circulating through the lungs also undergoes a corresponding and remarkable alteration. That the oxygen exerts an agency on the blood, is a fact shown by direct experiments ; the blood, whether arterial or venous, when agitated in contact with common air, imparts carbon, and converts the oxygen into carbonic acid : it is, therefore, a fair inference that, in the body, the change of inspired oxygen into carbonic acid is effected in the same manner. In the areolæ, or air-cells of the lungs, the oxygen may be considered as almost in contact with the blood contained in the ramifications of the pulmonary vessels ; inasmuch as nothing but the exceedingly thin substance of the vessels is interposed. When the oxygen of the air is taken into the lungs, after a momentary contact, as it may be called, with the blood, it is discharged again during expiration ; but part of it has combined with carbon. As it regards this combination, there have been two opinions. The one is that the oxygen of the air instantly dissolves, and combines with the carbonaceous matter found in the blood, and immediately after is expired as carbonic acid. The other is, that the oxygen of the air is absorbed by the blood in the lungs ; that it circulates with the blood throughout the whole system, during which it combines with carbon ; and that, on the return of the sanguineous current to the lungs, the carbonic acid thus produced exudes through the coats of the minuter vessels, and is expired. This latter opinion is most probable. For if blood is merely exposed to the atmosphere for the space of three minutes, no change is produced ; but if it is *agitated* with it during the same time, carbonic acid is produced. Independently of the evidence afforded by this experiment, it might be reasonably expected that the carbon of the blood would require more than an instantaneous contact with the oxygen of the air, before a combination could take place. Such a condition would be fulfilled, if the oxygen were to circulate with the blood for two minutes and a half; for this, as far as is known, is the space of time which the whole volume of the blood requires to travel from the lungs back again to the lungs ; and this is the space of time found necessary to continue the agitation of the blood in the experiment just named. If, in that experiment, actual contact of the blood with oxygen during three minutes did not evolve any carbonic acid, it would be singular if, in the lungs, carbonic acid could be formed during the time occupied by one inspiration, especially as the substance of the blood-vessels and air-tubes are interposed.

To confine the office of the lungs to the mere removal of redundant carbon from venous blood, is to take a limited view of its operation, and to underrate the utility and necessity of the complex and astonishing mechanism by which so simple an object would be accomplished. To the process of respiration, the construction of the chief parts of the animal system are subservient ; if respiration be suspended, so is life : even the atmosphere is constituted in such a way as to conduce to the due performance of this function. We know the important and extensive agency of oxygen in creation : can we doubt in the laboratory of the body, where chemical changes are incessantly taking place, that oxygen is less constantly in demand ? And is it not probable that the medium of supply of oxygen to all these parts is that obvious one, which, in order to receive the supply, is presented in thousands of currents, to thousands of currents of air, the absorption being promoted by the two most efficacious means — motion and extensive surface ?

The view here taken of the phenomena of respiration corresponds with the conclusions arrived at, from an extended series of experiments made by Dr. Edwards,* who appears to have established four fundamental points.

1st. The absorption of oxygen, which disappears.

2d. The exhalation of carbonic acid, which disappears.

3d. The absorption of azote.

4th. The exhalation of azote.

The oxygen which disappears in the respiration of atmospheric air is wholly absorbed. It is afterwards wholly, or in part, conveyed into the circulation. It is replaced by exhaled carbonic acid, which proceeds wholly, or in part, from that which is contained in the mass of the blood.

* On the Influence of Physical Agents on Life.

An animal breathing atmospheric air also obsorbs azote ; this is likewise conveyed wholly, or in part, into the mass of blood.

In different individuals, it has been found that different quantities of oxygen is consumed, and of course different quantities of carbonic acid returned. The breath expired has been shown to contain from six to eight per cent. of carbonic acid. Drs. PROUT and FYFE have proved experimentally, that particular conditions of body or mind render the quantity of carbonic acid variable. The former has shown that the quantity depends also on the time of day : at noon it is at its maximum ; it decreases until nine at night ; it then remains at its minimum for six hours, and at four in the morning it begins to increase. Probably it may vary likewise with the seasons of the year. The above were the results obtained in the month of August.

TRACHEA AND BRONCHI.

The *trachea* is a cylindrical fibro-cartilaginous and membranous tube, a little flattened posteriorly. It is situated before the vertebral column, in the posterior mediastinum, resting on the œsophagus, which, however, inclines somewhat to its left side, and extends from the lower part of the larynx to opposite the second or third dorsal vertebra. It is inclosed between the great vessels of the neck, and covered partly by the thyroid gland, and its veins, also by the sterno-hyoid and sterno-thyroid muscles, and crossed by the vena innominata the arteria innominata, and the arch of the aorta. At the second or third dorsal vertebra it divides into two lateral branches, termed bronchi, one of which passes to the right lung, and the other, which is the longer of the two, proceeds under the arch of the aorta to the left lung.

Each of the bronchi is subdivided where it enters the lung ; the right separating into three principal branches, corresponding to the number of the lobes on that side ; the left into only two, which are distributed to the same number of lobes of the lungs on the left side. When the bronchi have arrived in the lungs, they divide and subdivide throughout the whole pulmonary tissue, ramifying almost ad infinitum, so that it is extremely difficult to trace them to their termination. MALPIGHI thought that they ended in rounded membranous vesicles. SENEC describes the lobules of the lungs to be composed of polyhedral vesicles, into each of which a twig of the bronchi enters. If a lung be inflated and dried, its substance when divided, independently of the arteries cut through, appears uniformly porous. Some of the pores appear sections of tubes, others are small cups, being sections of air-cells, a hundredth of an inch in diameter.*

* After injection, a thin section of the lung may be made, and submitted to the microscope, when it will be found that the size of the areolæ, in the adult, is nearly as here stated ; and the shape of the areolæ appears to me to be, as stated by SENEC, polyhedral.

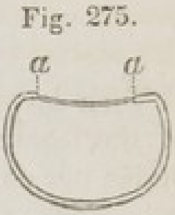
THE ORGANIZATION OF THE TRACHEA AND BRONCHI.

The air-tubes of the lungs are composed of fibro-cartilaginous, incomplete rings, membranous mucous follicles, bronchial glands, vessels, and nerves.

Fig. 274.

The *fibro-cartilaginous rings* in the trachea, Fig. 274, are from sixteen to twenty in number; they are not complete behind, but united by a fibrous membrane, which is closely connected with the œsophagus, and yields to it in the time of deglutition. Each cartilage forms nearly two thirds of a circle, as in Fig. 275, *a*, *a*; they are situated transversely with respect to the length of the trachea, and have their edges opposed to each other, leaving small spaces between them. These spaces consist of the same fibrous membrane which completes the canal at the posterior part: it has great elasticity, so that when the lungs are removed from the body, it draws the fibro-cartilages together.

Fig. 275.



At the superior part of the trachea the cartilages are sometimes united, but below they are perfectly distinct from each other; and the inferior cartilage is triangular, to adapt itself to the bifurcation of the bronchi.

In the *bronchi*, the primary ramifications are similar to those of the trachea, only thinner and smaller, and sometimes composed of several pieces. But in the secondary and ultimate ramifications, they are merely small irregular tubes, which gradually diminish until they arrive at the areolæ of the lungs.

The *outer membrane* is formed of longitudinal and parallel fibres, of which the most superficial is red, the deeper white. This membrane alone, posteriorly, connects the cartilages, and completes the diameter of the trachea. Anteriorly, the fibro-cartilages appear developed in its substance.

Posteriorly, this membrane contains numerous mucous follicles, the excretory ducts of which open on its inner surface. They are named the *glands of the trachea.*

The *mucous membrane* is a continuation of a membrane of the larynx, and extends to the termination of the bronchi; the mucous follicles constantly pour out a thick fluid on its inner surface.

The *lymphatic glands of the bronchi* are situated at the bifurcation of the trachea, around the bronchi, and are found even in the interior of the lungs. Their color is blackish; they are easily compressed under the fingers, to which they easily communicate their color. Their excretory ducts have not been discovered, and their functions also are unknown.

ART. XI.

ORGANS OF THE VOICE.

THE LARYNX.

The *larynx* is a complicated apparatus situated at the upper part of the trachea, with which cavity it communicates ; it is immediately under the os hyoides, which is placed at the root of the tongue. It is broader above than below, and is composed of several cartilages, muscles, ligaments, membranes, and mucous glands.

THE CARTILAGES OF THE LARYNX.

THYROID CARTILAGE.

The *thyroid cartilage*, Fig. 276, is the largest and most prominent of the pieces composing the larynx, and occupies its anterior and lateral parts : in its natural situation it forms two lateral wings, or portions of a quadrangular form, uniting in the middle in a longitudinal angle, which can readily be felt in the fore part of the throat : and from its being larger and more projecting in men than in women, has obtained the name of *pomum Adami*. The upper part of the angle is formed into a notch, from which, and from the upper edge of the cartilage in general, a broad ligament ascends to unite it to the inferior part of the os hyoides.

Fig. 276.

From the posterior angles we observe four projecting processes, called cornua, two of which, *a*, *a*, are termed the *superior cornua*, and are connected by round ligaments to the os hyoides. The other two, *b*, *b*, are called the *inferior cornua* ; these are shorter than the superior, and somewhat moved backwards, to be attached by smooth articulating surfaces to the sides of the cricoid cartilage.

CRICOID CARTILAGE.

The *cricoid cartilage* is placed below the thyroid, and like it can readily be felt in the fore part of the neck. It is narrow anteriorly, see Fig. 277 ; and thick, broad, and strong, posteriorly, see Fig.

Fig. 277.

Fig. 278.

278 ; its *superior edge* has its anterior part fixed to the thyroid cartilage ; the *inferior edge* is connected to the whole circumference of the commencement of the trachea.

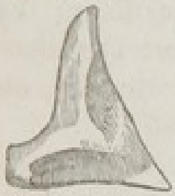
This cartilage has four small articulating surfaces, with distinct capsular ligaments ; two of which are situated at its upper part, for the articulation of the arytenoid cartilages, and two at the under part, for the attachment of the inferior cornua of the thyroid cartilage.

ARYTENOID CARTILAGES.

The *arytenoid cartilages* (Fig. 279, the outer, and Fig. 280, the inner view), are two in number ; they are situated at the upper and back part of the larynx, above the cricoid cartilage. Their form is before us ; the anterior surface is convex, but upon each convexity there is a depression, which is occupied by glands. Their upper extremities are placed towards each other : their lower extremities are broad, and are articulated by capsular ligaments with the cricoid cartilage, upon which they are moved by the action of various muscles. They are also connected to each other, and to the adjacent cartilages, by ligaments and muscles.

Fig. 279.

Fig. 280.



The aperture between the arytenoid cartilages is called the *glottis*.

EPIGLOTTIS.

The *epiglottis* (Fig. 281, the outer, and Fig. 282, the inner view) has obtained its name from its situation above the glottis : it is a

Fig. 281.

Fig. 282.

fibro-cartilage, situated at the upper part of the larynx, behind the base of the tongue ; its form is ovoid, its color a pale yellow, and its tissue very elastic. It is placed obliquely over the glottis, and may be seen and examined in the living body by pressing down the tongue.

This cartilage is attached by a broad and short ligament to the notch of the thyroid cartilage ; laterally it is united to the arytenoid cartilages, forming at this part the superior opening of the larynx. It is united to the os hyoides and tongue by a ligament which is termed the *frœnum epiglottidis.*

The surface is covered by a number of small perforations and depressions, which contain mucous follicles, or transmit nervous filaments.

THE LIGAMENTS OF THE LARYNX.

The *thyro-hyoid articulation.* The thyroid cartilage is connected at its upper part with the os hyoides by a broad yellowish membrane. The superior cornua of this cartilage is connected to the extremities of that bone by two round, fibrous cords, about an inch in length.

The *crico-thyroid articulation.* The thyroid cartilage, in the middle and anteriorly, is connected with the cricoid, by the *crico-thyroid membrane*, and on the sides, the inferior cornua of the thyroid cartilage are articulated with the cricoid cartilage, by means of a loose and humid synovial membrane. There are also two ligaments extending from the inferior cornua of the thyroid cartilage to the arytenoid cartilages, where they are expanded.

The *crico-arytenoid articulation.* Each arytenoid cartilage is articulated with the cricoid, by a synovial capsule, which is strengthened by fasciculi of ligamentous fibres.

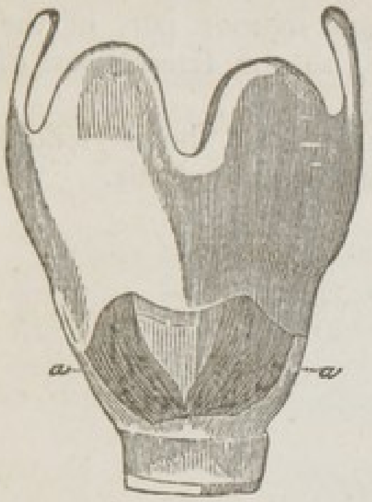
The *vocal ligaments*, or the *thyro-arytenoid articulation.* On the inside of the larynx we observe two ligaments, Fig. 283, *a*, about two lines in breadth, formed of elastic and parallel fibres, contained in a fold of the mucous membrane ; they are extended horizontally from the anterior prominence of the arytenoid cartilage, to the centre of the retiring angle of the thyroid cartilage. They are named the *vocal cords.*

Fig. 283.

THE MUSCLES OF THE LARYNX.

CRICO-THYROIDEUS.

Fig. 284.

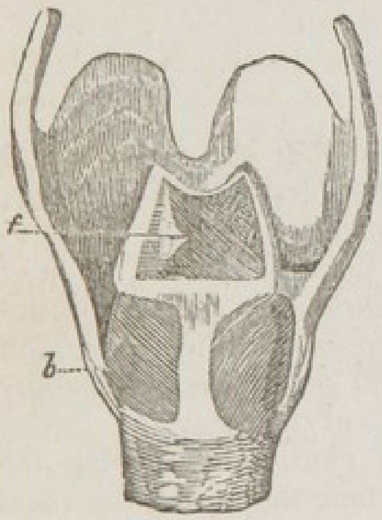


This muscle, Fig. 284, *a*, *a*, is situated on the side and at the anterior and inferior part of the larynx ; it extends from the lateral and anterior edge of the cricoid cartilage, to the lateral and inferior edge of the thyroid cartilage.

The office of this muscle is to depress and draw forward the thyroid cartilage, or to raise the cricoid cartilage.

CRICO-ARYTENOIDEUS POSTICUS.

Fig. 285.

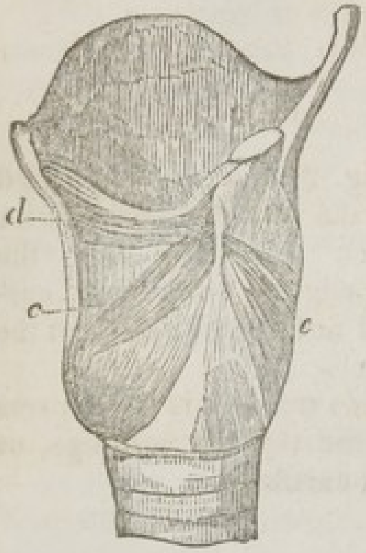


The muscle, Fig. 285, *b*, is extended from the back part of the base of the arytenoid cartilage, to the posterior part of the cricoid cartilage.

Its office is to draw back the arytenoid cartilage.

CRICO-ARYTENOIDEUS LATERALIS.

Fig. 286.



This muscle, Fig. 286, *c*, is extended from the lateral and inferior part of the arytenoid cartilage, to the lateral part of the cricoid cartilage.

Its office is to separate the arytenoid cartilages, and with them the glottis.

THYRO-ARYTENOIDEUS.

This muscle, *e*, extends from the fore part of the arytenoid cartilage to the inferior and posterior part of the thyroid cartilage.

Its office is to draw the arytenoid cartilage outwards, and forwards, and thereby to enlarge the glottis, and to shorten and relax the vocal cords.

A small fasciculus of this muscle, on its upper part, is called by ALBINUS *thyro-arytenoideus alter minor*.

ARYTENOIDEUS.

This is a single muscle, Fig. 285, *f*, situated at the superior and posterior part of the larynx ; it is formed of several planes of fibres, which have occasioned it to be divided by many anatomists into several distinct muscles. It is attached to the posterior part of each of the arytenoid cartilages, from whence the fibres take different directions ; some extend from the base of the right cartilage to the summit of the left, others take an inverse course, and some pass horizontally from the middle part of one to the same point of the other.

The office of this muscle is to close the glottis, by drawing the arytenoid cartilages together ; at the same time they bring the vocal cords in nearer apposition.

MUCOUS MEMBRANE OF THE LARYNX.

This membrane is continuous superiorly with the mucous membrane of the mouth ; inferiorly, with that of the trachea and bronchial tubes ; posteriorly, with that of the pharynx. Its tissue is very firm, but yet highly vascular, and it contains in its substance a number of mucous follicles, the orifices of which are easily perceived. It secretes a somewhat tenacious fluid, which keeps its inner surface in a moist state.

THE GLAND OF THE EPIGLOTTIS.

This gland consists of small granulations, deeply immersed in a quantity of adipose cellular tissue, and occupying a triangular space at the lower part of the anterior surface of the epiglottis. It pours its secretion upon the laryngeal surface of the epiglottis.

THE ARYTENOID GLANDS.

These glands are situated in the folds which the mucous membrane presents, in passing from the epiglottis to the arytenoid cartilages, and from these to the thyroid cartilage. They are composed of small granulations resembling those of the lachrymal gland.

There is much difficulty in discovering their excretory orifices.

THE OFFICE OF THE LARYNX.

All the modifications of the voice are produced by the air passing from the lungs through the larynx; sounds may also be produced by it in the time that air traverses the larynx to pass into the trachea, but these tones are produced with more difficulty, and are not according to the ordinary laws of economy. If we blow air into the trachea towards the larynx, at the same time bringing the arytenoid cartilages together, a sound will be produced something like the voice of the animal, to which the larynx used in the experiment belongs.

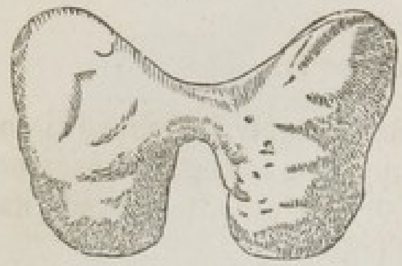
The sound will be dull or sharp according as the cartilages are pressed, more or less forcibly, together, and its intensity will be according to the force of the current of the air. We may observe, in this experiment, that the sound is produced by the vibrations of the vocal cords.

The strength of the voice depends upon the extent of the vibrations of the vocal cords, and these will be in proportion to the force with which the air is expelled from the chest. The tone of the voice generally agrees with the state of the cartilages of the larynx.

We can, therefore, account for the production of voice on physical principles. I will transcribe the explanation given by MAGENDIE. "The air being pressed from the lungs, proceeds in a pipe of considerable size; this pipe very soon becomes contracted, and the air is forced to pass through a very narrow slit, the two sides of which are vibrating plates, which permit and intercept the air, like the plates of reeds, and in the same manner, by these alternations, produce sonorous undulations in the transmitted current of air."

THE THYROID GLAND.

Fig. 287.



This body, Fig. 287, covers the lower and anterior part of the larynx, and the first two or three cartilages of the trachea : it is composed of two lobes, generally united in a great part of their extent ; but frequently they are unconnected, except by a sort of transverse cord.

The structure of the thyroid body is soft and spongy ; most commonly it is of a brownish red color, and is composed of a number of distinct lobules. An oily or a milky fluid may be pressed from its areolæ ; but it is an organ respecting the office of which we are totally ignorant, and which anatomists usually describe after the larynx, merely on account of its situation.

ART. XII.

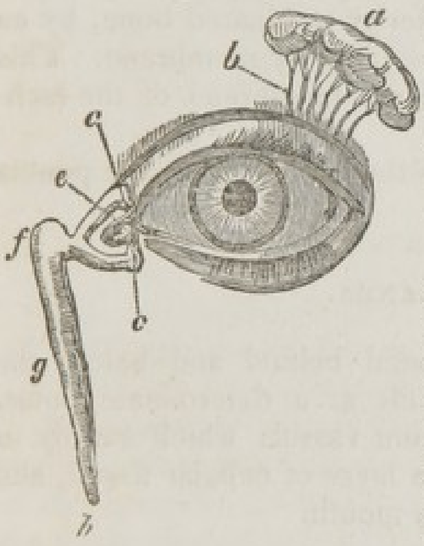
ORGANS OF SECRETION.

ORGANS FOR THE SECRETION AND TRANSMISSION OF THE TEARS.

These organs consist of the lachrymal glands, the puncta lachrymalia, the lachrymal ducts, the caruncula, the lachrymal sacs, and the nasal canals.

THE LACHRYMAL GLAND.

Fig. 288.



This gland, Fig. 288, *a*, is situated in a depression of the frontal bone, at the upper, outer, and fore part of the orbit. It is about the size of a small almond, but the form is various, most commonly it is a flattened ovoid. Its color is light yellow, inclining to red.

The lachrymal gland is formed of a considerable number of lobules, connected by cellular tissue, and these lobules are composed of granulations, the intimate structure of which is still entirely unknown. It is supposed that from each of them issues a small excretory tube, which unites with others in its vicinity, and forms trunks more distinct. It appears that there are six or seven in number, *b*, and that they open on the inner surface of the eyelid.

A fibro-cellular capsule of considerable thickness envelopes the lachrymal gland.

THE CARUNCULA LACHRYMALIS.

The *caruncula lachrymalis*, *e*, is a small red tubercle, situated in the inner angle of the eyelids : it consists of a mass of mucous crypts or follicles, covered by the conjunctiva, and forming, on its outer side, a fold* which allows of the motion of the globe of the eye.

* This folding of the conjunctiva is termed by anatomical writers, the *remains of the membrana nictitans ;* such a name, however, is quite absurd, as it has no such

Each orifice of the crypts is furnished with hairs of excessive delicacy, and visible only with a lens.

THE PUNCTA LACHRYMALIA.

The *puncta lachrymalia* are two in number, one for each eyelid; they occupy the centre of a small tubercle at *c*, *c*. These are the orifices of the lachrymal ducts, which convey the tears into, *f*, the lachrymal sac.

THE LACHRYMAL SAC.

The *lachrymal sac*, *f*, is a small membranous bag, situated in a groove of the os unguis, and ascending process of the upper maxillary bone. It receives the lachrymal ducts, and is continued into the nasal duct.

THE NASAL DUCT.

This canal, *g*, is continued from the lachrymal sac, and opens, at *h*, into the nasal fossa, beneath the inferior turbinated bone, by an orifice provided with a circular fold of the pituitary membrane. This canal is lined by a continuation of the mucous membrane of the lachrymal sac.

The nasal duct conveys the tears into the nose, which the puncta lachrymalia have absorbed.

THE SALIVARY GLANDS.

There are three salivary glands situated behind and below the lower jaw. They do not receive vessels at a determinate point, but are penetrated on all sides by adjacent vessels which ramify in their texture. They are surrounded by a layer of cellular tissue, and have excretory ducts which open into the mouth.

1. THE PAROTID GLAND.

The parotid gland, Fig. 289, *a*, is situated in the recess which exists on the side of the face, between the posterior border of the lower jaw and the ear, and extends from the zygomatic arch as far as the angle of the inferior maxilla.

This gland is of a grayish white color, and is composed of granulations united into lobules and lobes by condensed cellular tissue. These granulations give origin to excretory ducts, which, uniting,

office, structure, or muscular apparatus, as that membrane. The use of this fold is simply to permit of the turning of the eye outwards; for that purpose there is a similar lax fold at the opposite angle, and at the connexion of the superior and the inferior palpebræ with the globe of the eye. If these foldings of the conjunctiva did not exist, the eye would be fixed, and it would be impossible that the eye could be revolved in any direction.

Fig. 289.

form *b*, the *duct of* STENO, which proceeds over the masseter muscle, and, perforating the buccinator muscle, opens into the mouth, on a level with the second superior molar tooth.* The duct is formed of two membranes; one exterior, white, thick, and resistant; the other interior, a mucous membrane.

We find in the substance of the parotid gland a great number of branches of the facial nerve, the transverse artery of the face, the posterior auricular artery, and the vein which forms a communication between the external and the internal jugular vein.

2. THE SUBMAXILLARY GLAND.

This gland, Fig. 289, *c*, is situated on the inner side of the ramus of the lower jaw, between the two portions of the digastric muscle. Its structure is similar to that of the parotid.

Its excretory duct is commonly named WHARTON'S *duct;* it is much smaller than the parotid duct, and commences by minute roots in the granular substance of the gland, passes horizontally between the genio-glossus and the sublingual gland, until it reaches the side of the frœnum of the tongue, where it opens by a narrow orifice placed on the centre of a small tubercle.

3. THE SUBLINGUAL GLAND.

This gland is situated under the fore part of the tongue; it is smaller than the submaxillary gland, and nearly of the shape of an almond; it is covered by the mucous membrane of the mouth, beneath which it forms a prominence. It has several very slender excretory ducts: six or eight proceed from its upper part to open upon the sides of the frœnum linguale, while five or six others issue from the lateral parts, and perforate singly the mucous membrane of

* The duct of the parotid may be exposed by cutting in the direction of a line drawn from the lobe of the ear to the anterior openings of the nares.

the inferior part of the mouth. Two or three of these may be seen terminating in the submaxillary duct.

The organization is similar to the other salivary glands.

The saliva which these glands secrete flows constantly into the mouth, and mixes with the fluids produced by the membranes and mucous follicles. This liquid has been analyzed by BERZELIUS, and found to contain : water 93·9 ; a particular animal matter 2·9 ; mucus 1·4 ; muriate of soda and potass 0·7 ; tartarite of soda and animal matter 0·9 ; soda 0·2. The composition of the saliva is known to be variable, for in some instances it is sensibly acid.

The saliva is one of the most useful digestive fluids ; it is favorable to mastication and division of the food ; it assists in deglutition, and the conversion of the aliment into chyme ; it also renders more easy the motion of the tongue in speech and in singing. The greatest portion of the fluid is carried into the stomach by the motion of deglutition ; another portion must evaporate and go out of the mouth with the expired air.

THE PANCREAS.

The *pancreas*, Fig. 290, is a gland situated transversely in the abdomen, behind the stomach. Its form is irregular and very variable ; its weight is from three to six ounces. Its *anterior surface* is covered by the transverse mesocolon, the stomach, and the first portion of the duodenum. Its *posterior surface* presents, as its upper part, a groove which contains the splenic vessels. There is very frequently beneath it a small detached glandular mass, of the same structure, named the *small pancreas*.

Fig. 290.

The pancreas bears an exact resemblance to the salivary glands in its structure : its color is light red, and from its lobules we can trace the radicles of its excretory duct, which, progressively increasing in size, proceeds in a serpentine form towards the duodenum, where it is as large as a crow-quill. Near its termination it receives the excretory duct from the small pancreas, and after a short passage, the common pancreatic duct opens into the ductus communis choledochus ; or rather adheres to it as it enters the duodenum at the same point.

The pancreatic fluid, I believe, has never been collected in sufficient quantity to be analyzed ; but is generally considered to be analogous to saliva. Its office, therefore, is merely conjectural ; and it is only known that this fluid mingles with the bile, and is poured into the duodenum.

ORGANS FOR THE SECRETION AND TRANSMISSION OF THE BILE.

THE LIVER.

The *liver* is the largest of all the glands ; it entirely occupies the right hypochondrium, and that part of the epigastric region which is beneath the diaphragm and above the stomach, the lesser omentum, the duodenum, the arch of the colon, the gall bladder, and the right kidney ; it is placed in front of the aorta and inferior vena cava, and behind the anterior parietes of the abdomen. It is very dense, its weight, in the adult, varying from two to five pounds. It is convex on the superior surface, and irregularly concave on the inferior surface. It is divided into three lobes.

1. The *great lobe* is situated obliquely in the right hypochondriac region ; it corresponds with the curve of the diaphragm, and rests upon the pylorus, colon, and superior extremity of the right kidney.

2. The *small lobe* is partially separated from the greater by a broad ligament, and is situated almost horizontally in the epigastric region ; only a small part extending to the left hypochondriac region.

3. The lobulus SPIGELII is situated on the left side of the great lobe, and is of a pyramidal form, projecting between the cardia and vena cava, at the small curvature of the stomach. Two prolongations* appear to connect its base to the great lobe of the liver ; one of these gradually loses itself at its surface ; the other ascends posteriorly towards the groove of the inferior vena cava, and contributes to its formation.

The liver has several depressions and fissures, namely :

The *fissura umbilicalis*, or *the groove of the umbilical vein*, situated between the large and small lobes, at the under and fore part of the liver, which, in the fœtus, contains the umbilical vein ; and in the adult it is occupied by the fibrous cords which are formed by the remains of these obliterated vessels.

The *sinus portarum*, or groove of the interior vena cava, is situated behind, near the convex edge of the liver ; it is short, but deep, and often exists as a true canal. The porta receives the great blood-vessels, and the nerves which pass into the liver, and the biliary ducts and absorbents which proceed from it.

LIGAMENTS OF THE LIVER.

The liver is retained in its position by folds of the peritoneum, termed the ligaments : —

1. The *ligamentum latum*, which is united to the diaphragm and the tip of the ensiform cartilage, and then descends in an oblique direction, adhering to the inner edge of the vagina of the rectus abdominis of the right side as far as the umbilicus.

* These parts of the liver are frequently described as the *lobulus caudatus*, and the *lobulus anonymus*, or *quadratus*.

2. The *ligamentum rotundum*, which was the umbilical vein in the fœtus, is placed in a duplicature of the ligamentum latum, and united to the umbilicus.

3. The *ligamentum coronarium*, unites the root or posterior part of the liver to the tendinous portion of the diaphragm.

4. The *ligamentum dextrum*, or right lateral ligament, connects the posterior part of the great lobe of the liver to the diaphragm.

5. The *ligamentum sinistrum*, or left lateral ligament, connects the small lobe to the diaphragm. The two lateral ligaments are merely the extension of the coronary ligament.

Haller has described two other ligaments, the one connecting the gall bladder and the contiguous sinus portarum to the colon, called the *hepato-colic* ligament; the other termed the *hepato-renal*, which unites the liver to the kidney.

ENVELOPES OF THE LIVER.

The *peritonæal envelope* is reflected from the lower surface of the diaphragm over the liver, and gives it externally its shining appearance.

The *cellular envelope* covers all the parts of the liver, and is extended into its substance, forming sheaths which accompany the branches and twigs of the vena portæ, the hepatic artery, and hepatic duct. These sheaths have been designated the *capsule* of Glisson.

The interior substance of the liver is of a reddish brown, or yellowish color. Its general aspect is porous; this, however, arises from the great number of small vessels which are divided in cutting it. If the tissue of the liver is torn instead of being cut, it then appears composed of an immense quantity of granulations, in which the extreme ramifications of the blood-vessels and biliary ducts terminate. The most minute researches have disclosed nothing further with respect to its intimate structure.

THE HEPATIC DUCT.

The *hepatic duct* commences by a great number of very slender radicles in the granulations of the liver; these radicles, termed *pori biliarii*, unite successively into branches, accompanied by the divisions of the vena portæ and hepatic artery, und form two principal trunks, one from the left lobe, the other from the right; these proceed outwards, and, uniting at a right angle, form the hepatic duct. This duct is about an inch and a half in length, and a line and a half in diameter; it ascends between the two folds of the gastro-hepatic omentum, before the vena portæ, on the left of the neck of the gall bladder, and unites with the cystic duct.

THE GALL BLADDER.

The gall bladder is a membranous reservoir, situated in a superficial depression of the inferior surface of the right lobe of the liver. It is composed of three membranes. 1st. A *serous membrane*, which is the peritoneal covering on the lower surface. 2d. A *cellular membrane*, which unites the serous to the inner membrane. 3d. A *mucous membrane* of considerable thickness, which lines the interior, and has a peculiar honeycomb appearance. At the neck of the gall bladder this membrane forms several folds, which, from their arrangement, have been called the spiral valve.

CYSTIC DUCT.

This duct, which is situated in the gastro-hepatic omentum, forms a continuation with the neck of the gall bladder, of about one inch and a half in length ; it is in apposition with the hepatic duct for a short distance, and afterwards unites with it, forming the *ductus communis choledochus*, or the common canal for the transit of the bile.

THE DUCTUS COMMUNIS CHOLEDOCHUS.

This duct is formed by the junction of the cystic and hepatic. It is from three to four inches in length, and is situated between the two folds of the gastro-hepatic omentum. It opens with the pancreatic duct obliquely, into the duodenum near its last curve.

Fig. 291.

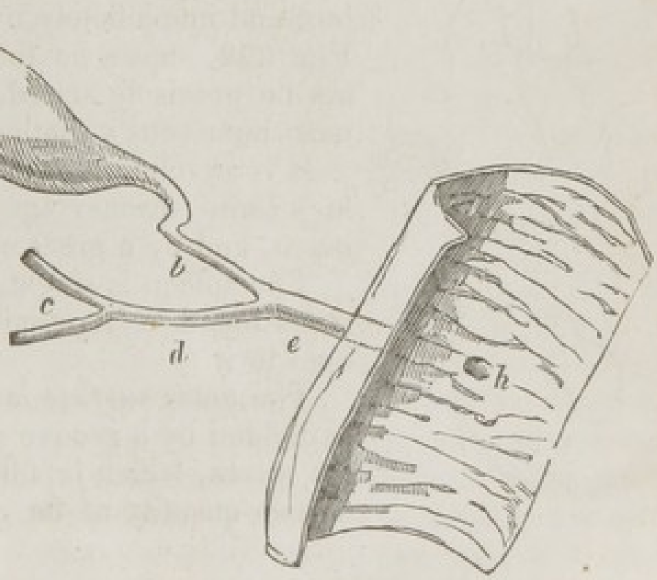


Fig. 291, *a*, the gall bladder, *b*, the cystic duct, *c*, the principal branches of, *d*, the hepatic duct ; these unite and form, *e*, the ductus communis choledochus, which terminates at, *h*, by an aperture in the inner surface of the duodenum.

SECRETION OF BILE.

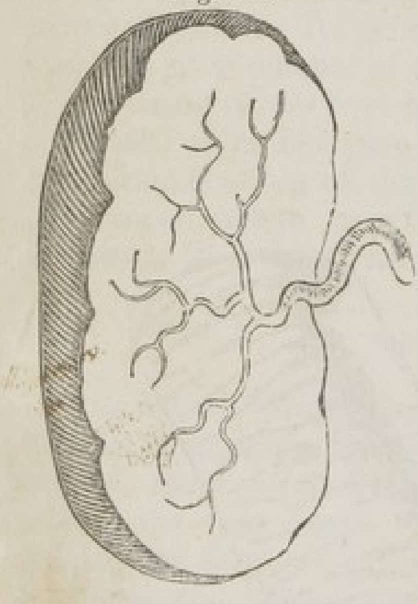
The circulation in the liver is very remarkable, from its receiving blood from two sources ; the hepatic arteries, and from the department of veins continued from the vena portæ, which are distributed after the manner of an artery throughout the substance of the liver. There is another department of veins for returning the blood, consisting of the venæ cavæ hepaticæ, which open into the inferior cava. Fluids injected into the hepatic artery, or into the vena portæ, readily pass into the venæ cavæ hepaticæ, and into the hepatic ducts. We may infer from this that both venous and arterial blood may serve for the secretion of bile.

The bile appears to be the most complex of all the animal fluids. Professor Mayo states that, besides a number of saline ingredients, it contains *mucus*, *albumen*, *osmazome*, *gliadine*, *caseïn*, *picromel*, *asparagin*, *acetic acid*, *oleïc acid*, *margaric acid*, *cholic acid*, *resin*, and *coloring matter*.

The bile contributes very essentially in the digestive and assimulative processes, but in what manner is unknown. Persons commonly attribute noxious properties to the bile, which it is probably far from possessing.

THE SPLEEN.

Fig. 292.



The spleen is situated in the posterior part of the left hypochondrium, beneath the diaphragm, behind the descending colon, and immediately over the left kidney. Fig. 292, shows its form ; its weight cannot be precisely stated, as it presents the most numerous variations.

It is attached to the surrounding organs in a loose manner by folds of the peritoneum, and by a great number of vessels.

The spleen is single, but I have several times found a supernumerary spleen adjacent to it.

The *outer surface* is convex ; the *inner* is divided by a groove called the *fissure of the spleen*, which is filled by vessels and a certain quantity of fat.

ORGANIZATION OF THE SPLEEN.

It is of a spongy consistence : it always contains a very large proportion of blood, which seems identified with its tissue, and which is found not only in its vessels, but also in the very numerous cellules and areolæ of which this organ is chiefly formed. It contains also a number of soft grayish, semitransparent granulations, disseminated irregularly in its tissue. MALPIGHI considers them small glands; but their nature is quite unknown.

Sometimes two or more small bodies, of the same color and structure of the spleen, are found in its vicinity, between the laminæ of the omentum.

OFFICE OF THE SPLEEN.

Regarding the office of the spleen, there has been a number of speculations; I shall only refer to some of the most plausible, and those which meet with the most general support. Dr. HAIGHTON advanced it as his opinion, that the spleen was subservient to digestion, by occasioning an increased secretion of the gastric and pancreatic fluids, at the precise time when they are most required. In explaining the mode in which this effect is to be produced, he agreed with HALLER in the opinion, that the stomach, when distended with food, makes sufficient pressure on the spleen, to prevent the ordinary supply of its cells, and to direct the blood, commonly sent to it, to the stomach itself and to the pancreas.

It is suggested by Sir ASTLEY COOPER, that it is a part of the function of the spleen to elaborate venous blood, and thus assist the liver in the formation of bile.

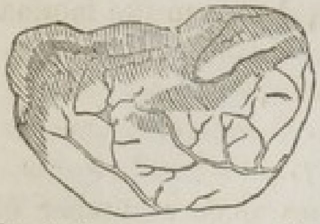
Sir. C. BELL also regards it, "as a provision for giving the vessels of the stomach an occasional power and greater activity, enabling them to pour out a quantity of fluid proportioned to the necessity of digestion."

My talented and indefatigable friend, Dr. HODGKIN, has devoted much attention to this subject, and from considering the situation and structure of the spleen, — the different appearances which it assumes according to the circumstances under which death has taken place,— the causes which derange it, and the effects which it produces on the system when deranged, — together with the result of experiments made on inferior animals, — he has been induced to adopt a very different opinion: he believes, "that the spleen performs, in the animal system, a similar office to that which tubes and valves of safety do in various chemical and mechanical apparatuses." By this comparison he (Dr. HODGKIN) would wish to be understood; "that the spleen tends to obviate any inconvenience which might arise from a sudden disturbance of the proportion between the capacity of the vascular system, and the fluids which circulate in it. These disturbances," he adds, "must, I conceive, be frequently induced by various causes to which the animal system is continually exposed, and which operate more powerfully than the elasticity of the vessels alone can compensate for, and more readily than absorption, secretion, and excretion, can, in every case, counteract."

50

SUPRA-RENAL CAPSULES.

Fig. 293.



The *supra-renal capsules*, Fig. 293, are two small bodies, situated above the kidneys; they are of a light brown color, and consist of a small bag, the exterior of which is granulated and collected into lobules. In its interior we observe a narrow, smooth, triangular cavity, without any known orifice: it is furnished in its inferior part with a prominent ridge, and it contains, in the fœtus, a considerable quantity of a reddish, viscid, albuminous fluid. In after life this fluid is of a deeper color.

The office of these capsules has hitherto eluded research; their volume is much greater in the fœtus than in the adult. On this account it is supposed that they have some connexion with the exercise of nutrition in the first stages of life, or that these organs are useful in the fœtal state, by deriving the blood from the kidneys, those glands not then having undertaken their proper functions of secreting urine.

THE KIDNEYS.

The *kidneys* are two glandular bodies, situated in the lumbar regions, on the sides of the vertebral column, opposite the two last dorsal and the two first lumbar vertebræ. The right kidney is placed at the under and back part of the large lobe of the liver, and is usually a little lower than the left kidney; the latter is placed under the back part of the spleen, and behind the left portions of the stomach, pancreas, and colon.

The kidney is four or five inches in length, and in shape, as we may see in the following figures, resembles the kidney bean which is named from it.

It is totally imbedded in a very solid and more or less thick mass of fat. This adipose tunic is extended likewise to the renal vessels, and is supposed to defend them from the pressure of the surrounding viscera.

The right kidney is connected to the liver, the left to the spleen, and both to the muscles on which they are placed, and to the supra-renal glands and colon by cellular tissue; the peritonæum is reflected from the liver and the spleen to the kidneys.

ORGANIZATION OF THE KIDNEYS.

The surface of the kidney is usually smooth and uniform, though sometimes it is irregular, in consequence of the lobes which originally form it not being so completely incorporated. Each kidney receives from the aorta an artery of considerable diameter, and returns its blood by a large vein into the inferior vena cava. A very distinct nervous plexus surrounds these vessels, and the lymphatics are very easily to be traced.

The kidney appears to be formed of two distinct substances; an external or *cortical*, and an internal *tubular*, or medullary substance.

The *cortical substance* of the kidneys forms the external layer of these organs, and internally it is prolonged into them in the form of septa, between which we find the conical fasciculi of the tubular substance. When viewed with a microscope, the cortical substance appears composed of solid granulations of a very small size, formed by the capillary extremities of the renal arteries and veins.

The *tubular substance* presents a number of conical fasciculi, surrounded on all sides, except at their summits, by the cortical substance. The base of each cone is directed towards the circumference of the kidney, and their summits, on the contrary, are directed towards the pelvis, or fissure of the kidney.

The color of this substance is a pale red; its tissue is dense, and is formed of a multitude of very minute convergent canals, termed *tubuli uriniferi*, which derive their origin from the cortical substance, and, terminating in larger ducts at the summits of the cones, present so many mammillæ,* at the points of which the urine oozes out. The number of mammillæ is twelve or fourteen; the orifices of the canals (called the ducts of BELINI) of the tubular substance are less numerous than the canals themselves, on which account it is to be presumed that several of these uriniferous tubes unite before they terminate.

THE CALYCES, PELVIS, AND URETER.

The *calyces*, or *infundibula*, are membranous tubes which embrace the mammillæ, and which receive the urine from them. The infundibula are commonly the same in number as the mammillæ; the number, however, varies in different subjects, two or more mammillæ sometimes opening into the same infundibulum.

The *pelvis* is a membranous bag formed by the union of the infundibula; it is contracted at the inferior part to be continued into the ureter.

The *ureters*, or the excretory ducts of the kidneys, are long membranous canals, of a cylindrical form, and about the size of a writing quill; each extends from the pelvis of the kidney, with which it is continuous, to the fundus of the bladder into which it opens.

The ureters descend in the loins obliquely inwards behind the peritonæum, and over the psoas and iliac muscles, and passing into the pelvis, terminate in the under, outer, and back part of the bladder, by a narrow oblique orifice.

The infundibula, pelvis, and ureters, appear to have the same organization; being composed of two membranes, namely an *outer*, thick, white, opaque membrane, which may be considered as a prolongation of the fibrous capsule of the kidney; and an *inner*,

* Frequently termed *papillæ*.

mucous, transparent membrane, which is extended from the infundibula over the mammillæ, and perhaps even introduced into the uriniferous tubes.

Where the ureters open into the bladder, some few pale muscular fibres may in general be found. These have been named the *muscles of the ureters*, by Sir CHARLES BELL, who describes each as arising from the vesical extremity of the ureter, and thence descending obliquely forwards and inwards, to be inserted by a tendon common to its fellow into the tubercle or uvula of the urethra. The use which he assigns to them is, to restrain the termination of the ureters, and preserve the obliquity of the passage of these tubes through the coats of the bladder when it is contracted ; for without this provision, he remarks, the urine would be sent retrograde into the ureters, instead of forward into the urethra.

Fig. 294.

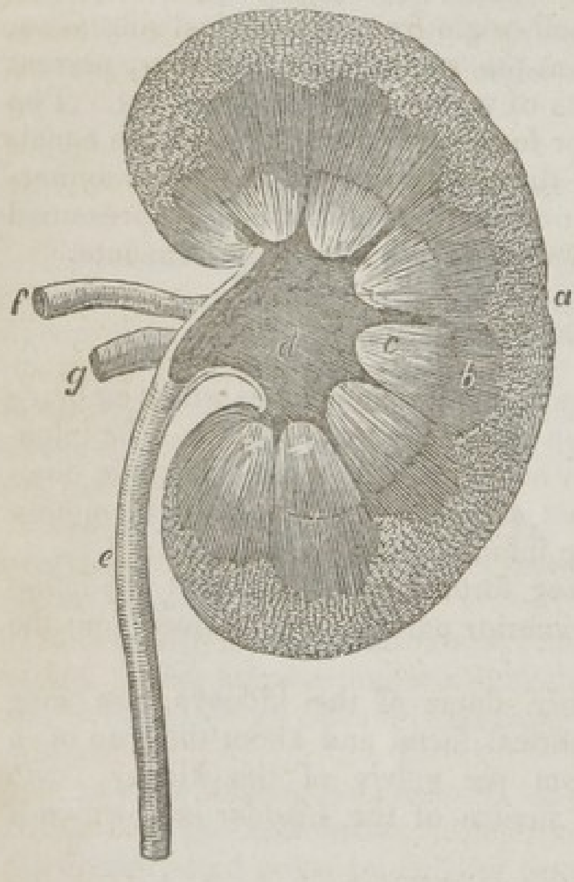


Fig. 294 exhibits a section of the kidney.
a, the cortical substance.
b, the tubular substance.
c, the mammilæ, around which are the infundibula.
d, the pelvis.
e, the ureter.
f, the renal artery.
g, the renal vein.

THE BLADDER.

The *urinary bladder* is a musculo-membranous reservoir, whose office it is to retain for some time the urine, which is afterwards to be ejected from it. The bladder is situated in the pelvis at the bottom of the hypogastric region.

The superior part of the bladder is in contact with the inferior convolutions of the small intestine ; and from its centre we observe a fibrous cord termed the *urachus*, which ascends between the linea alba and the peritonæum to the umbilicus, where it terminates in the abdominal aponeurosis.

The *inferior* part or fundus of the bladder, in the male, is connected by cellular tissue to the vesiculæ seminales, and the end of the vasa deferentia. That portion of the bladder, which is between the two vesiculæ, rests upon the rectum. In the female the bladder is connected with the levator ani and the vagina.

The *anterior* part is situated behind the pubes; but when the organ is distended by urine, we find it in the hypogastric region. There is a fasciculus of fibrous membrane which attaches the anterior part of the bladder to the symphysis of the pubes, named the *anterior ligament of the bladder*.

The *posterior* part is entirely covered by the peritonæum, and is contiguous, in the male, to the rectum, and in the female, to the uterus.

The *internal* surface of the bladder is formed by a mucous membrane, which, in its empty state, presents numerous irregular rugæ, but these disappear when the bladder is full; and we always find on the fundus a remarkable triangular space, where the mucous membrane is destitute of rugæ; it is named the *trigonal space of the bladder*.

The *neck* of the bladder has a cresent-like form, the margin of which is very thick, and it embraces a small tubercle, designated by the name of the *uvula vesicæ*.

THE ORGANIZATION OF THE BLADDER.

The *peritonæal membrane* is reflected over part of the superior, posterior, and lateral portions of the bladder, and it is united to the muscular membrane by loose cellular tissue.

The *muscular membrane* consists of muscular fibres, spread out in various directions over the bladder; the greater number, however, are longitudinal, a few only being transverse. These fibres are stronger on the anterior and posterior surfaces than on the sides. On the latter region they run obliquely. The anterior fibres, from having a fixed attachment, are called by some anatomists the *detrusor urinæ muscle*.

The *neck of the bladder* is formed of a firm, white, extensile, fibrous membrane, with muscular fibres, having the same arrangement as on the bladder itself; this is generally designated by anatomists as the sphincter vesicæ. J. CLOQUET altogether denies that it is a sphincter muscle, and states it to be merely the fleshy fibres brought closer together than elsewhere.

The *cellular membrane* is that which connects together the mucous and muscular structure of the bladder, and in which we observe the most numerous vessels and nerves.

The *mucous membrane* is continuous with the inner surface of the ureters and the urethra. Its villosities are very delicate and not easily detected; in its natural state no mucous follicles are to be observed, but in certain morbid conditions their presence is very apparent.

THE OFFICE OF THE KIDNEYS AND THE BLADDER.

The kidneys separate the urine from the blood, and convey it by means of the ureters to the bladder. There is every reason to suppose that substances hurtful to the animal economy are discharged in this fluid ; for when there is a total suppression of this secretion, or when the renal arteries are tied, death occurs in a short space of time.

When the pelvis of the kidney is cut open, in the living animal, the urine may be seen to pass out slowly at the points of the excretory cones. Or if we remove the kidney from the body, and compress the uriniferous cones, we observe a considerable quantity of this fluid issuing from them. The urine then enters the pelvis of the kidney, and by small quantities proceeds through the ureter by a constant exudation, and slowly distends the bladder. The urine is prevented from flowing back into the ureters, by these conduits passing a considerabie distance into the sides of the bladder, so that, in proportion as the urine distends this organ, it compresses the ureters, and closes them more firmly as it is more abundant. This mechanism may be observed in the dead body ; for if we inject the bladder with water, or even air, by the urethra, we find that it never enters the ureters.

There is no fluid of the human body so variable with respect to quantity and quality ; for it varies according to age, to the quantity of fluids drank, the nature of the aliments or medicines taken, or according to the season of the year : in the winter it is more copious, and in the summer, from the increased transpiration, it is more sparing and high-colored. Affections of the mind also influence the secretion ; thus fright makes the urine pale and copious.

The numerous researches made concerning urine have given the following as its compotent parts : 1 water ; 2 urea ; 3 phosphoric acid ; 4, 5, 6, 7, phosphate of lime, magnesia, soda, and ammonia ; 8, 9, 10, 11, lithic, rosacic, benzoic, and carbonic acid ; 12 carbonate of lime ; 13, 14, muriates of soda and ammonia ; 15 gelatin ; 16 albumen ; 17 resin ; 18 sulphur.*

According to BERZELIUS the following are the ingredients of 1000 parts of healthy urine.

Water,	933·00
Urea,	30·10
Sulphate of potass,	3·71
Sulphate of soda,	3·16
Phosphate of soda,	2·94
Muriate of soda,	4·45
Phosphate of ammonia,	1·65
Muriate of ammonia,	1·50
Free lactic acid, — lactate of ammonia, — animal matter soluble in alcohol, — urea not separable from the preceding,	17·14
Earthy phosphate, with a trace of fluate of lime,	1·00
Uric acid,	1·00
Mucus of the bladder,	0·32
Silex,	0·03
	1000·00

* Dr. URE.

ART. XIII.

ORGANS OF GENERATION IN THE MALE.

THESE consist of the testicles and their appendages, the vesiculæ seminales, the prostate, the ductus ejaculatorii, and the penis.

THE TESTICLES AND THEIR APPENDAGES.

1. THE ENVELOPES OF THE TESTICLES.

1st. The *scrotum*, or the cutaneous envelope of the testicles, is a continuation of the skin of the adjacent parts. It is remarkable for having a deeper color than other parts of the skin, for the great number of mucous follicles which it contains in its substance, and for its long and scattered hairs which are inserted obliquely, and so superficially that their bulbs produce distinct elevations of the skin. Upon the surface of the scrotum there is a superficial, longitudinal, elevated line, called the *raphe*, which divides it into two equal parts, and extends as far as the anterior part of the anus.

2d. The *dartos* is a filamentous cellular membrane of a rose color, entirely destitute of adipose substance, in which an infinite number of vessels are distributed ; and although some authors have described it as a muscle, it certainly does not exhibit the smallest appearance of muscular fibres. It is attached to the ischium and pubes ; meeting in the middle that of the opposite side, thus forming a septum which separates the testicles. The inner surface is applied to the fibrous tunic of these organs, and on the extremity of the cremaster muscles ; the outer surface adheres to the scrotum.

3d. The *cremaster muscle*. This has been already described. See page 125, Fig. 131.

4th. The *fibrous tunic* is thin, transparent, and very little resistant ; it forms an elongated sac, placed within each dartos. Superiorly, it forms a sheath for the spermatic cord, and, inferiorly, it contains the testicle and epididymis.

5th. The *tunica vaginalis*, a serous membrane which constitutes, like all other serous membranes, a sac without an opening ; it covers the whole internal surface of the fibrous tunic, and is extended to the epididymis and testicle ; entirely covering the latter, excepting at its upper edge. In infancy it is manifestly continuous with the peritonæum, having descended with it into the scrotum. This circumstance explains the formation of that species of hernia in which the intestine is in immediate contact with the testicle.

2. THE TESTICLES.

The testicles are two ovoid glandular organs, lodged in the scrotum. The right testicle is generally a little higher than the left.

ORGANIZATION OF THE TESTICLE.

The *tunica albuginea* is a fibrous membrane, white and opaque, not unlike the sclerotica; it serves as a direct envelope to the testicle. Its outer surface is covered by the serous membrane; its inner is applied upon the proper substance of the testicle, and sends into the interior of it a number of delicate prolongations, directed towards its posterior part. These septa divide the testicle into several cells, which contain the seminal vessels.

On the inner side of this membrane we observe the *corpus Highmorianum*, an elongated prominence at the superior part of the testicle, across which the principal trunks of the seminal vessels pass obliquely towards the epididymis.

The *parenchyma of the testicle* is soft, of a gray color marbled with red, and is formed of an immense number of very minute tortuous tubes, slightly connected to each other. According to the observations of MONRO, they do not exceed the two hundreth part of an inch in diameter; these tubes, termed *vasa seminalia*, or *tubuli seminiferi*, do not ramify, but their length is very great; the same author estimates their number at about sixty-two thousand five hundred, and he considers their total length to be five thousand two hundred feet: capillary arteries and veins of still greater minuteness are observed among them.

The seminal ducts just described are all directed towards the superior part of the testicle, where they form from twenty to thirty considerable trunks, which traverse the corpus Highmorianum, opposite and a little below the epididymis, where they dilate and give origin to the duct which forms the epididymis.

3. EPIDIDYMIS.

This name is given to the canal formed by the union of all those smaller tubes, which compose the body of the testes and the corpus Highmorianum. The epididymis is situated upon the upper part of the testicle, is inclosed in the same covering with it, and is exceedingly convoluted until it passes into the spermatic cord. Its superior part arises from the corresponding part of the testicle, where it receives the *vasa efferentia*; its inferior part is adherent to the testicle, and is continuous with the *vas deferens*; its middle portion is adherent to the testicle.

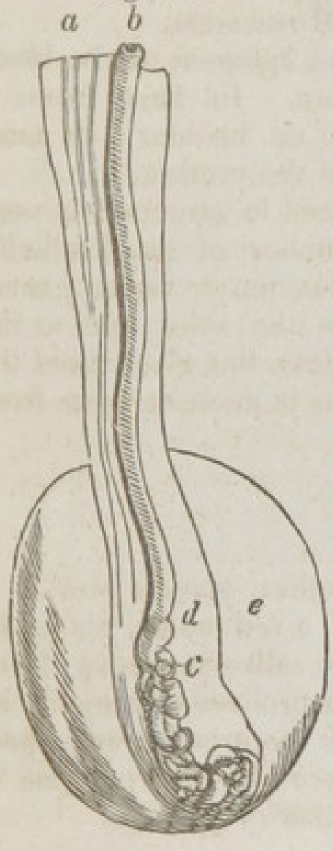
4. VAS DEFERENS.

The *vas deferens* is the large excretory duct of the testicle. It commences at the lower part of the epididymis, ascends, describing many flexuosities, behind the testicle, and immediately enters the spermatic cord, where it is placed behind, and internally to the artery and nerves which accompany it. After passing the ring it leaves the other vessels of the cord, and descends backwards and inwards upon the side of the bladder. Then, arriving under the inferior and posterior region of the bladder, it approaches its fellow, and proceeds along the inner edge of the vesiculæ seminales. At the base of the prostate gland, it receives a canal from the vesiculæ seminales, and is continued into the ejaculatory duct.

The vas deferens is slender near its origin, but on passing through the abdominal ring it increases in size, and becomes twice as large along the vesiculæ seminales : at its termination, however, it resumes its original size. The parietes of this duct are very thick, and have almost a cartilaginous consistence ; its cavity is so small as scarcely to admit a hair, except near the vesiculæ, where it is much larger.

5. SPERMATIC CORD.

Fig. 295.



The *spermatic cord* is composed of the last-mentioned duct, namely, the vas deferens, the spermatic artery and vein, of some other inconsiderable and irregular blood-vessels, lymphatics, and nerves. It is enveloped by several membranous layers, and contains a large quantity of cellular tissue in the intervals of its component parts. It ascends from the upper part of the testicle, and enters into the abdomen by the inguinal ring. The organs of which it is composed then separate from each other, and follow a course with which we are already acquainted.

Fig. 295. Posterior view of the testis and tunica vaginalis.
a, the spermatic cord.
b, the vas deferens.
c, the commencement of the epididymis.
d, the testis, devoid of the tunica vaginalis.

THE VESICULÆ SEMINALES, PROSTATE, COWPER'S GLANDS, AND DUCTUS EJACULATORII.

1. VESICULÆ SEMINALES.

The vesiculæ seminales are situated beneath the bladder, in front of the insertion of the ureters, and on the outer side of the vas deferens. They are two membranous reservoirs about two inches and a half in length, and six or seven lines in breadth. In dried preparations the vesiculæ appear as a cavity composed of numerous cells ; but if they are carefully dissected they present a flexuous canal.

These vesiculæ are filled with a thick yellowish fluid, which has been supposed to have retrograded from the vasa deferentia ; but as, in some animals, the vesiculæ seminales have no connexion with the excretory ducts of the testes, we may reasonably infer that they are not mere receptacles of the secretion of the testicles. The vesiculæ are organs of secretion, producing a peculiar fluid which is ejected at the same moment as the secretion just mentioned.

2. PROSTATE GLAND.

The *prostate gland* is a body of the size and figure of a chestnut, formed of an assemblage of mucous follicles, surrounding the neck of the bladder and the commencement of the male urethra.

This gland has a division forming it into two lateral lobes, and there is sometimes an inferior lobe at the base of the prostate, first noticed by MORGAGNI, and subsequently very particularly described by Sir EVERARD HOME. It is called *lobus* MORGAGNI.

The upper surface is covered by the inferior ligament of the bladder ; the lower surface rests upon the rectum. Its base forms a very remarkable prominence round the neck of the bladder ; its summit terminates upon the membranous portion of the urethra.

The prostate gland is of a light gray color, and its structure is very dense and firm ; it is filled with a great number of small follicles containing a viscid fluid. From these follicles ten or fifteen excretory ducts arise and open into the urethra, on the sides and at the surface of the Verumontanum. When we remove this gland from the dead body and compress it, the fluid it contains is made to issue from the orifices of these ducts.

3. COWPER'S GLANDS.

These are two small granulated glandular bodies, placed parallel to each other before the prostate. They are of a red color, about the size of a pea, and of a structure resembling the salivary glands. Each of these glands has an excretory duct, which proceeds obliquely inwards and forwards in the spongy tissue of the urethra, and opens before the Verumontanum. These glands are for the purpose of secreting a mucus, to be discharged into the unariry passage.

4. EJACULATORY DUCTS.

These ducts commence at an acute angle, formed by the junction of the vasa deferentia with those which terminate the vesiculæ seminales ; they are about an inch in length, and proceed parallel to each other, in the substance of the prostate gland, opening into the urethra by two small oblong orifices, situated upon the lateral and anterior part of the Verumontanum.

Fig. 296.

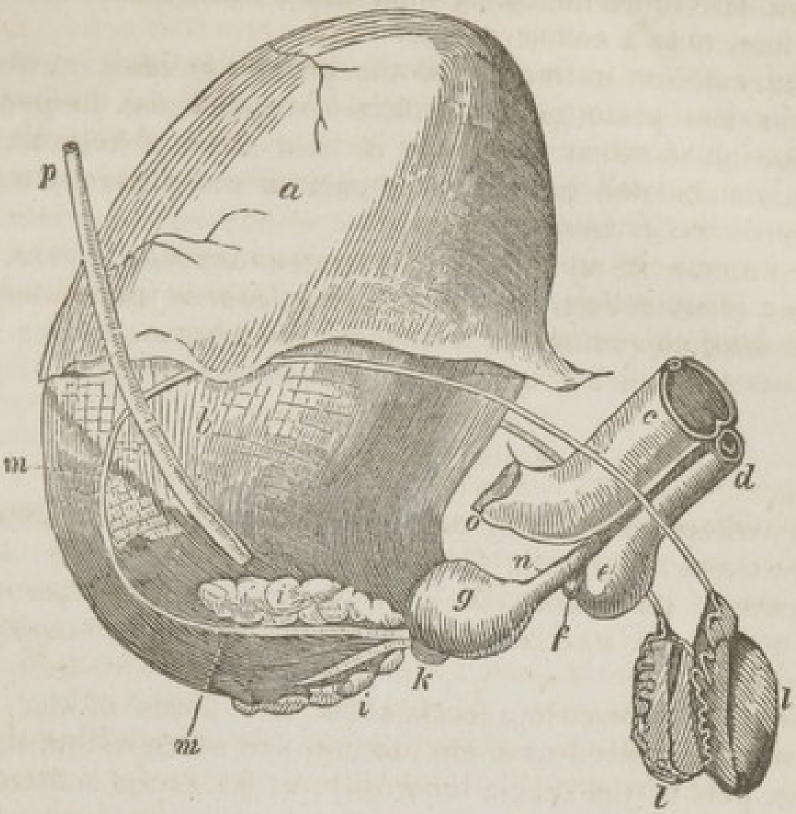


Fig. 296, exhibits the urinary bladder inflated, and the principal parts of the organs of generation of the male.

a, the peritonæum covering the bladder.
b, the muscular membrane of the bladder.
c, the corpus cavernosum penis.
d, the corpus spongiosum urethræ.
e, the bulb of the urethra.
f, one of COWPER's glands.
g, the prostate gland surrounding the neck of the bladder.
k, the inferior lobe of the prostate gland.
i, *i*, the vesiculæ seminales.
l, *l*, the testes.
m, *m*, vas deferens.
n, the membranous portion of the urethra.
o, the right crus of the penis.
p, the ureter, terminating in the bladder.

PENIS.

The *penis* is formed by the *corpus cavernosum*, the *urethra*, the *corpus spongiosum urethræ*, terminated by the *glands*; the *vessels*, *nerves*, and a *cutaneous investment*, which, by its prolongation, forms the *prepuce*.

1. INTEGUMENTS OF THE PENIS AND PREPUCE.

These parts are merely a continuation of the common integuments, which are here more delicately thin, and instead of fat, there is, as in the scrotum, only a cellular tissue.

At the anterior extremity of the penis the integuments form a greater or less prolongation, which is termed the *prepuce*, which covers the glans when the penis is in a state of relaxation. The prepuce is connected to the under part of the glans by a triangular fold, termed the *frænum preputii*.

The prepuce is composed of two membranous layers, between which is a plane cellular tissue; the outer layer is formed by the skin; the inner is of the nature of a mucous membrane, and is furnished with sebaceous follicles, termed the *glandulæ odoriferæ*.

2. CORPUS CAVERNOSUM.

Most writers on anatomy describe two corpora cavernosa penis, but there exists only one; there are certainly two roots, and a septum in part of its extent; but it is so incomplete a partition, that, with CLOQUET, CHAUSSIER, and others, we must consider it as a single body.

The corpus cavernosum forms about two thirds of the volume of the penis; it is placed over the urethra, and extends from the anterior and inner part of the sciatic tuberosity, as far as the substance of the glans.

The *roots* of the corpus cavernosum are attached to the inner border of the ramus of the ischium and pubes; they are about two inches in length, commencing in front of the sciatic tuberosity, and uniting at the inferior part of the symphysis pubis. The triangular space which separates them from each other, is occupied by fat and by the urethra.

The *anterior extremity* of the corpus cavernosum is united to the base of ths glans, and perforated by several apertures for the passage of vessels. Its *upper surface* is marked with a longitudinal groove, in which we observe the dorsal artery and veins of the penis. Posteriorly it gives attachment to the suspensory ligament of this organ, being a fibrous fasciculus attached to the inferior part of the symphysis pubis. The inferior surface is marked by a broad, deep groove, which receives the superior side of the canal of the urethra, to which it adheres by a filamentous cellular tissue.

ORGANIZATION OF THE CORPUS CAVERNOSUM.

The *corpus cavernosum* is composed of a very strong fibrous tunic, of an opaque white appearance, excepting at its roots and at the anterior extremity, where its color is more or less livid. Its fibres are for the most part longitudinal, and are interwoven posteriorly with the periosteum of the bones of the ilium, and the aponeurosis of the muscles, which are attached to their lower edge.

The cavity of this fibrous membrane is partially divided into two lateral portions, but the partition does not extend beyond two thirds of its length; it is then continued merely as a few fibrous fasciculi to the glans.

The *spongy tissue*, enveloped by the preceding membrane, appears to consist of a complicated net-work of arterial and venous vessels, probably of nerves also, and of small fibrous laminæ, which latter form numerous cellules communicating with each other, and with the blood-vessels, and always containing a greater or less quantity of blood. An injection made by the cavernous artery passes into these cellules, and if, on the contrary, we inflate these cellules with air, it passes into the cavernous vein, so that we may conclude that they are intermediate with the arteries and veins.

3. URETHRA.

The *urethra* extends from the neck of the bladder to the extremity of the glans penis; its capacity very much exceeds that of any other excretory duct. Its parietes are partly spongy, and partly membranous. At first its course is directed a little forwards and downwards; next traversing the prostate gland, it passes through a circular aperture of the triangular ligament of the bladder, and under the symphysis pubis mounts in front of it between the two roots of the corpus cavernosum, and then descends in the groove, in the superior surface of the latter as far as the summit of the glans penis, where it opens by a vertically elongated orifice. It is distinguished into three portions:

1st. The *prostatic portion*, which is from fifteen to eighteen lines in length, and passes obliquely through the prostate gland.

2d. The *membranous portion* is thin and contracted; it is from eight to ten lines in length, and united to the rectum inferiorly and posteriorly, and anteriorly approaching the inferior part of the symphysis pubis.

3d. The *spongy portion* commences posteriorly by the bulb of the urethra, which is situated beneath the angle of union of the roots of the corpus cavernosum. Anteriorly it expands to form the glans penis.

The cavity of the urethra has not the same dimensions through its whole extent; it is rather broad at its origin; it contracts and again dilates in the centre of the prostate gland. The membranous portion is much narrower than any other part of the canal, and in its spongy portion its breadth is very nearly equal except towards its extremity, where there is a remarkable dilation, termed the *fossa navicularis*.

The *interior* of the urethra, through the whole length of the canal, presents two white lines, the one superior, the other inferior; the latter line terminates posteriorly in a prominence, about an inch long, named the *verumontanum*, or the *caput gallinaginis*, continuous posteriorly with a small fold of the mucous membrane: the orifices of the ejaculatory ducts open at its sides; those of the prostate on its surface, and those of COWPER's glands in front of it.

ORGANIZATION OF THE URETHRA.

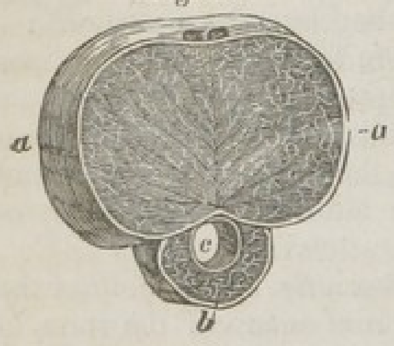
The *mucous lining* of the urethra is continuous at the one extremity with that which covers the glans, and at the other, with the mucous membrane of the bladder. Its color is a bright red near its orifice, but it becomes pale and white through the remainder of its extent. A great number of small foramina are observed opening on its surface, named *sinuses of* MORGAGNI ; and by a folding of the membrane they form so many lacunæ, commencing at the bulb, and becoming more numerous towards the fossa navicularis.

The *spongy tissue* surrounds the three anterior fourths of the length of the urethra ; it is somewhat thick at the bulb, then becomes contracted into a cylindrical tube as far as the glans penis ; this spongy tissue being expanded so as to form this part.

The membranous portion of the urethra is braced to the arch of the pubes by muscular fibres, discovered by Mr. WILSON, and named by him the *compressor urethræ :* when this muscle acts, it compresses the urethra so as to close it as completely as a sphincter, while, from its attachments, it draws the urethra towards the pubes.

GLANS PENIS.

Fig. 297.



The glans is covered by a very delicate epidermis, and is circumscribed by a prominent ridge, called the *corona glandis*. Its internal tissue has the same characteristics as the corpus cavernosum, only appearing more dense.

Fig. 297, exhibits a section of the penis.
a, *a*, the corpus cavernosum penis.
b, the corpus spongiosum urethræ.
c, the urethra.

ART. XIV.

ORGANS OF GENERATION, AND FOR THE NUTRITION OF THE CHILD, IN THE FEMALE.

THE genital organs of the female consist of the vulva, the vagina, and the uterus, and its appendages.

The *vulva*, or *pudendum*, is the name given to the external parts of generation in the female, under which are comprehended —

1st. The *labia pudendi*, two membranous folds, formed by a prolongation of the skin, beneath which there are a considerable number of sebaceous follicles. The integument on the fore part of the symphysis pubis is slightly elevated by a quantity of cellular and adipose substance deposited beneath it, and is covered with hair. This part, from its surmounting the labia, has been called *Mons Veneris.* The inner surface of the labia is a red mucous membrane, continuous with the other parts of the vulva. The intervening substance, that is, between the skin and the mucous membrane, consists of adipose tissue and some fibres of the constrictor vaginæ muscle. The labia unite both beneath the mons and before the perinæum, the points of union being called commissures. The inferior one has also received the name of *fourchette*, and the interval between this and the entrance of the vagina has been called *fossa navicularis.*

2d. The *clitoris*, a small elongated tubercle, placed at the middle and superior part of the vulva : it is supposed to bear some analogy to the penis of the male, in having a sort of glans surrounded by a fold of the mucous membrane similar to the prepuce. It has also a corpus cavernosum, of a spongy texture, adherent by two roots to the rami of the ischia ; it receives a great quantity of nerves.

3d. The *nymphæ* are two membranous crescent-like folds, extending from the prepuce of the clitoris to the middle of the orifice of the vagina ; each of the nymphæ is formed of two laminæ of the mucous membrane of the vulva ; they contain also in their substance a small quantity of spongy erectile tissue.

4th. The *urethra* is only an inch in length ; it is wide at its commencement, and descends obliquely forwards, terminating at the superior part of the entrance of the vagina, by an orifice called the *meatus urinarius :* in its course it describes a slight curve, the concavity of which is turned upwards. It is lined by a vascular mucous membrane, and contains a great number of mucous lacunæ.

5th. The *orifice of the vagina* commences beneath the meatus urinarius ; it is occupied by the *hymen*, or by the *carunculæ myrtiformes.*

The *hymen* is considered as one of the surest signs of virginity; it consists of a more or less distinct fold of the mucous membrane of the vulva; at the entrance of the vagina its form is semilunar, consequently not completely closing the opening.

The *carunculæ myrtiformes* are small red tubercles, existing only after the rupture of the hymen; they are in fact the remains of the lacerated hymen.

The *vagina* is situated in the pelvis, between the bladder and the rectum, and extends from the vulva to the neck of the uterus. It is from six to eight inches long, somewhat curved, its concavity being next to the bladder, therefore shorter before than behind, and somewhat more contracted at its extremes than in the middle part; its position is nearly vertical, or rather directed a little downwards and forwards.

The *outer surface* is invested superiorly, to a small extent, by the peritonæum; inferiorly it is contiguous with and between the bladder and rectum, being connected with these parts by a dense cellular tissue. On the sides it corresponds above to the broad ligaments of the uterus, and below to a mass of cellular tissue which separates it from the levatores ani muscles.

The *internal surface* is covered by the mucous membrane, and presents numerous transverse wrinkles, termed *rugæ*, which are less distinct on the sides, and are most prominent inferiorly; near the uterus the rugæ follow every variety of direction. There are also two longitudinal ridges formed by the mucous membrane, and intersecting the former at right angles.

ORGANIZATION OF THE VAGINA.

The *mucous membrane* is continuous with that of the vulva and the uterus. Between the rugæ it is perforated by a multitude of orifices of mucous follicles.

The *erectile spongy tissue* forms around the inferior part of the vagina, a layer about an inch broad, and two or three lines thick; it is desbribed by De Graaf under the name of *retiformis*, and by later anatomists under that of the *corpus cavernosum vaginæ*. Superiorly it becomes very thin; but it may be traced as far as the uterus, and seems to be continuous with the proper tissue of that organ.

THE UTERUS AND ITS APPENDAGES.

The *uterus*, or *womb*, is situated in the middle of the pelvis, between the bladder and rectum, above the vagina, with which it is intimately connected, and beneath the inferior convolutions of the small intestine. Its figure is annexed. It is flattened from before backwards, and is nearly an inch in thickness. Superiorly it is about two inches broad; but it is contracted inferiorly towards the vagina, and terminates by a narrow portion called the *neck*, to distinguish it from the other part of the organ, which is called its *body*. The *fundus* is the broad part which projects above the attachments of the Fallopian tubes, surmounting the body. It presents a convex border, and is covered by peritonæum in its entire extent.

The *body of the uterus* is about two inches in length ; its surfaces are convex, and invested with the peritonæum ; its anterior part is in contact with the bladder, its posterior with the rectum. The *cervix*, or *neck of the uterus*, is about fourteen lines in length, its transverse diameter from eight to ten. Its upper part is embraced by the vagina ; the orifice of the uterus, called the *os tincæ*, projects into the superior part of that canal.

The *cavity of the uterus* is small in proportion to the volume of the organ. It is triangular and compressed ; its edges are curved, and its upper angles present the extremities of the minute openings of the Fallopian tubes. Each of its surfaces are traversed by a longitudinal slightly elevated line. The cavity of the cervix is nearly cylindrical, and somewhat dilated before it terminates in the vagina. It presents a continuation of the vertical lines I have just mentioned, and some faint rugæ taking a transverse direction.

Fig. 298.

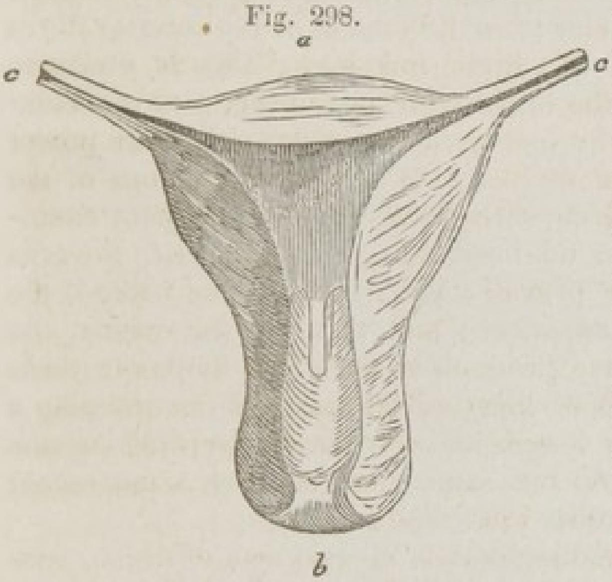


Fig. 298, exhibits a section of the unimpregnated uterus, in which we observe the relative size of its cavity and the thickness of its parietes.

a, fundus uteri.

b, os tincæ.

c, *c*, a section of the uterine extremities of the Fallopian tubes.

ORGANIZATION OF THE UTERUS.

The *serous membrane* is a covering formed by the peritonæum, which adheres firmly to its upper edge, but upon the two surfaces it is separated from the proper tissue of this organ by a quantity of cellular tissue and blood-vessels. In uniting with the lateral borders, it forms two angles, at the middle part of which the Fallopian tubes terminate, above the insertion of the ligament of the ovary which is posteriorly, and of that of the round ligament which is anteriorly.

The *mucous membrane* is similar to that of the vagina. It is covered with fine villosities, and, towards the neck, presents very numerous orifices of mucous crypts, some of which assume the form of transparent vesicles.

The *proper tissue of the uterus* is dense, elastic, and traversed by a great number of blood-vessels. Although it is impossible to describe the exact disposition of its fibres, as its structure is inextricable in the ordinary state, yet I entertain no doubt of its muscularity. In its impregnated state, or immediately after parturition, its muscular fibres are very apparent in dissection. Sir C. BELL has stated that the fibres of one order, which cover the upper segment of the gravid uterus, arise from the round ligaments, and, regularly diverging, spread themselves over the fundus, until they unite and form the exterior stratum of the proper tissue of the uterus. On the outer surface and lateral parts, other muscular fibres have an appearance of irregularity among the larger blood-vessels ; but they are so disposed that they are well calculated to compress the vessels, whenever the uterus is excited to contraction. These who have the opportunity of examining the gravid uterus in its recent state, will feel convinced, that it is distinctly and powerfully muscular ; but the course of the interior fibres are less easily described than we might imagine. This is owing to the intricate interweaving of the fibres with each other ; an intertexture, however, which gradually increases the extent of their power in diminishing the cavity of the uterus. After making sections of the substance of the womb in different directions, says the eminent anatomist just mentioned, "I have no hesitation in saying that, towards the fundus, the circular fibres prevail ; that, towards the orifice, the longitudinal fibres are most apparent ; and that, on the whole, the general course of the muscular fasciculi is from the fundus towards the orifice." This prevalence of longitudinal fibres is undoubtedly a provision for diminishing the length of the uterus, by drawing one extreme towards the other. At the same time, such an arrangement of the fibres, by their action, must dilate the orifice.

The inner surface of the fundus consists of two sets of fibres, running in concentric circles round the orifices of the Fallopian tubes : these circles, at their circumference, unite and produce an intricate tissue. There are other strata of fibres commencing at the centre of the last muscular fasciculi, and, having a course at first circular, then descend in broad irregular bands towards the orifice of the uterus.

The arteries of the uterus are derived from the spermatic and hypogastric ; their principal branches are very flexuous, and unite frequently together beneath the peritonæum. Its veins follow the same course, but are still more tortuous, and form cavities in its parietes, which become so large, during gestation, as to obtain the term of *uterine sinuses.*

When the uterus is contracted, the blood-vessels are invisible ; but, during pregnancy, they are so large and distinct, that the orifices of some of them, when divided, will admit the end of the little finger. This fact, then, of the natural closing of the vessels by uterine contraction, leads us to contemplate this organ as admirably constructed for the reception of the ovum, the growth of the fœtus, and the expulsion of the placenta without dangerous hæmorrhage.

THE BROAD LIGAMENTS.

The *broad ligaments** are two folds of the peritonæum ; they form, with the uterus and the upper part of the vagina, a transverse septum, which divides the cavity of the pelvis into two parts. These ligaments are continuous by the inner edge, with the peritonæum which invests the two surfaces of the uterus, and are externally expanded upon the sides of the excavation of the pelvis. They are formed of two peritonæal laminæ, the interval of which contains cellular tissue ; and superiorly on each side, the Fallopian tubes ; beneath and anteriorly, the round ligaments ; and posteriorly, the ovaries. The tubes occupy the free edge of the ligament ; the other two organs raise its surface and form two smaller foldings.

THE ROUND LIGAMENTS.

The *round ligaments* are two long and slender cords, commencing immediately before and below the Fallopian tubes, near the angles of the uterus from which they descend in the broad ligaments, and, diminishing a little in their course, direct themselves toward the internal inguinal ring, pass through it, and terminate by expanding in the cellular tissue of the pudendum.

Their structure is dense and fibrous, with an interposed cellular tissue and an evident vascularity.

THE FALLOPIAN, OR UTERINE TUBES.

The *Fallopian tubes*, formerly very well named the *oviducts*, are two canals placed at the superior edge, and in the duplicature of the broad ligaments. They are about four or five inches in length, and extended from the upper angles of the cavity of the uterus, to near the side of the upper diameter of the pelvis. In the inward half of their length they are small and straight ; afterwards these tubes become larger and more flexuous, and terminate in a wide floating fringed extremity, called *fimbriæ*.

The cavities of the Fallopian tubes are very small, indeed scarcely admitting the entrance of a bristle ; they gradually become larger as they approach the sides of the pelvis ; near their outer extremity they are considerably dilated, but are afterwards suddenly contracted, and terminate by an opening of sufficient size to admit the point of a writing quill.

These tubes are lined by a very thin mucous membrane, of a florid color, slightly villous, and presenting several longitudinal plicæ. No mucous follicles have hitherto been discovered in them.

Externally, these organs are formed by a layer of spongy and erectile tissue, similar to that of the urethra, and, as before noticed, invested by the peritonæum.

* *Ligamenta lata*, termed sometimes, *alæ vespertilionis*.

THE OVARIES.

The *ovaries*, anciently termed *testes muliebres*, are two compressed oval bodies placed in the substance of the broad ligament ; they are of a pale red color, and somewhat irregular at their surface. Their outer extremity is attached to one of the fimbriæ of the Fallopian tubes ; the inner is connected to the uterus by a small filamentous cord, about an inch and a half long, called the *ligament of the ovary*.

Each ovary is enveloped in a dense cellular membrane, which is prolonged into the parenchyma of the organ, the texture of which is composed of a loose and spongy substance. When minutely examined we perceive cellular and vascular lobules, of a gray color, filled with fluid. In the midst of these lobules we find from fifteen to twenty transparent small vesicles, called *ova ;* these are formed by a very delicate membrane filled with an albuminous fluid.

The *ova* differ in the same ovarium from the size of a mustard seed to that of a pea, and the largest are commonly situated nearest the surface.

In the prime of life the ovaria are large and uniform at their surface ; but in females advanced in life they become small, unequal, and irregularly formed ; and in those who have borne many children a similar irregularity is apparent.

The ovaria are intended for the nourishment of the ova, which contain the embryo or rudiments of the fœtus.

Fig. 299.

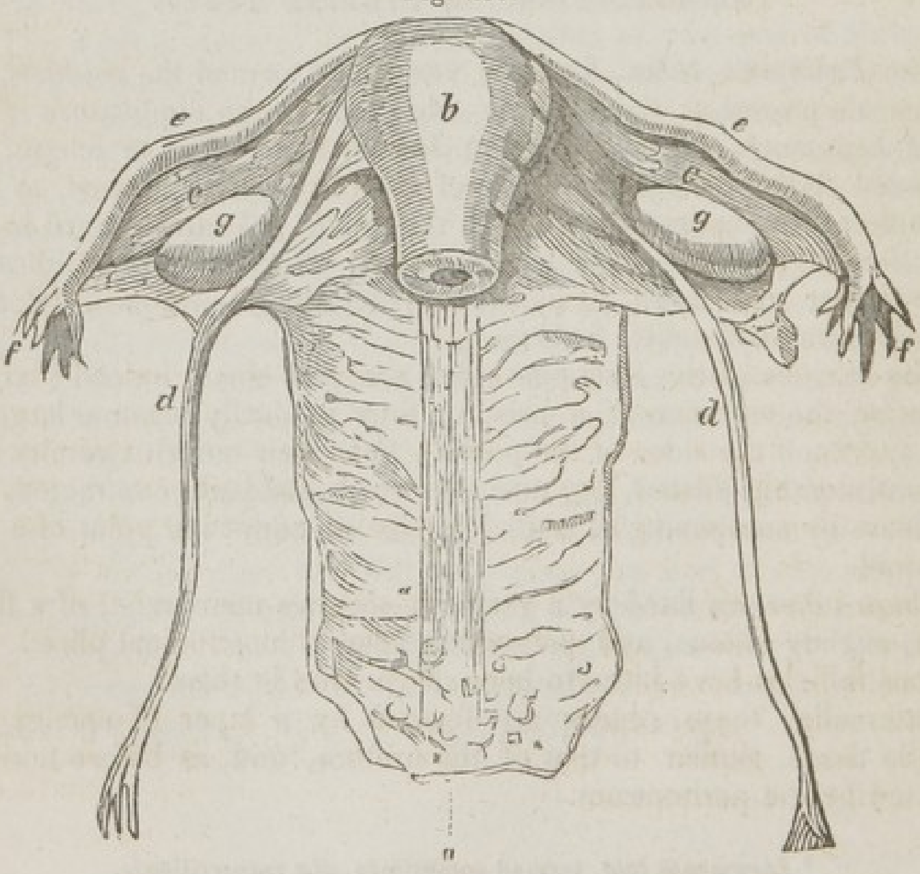


Fig. 299, exhibits the vagina, the uterus and its appendages.

a, the vagina cut open, showing on its inner surface the rugæ and carunculæ.

b, the uterus.

c, *c*, the broad ligaments.

d, *d*, the round ligaments.

e, *e*, the Fallopian tubes.

f, *f*, the external opening of those tubes with their fimbriæ.

g, *g*, the ovaria.

THE GRAVID UTERUS.

When the ovum has been conveyed through the Fallopian tube, from its receptacle, into the cavity of the uterus, conception has taken place. Do the rudiments of the fœtus proceed from the male or from the female ? We may pass over the theories of the ancients and moderns on generation ; at best they are but "brilliant reveries which overload the mind of the student, and do more injury than is generally supposed to the progress of science." * All that physiologists have discovered, as it regards fecundation, is, that the part of the male, in the act of reproduction, is to deposit the semen in the vagina at a greater or less distance from the orifice of the uterus. The function which the female discharges is more obscure. The uterus, at impregnation, is supposed to attract the semen and direct it to the ovarium by means of one of the Fallopian tubes, whose fimbriated extremity closely embraces that organ.

The contact of the semen occasions the rupture and delivery of one of the ova, and the fluid that passes from it, or the ovum itself passes into the uterus, where the new individual is to be developed.

The time which intervenes between the instant of fecundation and the delivery of the child, is called *uterogestation*, or *pregnancy;* it is generally nine calendar months, or forty weeks.

When the ovum has arrived in the cavity of the uterus, it closely unites with the anterior part of this organ ; here it receives the materials necessary for its growth, and acquires, by degrees, a considerable volume : the uterus yields to this augmentation, and consequently, changes its form and position.

During the first three months of pregnancy, the development of the uterus is inconsiderable, and takes place in the hollow of the pelvis ; but in the fourth, as the organ becomes larger, this cavity will no longer contain it, and it rises into the hypogastrium. The uterus continues to increase in all directions until the eighth month, when it occupies a large space in the abdomen, compresses and displaces the surrounding organs, and crowds the intestines into the lumbar and iliac regions, and its fundus reaches the epigastric region. After this period the fundus recedes towards the umbilicus.

The cervix uteri becomes softer and wider about the fourth month,

* Magendie.

and afterwards diminishes in length, and is so expanded as to entirely disappear; at the seventh month the uterus has an ovoid form, and its volume is twelve times larger than in its unimpregnated state.

The appendages of the uterus are also considerably altered in relation to the adjoining part; the laminæ of the peritonæal folds, that form the broad ligaments, separate and assist in forming a covering to the uterus. The vagina is increased in length. The ovaria, retained by their vessels, do not ascend with the fundus uteri; but, with the Fallopian tubes, are now situated on its lateral parts. The round ligaments are thicker, more vascular, and yield to its elevation.

The abdominal parietes suffer very considerable distention, so that the umbilical depression is entirely obliterated.

As the magnitude of the uterus increases, it assumes a cellular appearance of a deep red color, and its fibres become more evident. On the exterior, they take a direction I have already described; but the internal fibres of the uterine tissue have some analogy with those of the heart and the tongue, in presenting an inextricable interlacement, where no regular arrangement can be distinguished. Its interior surface contains, immediately after impregnation, an albuminous layer, which increases with the organ in the earlier periods of pregnancy, and subsequently becomes a vascular membrane. Dr. HUNTER, who first carefully described it, called it the *decidua*, from its being ultimately cast off from the uterus. It is supposed to favor the adherence of the ovum to the internal surface of the uterus.

The arteries are now observed to have very frequent communications, and in their course are remarkably enlarged and convoluted. But the veins are much larger than the arteries, their diameter, as we have stated, being such as to distinguish them as sinuses; these materially contribute to form the great bulk of the uterine parietes. The lymphatic vessels also become very voluminous. It is evident that the quantity of blood that traverses the uterus, is in relation to the changes it has undergone, and the new functions it is required to fulfil.

DEVELOPMENT OF THE OVUM IN THE UTERUS.

The ovum is quite unattached during the first period of its abode in the uterus; but in the course of the second month its dimensions have increased; it becomes covered with filaments which ramify in the manner of blood-vessels, and are implanted into the decidua. About the third month they exist on one side of the ovum only, and are connected with that part of the deciduous membrane, forming the *placenta*. The ovum in the remainder of its surface presents a flocculent layer, sometimes termed the *decidua reflexa*.

The ovum, at the termination of the second month, is of the size of an egg; and, when there has been an abortion, we trace very distinctly the membranes which inclose the embryo, viz. —

MEMBRANES WHICH INCLOSE THE FŒTUS.

1st. The *amnion*, a membrane placed next to and directly enveloping the fœtus; it is very thin and pellucid, but firm in texture, and not easily torn; it covers the placenta, is reflected over the umbilical cord, and terminates at the umbilicus. It is united to the chorion by the intervention of a gelatinous substance.

2d. The *chorion*, a flocculent, spongy membrane, completely investing the ovum, and lining the uterus; this membrane is considerably thicker in the earlier than in the more advanced stages of utero-gestation: it then becomes transparent, and is united to the amnion in the manner just mentioned.

3d. The *decidua*, which may be properly considered as the membrane lining the cavity; it is much thicker than either of the other membranes, but its texture is less dense, and it is very easily torn. It is placed between the proper membranes of the impregnated ovum and the uterine surface. The decidua is only formed by the uterus during impregnation; its formation commences with conception. At first it is a mere fluid secretion, which afterwards assumes a flocculent membranous appearance; it increases in extension and thickness in proportion to the evolution of the uterus. It is adherent to the inner surface of that organ, and is extended over the chorion, to which it is connected by a vascular attachment; it is always thrown off after parturition.

The decidua serves as a capillary system, intended to be the medium of communication between the blood-vessels of the mother and the fœtus. The decidual vessels receive the arterial blood of the former, and these vessels are extended over a very considerable surface of tabular structure, which, in its distribution, is in apposition with the infinite ramifications of the umbilico-placental vessels at innumerable points; and by these means the required changes in the blood of the fœtus are as effectually produced, as the changes called for in the pulmonic blood are produced by the peculiar arrangement of the pulmonary apparatus. When the arterial blood of the mother has produced the desired effect on that of the fœtus, it is returned by the decidual veins to the surface of the uterus, where it enters into the general venous system of the mother.

LIQUOR AMNII.

The membranes contain a quantity of fluid termed liquor amnii, which is augmented in proportion to the advanced state of gestation. According to Professor VAUQUELIN, it is formed of water, albumen, soda, muriate of soda, and phosphate of lime. The uses of this fluid are to afford a soft medium for the residence of the fœtus, to which it allows a free motion, and protects its delicate structure from any external injury, to which, from the exertions of the mother, it might occasionally be liable. The waters of the amnios are also useful in parturition, by dilating the orifice of the uterus, and lubricating the external organs of generation.

THE PLACENTA. (Fig. 303.)

The *placenta* is a rounded, oblong and soft mass, by means of which the ovum is attached most intimately to the uterus. This body is generally about eight inches in its greatest diameter, six in the smallest, and one thick ; but it gradually becomes thinner towards the circumference. Its thickest portion is where the umbilical cord is connected to it.

This organ forms a most important part of the uterine contents : its structure is entirely vascular, with the simple interposition of cellular membrane ; so that in its general substance, when excluded from the uterus, it is found to consist of the different branches and divarications of the umbilical arteries and veins, united together by a fine cellular tissue. The whole of this organ is strictly fœtal : it contains within its structure cells or sinuses of considerable extent, into which the uterine vessels at the point of contact open, and over which their contents are circulated and returned, as long as the organ is attached to the uterine surface. This cellular part of the placenta has acquired the name of the maternal portion.

The placenta possesses within its structure the means of two distinct circulations, each of which is continued through distinct channels : the one passes the blood from the uterine parietes into the placental cells, and returns it back to the uterus : this is properly the *maternal circulation*, and continues as long as the placenta is attached to the uterine surface. The other conveys the blood of the child from its body, and back again through the numerous ramifications of the umbilical vessels : this forms the *fœtal circulation.* These two circulations are so completely separate and distinct, that they do not interfere with each other : each is entirely unconnected with, and independent of the other ; as far as positive communications of vessels are concerned, the fœtal vessels do not pass their contents into the placental cells, neither do the uterine vessels, communicating with the placental cells, pass their contents into the fœtal structure. There is no mixture of fœtal and maternal blood ; and no circulating communication, direct or indirect, exists between the fœtus, from apposition at the part to which the placenta is attached and through its medium.

A satisfactory notion, therefore, of the mode in which the principles of life are communicated to the embryo, of the materials from which it is evolved, or the manner in which the placenta is appropriated to its service, has hitherto never been obtained ; yet there are some points which are obvious and acknowledged. The following are facts which almost admit of demonstration.

1st. When conception has taken place, a principle of internal action and growth is established in the uterus, by which its parietes are enlarged in every direction, and its cavity is increased in capacity. 2d. One of the immediate effects of this primary change, is a secretion furnished by the vessels of its internal surface, which at first becomes the connecting medium between the mother and the embryo, and afterwards the deciduous membrane. 3d. When the ovum is received into the uterine cavity, it attaches itself to a point to which the uterine vessels are more particularly directed, and at which also certain vessels from itself are implanted. 4th. These several parts increase in size until the rudiments of the placenta are formed, and there is a regular increase of its whole substance, proportionate to the demand of the embryo for nourishment, and to the uterine growth.

The placenta adheres to the uterus by a simple apposition of parts, and by that peculiar connexion of vascular circulation which subsists between the uterine vessels at the point of contact, and the placental cells. The blood-vessels of the gravid uterus run through its parietes in a serpentine direction: and, in the distribution of blood, the venous system possesses a larger diameter than the arterial. Though the placenta is in apposition in so simple a manner with the uterine surface, it is not in immediate contact with it, the deciduous membrane being interposed becomes the bond of union between the two, except at those points at which the uterine vessels pass their blood into the placental cells.

The placenta is commonly attached to the fundus uteri; but there is no part of its internal surface at which this organ may not occasionally be found.

OFFICE OF THE PLACENTA.

The office of the placenta is strictly fœtal; it is an organ originally formed for and appropriated to the service of the fœtus, and is the only communication between the mother and her infant: it is the sole medium through which the principles of nourishment and growth can be conveyed from the one to the other. The fœtal blood distributed by the branches of the umbilical arteries over the placental mass, receives, as before stated, from the decidual apparatus, certain additions in that circulation necessary to fœtal life; and is returned to the child by the umbilical vein, replete with that vitality which it has acquired in its passage through the placenta. The blood of the child under this state of improvement, if I may be allowed the expression, may be compared to that of the adult after its passage through the lungs. Thus if interruption to the return of the fœetal blood, from the placental circulation, occurs from any cause, the life of the fœtus is as certainly destroyed, as if the free passage of the air into the lungs was prevented during breathing life.

FUNIS UMBILICALIS.

The *funis umbilicalis* is that vascular cord which, passing from the placenta to the umbilicus of the child, maintains the communication between the fœtus and the placenta. Its length is almost two feet; it is composed of two arteries and one vein, the spaces between which are occupied by a gelatinous substance, contained in cells, which serves to prevent any obstruction to the current of the blood from accidental compression. The funis is covered by the amnion, or inner membrane of the ovum, and the vein is sufficiently large to reconduct to the fœtus the whole or an equal quantity of blood to that which is conveyed from the two arteries from it to the placenta. The arteries twist round the vein in a beautiful spiral manner.

The funis seems to be the production of the placenta, for, soon after the birth of the child, there is a spontaneous separation of the funis at the umbilicus.

UMBILICAL VESICLE.

In the first months of gestation, a vesicle is found in the body of the umbilical cord, between the chorion and amnion, near the umbilicus: it receives small vessels from a prolongation of the mesenteric artery and the meseraic vein. It contains a yellowish fluid, the uses of which are not known: after the fourth month it becomes absorbed.

Sometimes this vesicle has been observed, at the full period of gestation, placed near the placenta; it is connected, as before stated, by vessels to the intestines, at the termination of the ilium or cæcum. At the lower end of the anal intestines there projects another vesicle or sac to which the name of *allantoid* has been given; it exists in all the mammalia, and in the human embryo it appears about the fourth week, but by the third month it disappears: the use of this vesicle also is unknown.

THE BREASTS (MAMMÆ).

The breasts form part of the generative organs: before the age of puberty they are small and flat; but in the adult and well-formed female, they present two hemispheres, or conical eminences, covered by a smooth semitransparent skin, softer and less colored than that of the other parts of the body.

Near the centre of each breast the color of the skin abruptly changes, and assumes a rosy tint in young females, and a reddish brown one in women who are pregnant or have suckled several children. This deep-colored circle is called the *areola* of the nipple.

The *nipple* (*papilla*) rises in the middle of the areola, and is always of the same color: it is susceptible of a kind of erection.

The skin of the areola and nipple has a wrinkled appearance, and is remarkable for its tenuity: it presents a number of sebaceous glands, which furnish an unctuous fluid calculated to protect these parts against the action of the saliva of the child. We observe upon the surface of the nipple numerous very fine papillæ, in which are the orifices of the lactiferous ducts.

ORGANIZATION OF THE BREASTS.

Beneath the skin there is a layer of *adipose tissue*, and it is chiefly to this that the breast owes its size and form.

The *mammary gland* is situated behind the adipose tissue, and before the great pectoral muscle ; it has a convex and uneven surface, and an irregularly circumscribed base. Adipose tissue is also found in the intervals which intersect the lobules.

The tissue of the mammary gland consists of an assemblage of lobes of different sizes, closely connected with each other by a dense cellular tissue. Each of these lobes is composed of several lobules, which are obviously formed of granulations of a pink color, and the size of a poppy seed. If we further examine these small granules, we find that they consist of a number of minute vesicles and an organized tissue.

Fig. 300.

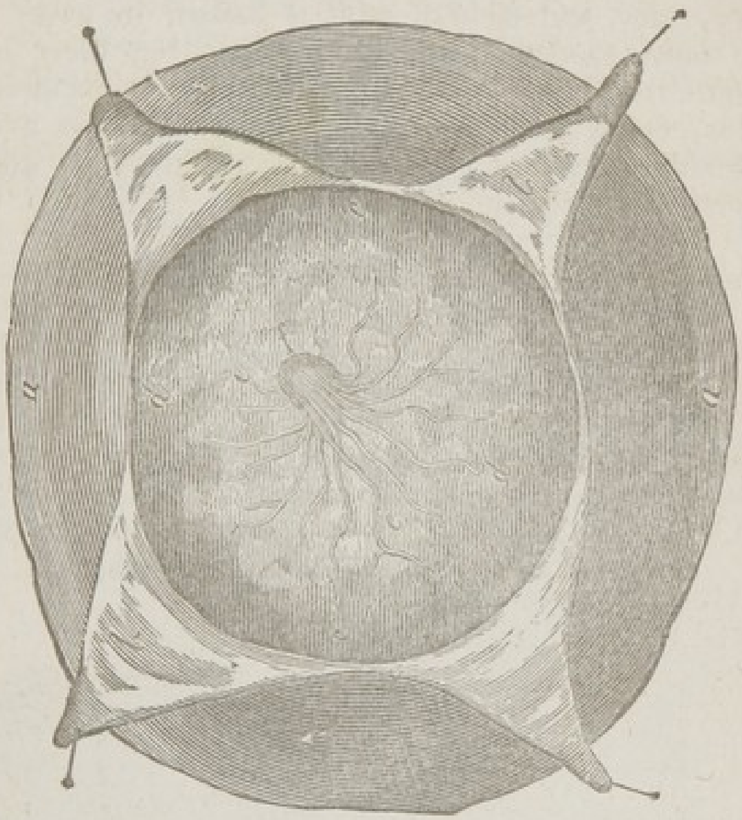


Fig. 300, represents one of the mammæ dissected from the pectoralis major muscle.

a, the skin.

b, the same dissected and reflected to show

c, *d*, the mammary glands ;

e, the origins of the lactiferous ducts, and

f, the nipple.

The lactiferous ducts arise from the granulations of the vesicles just mentioned ; they commence in capillary tubes, termed the *tubuli lactiferi*, which, uniting into branches, collect into trunks, and proceed towards the centre of the gland. Those of the different lobes do not communicate with the others, so that there are as many series of vessels as there are lobes in the gland ; but they all terminate in fifteen or sixteen sinuses in the centre of the nipple, and open separately on its surface.

When the nipple is contracted, the lactiferous canals are compressed, and the milk usually ceases to flow; but by the sucking of the child a vacuum is produced: into which the milk very readily escapes from the orifices of these canals.

OFFICE OF THE MAMMÆ.

The child continues, for some time after birth, dependent upon the maternal system for its nourishment, and a food is provided which alone is suitable to the delicacy of the infantine organs. This food is the milk; it is furnished by the mammæ until the termination of nursing, or continues until the end of the second year.

The color, odor, and taste of milk is known to every one; it is one of the most azotized glandular liquids; but there is no fluid secretion more readily modified by the diet, by the time after delivery, by medicines, or by affections of the mind. On the average, the milk of a healthy person, according to BERZELIUS, is composed of milk, properly so called, and cream.

MILK CONTAINS:	
Water,	928·75
Cheese, with a trace of sugar,	28·00
Sugar of milk,	35·00
Muriate of potass,	1·70
Phosphate of potass,	0·25
Lactic acid, acetate of potass, and lactate of iron,	6·00
Phosphate of lime,	0·30

CREAM CONTAINS:	
Butter,	4·5
Cheese,	3·5
Whey,	92·0

In this last 4·4 of sugar of milk, and salt is found.

ART. XV.

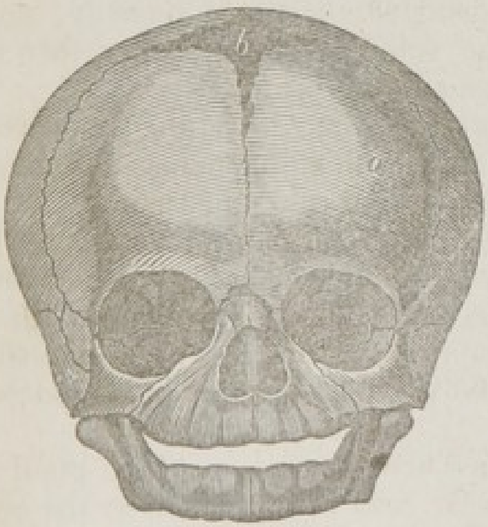
THE FŒTUS.

PECULIARITIES OF THE FŒTUS.

THE osseous system of the fœtus is found in a very different state to that of the adult; the fœtal bones are soft and yielding. The situations of many of them are occupied by mere cartilage; indeed, all the bones, prior to their assuming a regular form, are of a cartilaginous consistence, and the parts termed epiphyses, that is, the extremities of long bones, up to the period of birth, have entirely this character. Most of the cylindrical, and some of the flat and irregular bones, are formed of several distinct parts, each of which has its centre of ossification, and these parts can be easily separated by boiling, or by maceration in water.

In the chemical composition of the bones of the fœtus, there is a smaller proportion of the phosphate of lime, than in the adult. The fœtal bones are also more uniform on their surface, as they are not marked by the action of muscles; their cavities are filled with gelatin instead of marrow.

Fig. 301.



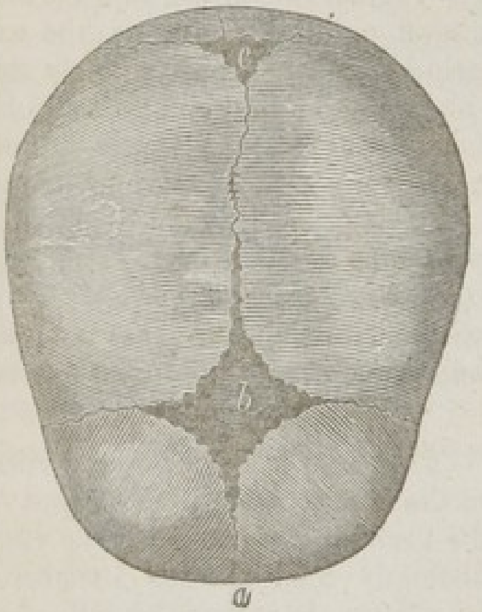
The head is large in proportion to the body, and in the bones of the cranium we may observe very distinctly their fibrous structure. In a fœtus about three months after conception the commencement of ossification in each bone is like a fine irregular net-work, in the centre of which, the fibres are more closely connected than at its circumference. In viewing the flat bones of the fœtus, at a more advanced period, the osseous particles are observed to have a radiated appearance; as the fœtus, however, attains a larger growth, the osseous fibres increase in number, until a lamina is produced; and in the progress of ossification, other laminæ are added, and a succession of these laminæ form the more solid fabric of the bone.

a, the os frontis, which at early life consists of two pieces divided by a vertical suture termed the *frontal*.

b, the anterior fontanel.

In the child the cranium bears a large proportion to the face, owing to the size of the brain, the absence of the sinuses in the forehead, and of the teeth in the gums; and the younger the embryo, the greater is the disproportion between the head and the rest of the body. Between the frontal and parietal bones, is the space called *anterior bregma*, or *fontanel*, (Fig. 301, *b*,) formed by an irregular quadrangular membranous substance, which commonly disappears before the child attains the age of two years, the margins of the bones being then united. Between the middle of the lambdoidal and posterior extreme of the sagittal suture, a similar membrane of a triangular form is also frequently observed, termed the *posterior bregma*, or *fontanel*, (Fig. 302, *c*,) but in a well-formed head is scarcely to be traced.

Fig. 302.



a, the frontal suture.
b, the anterior fontanel.
c, the posterior.

The rudiments of the teeth are situated in canals in the jaws, in sacs called the capsules of the teeth; these consist of two membranes, containing a pulpy matter. The inner membrane, about the sixth month, forms a thin layer of enamel: and at the period of birth the shells of ten teeth are found in each jaw.

The fluids in the fœtus are proportionally large in quantity, and the solids generally softer than in the adult.

The skin is of a florid color, in consequence of a greater degree of vascularity, and is generally covered with an unctuous substance, supposed to be secreted by the vessels of the rete mucosum.

Adeps is chiefly found near the surface of the body; very little is formed in the interior parts until later in life, when, in healthy persons, it afterwards gradually accumulates as they advance to a certain age.

The brain, spinal marrow, and nervous system, are proportionally large, but soft in their texture. The vascular system, and glandular organs bear the same proportion.

The cornea of the fœtal eye is thick and prominent. The pupil is occupied by the *membrana pupillaris*, which is attached to the circumference of the inner margin of the iris, and continues there until the seventh month, when it gradually disappears in consequence of being absorbed. This membrane is very vascular, and separates the two chambers of the eye from each other. The only use that can be assigned to it is, that it is an organ of secretion, which is requisite for the production of the humors during the rapid increase of the globe of the eye. The crystalline lens is almost spherical, and numerous vessels pass from the ciliary process to be dispersed upon its capsules.

The meatus auditorius is wholly cartilaginous, and adheres to a ring of bone in which the membrana tympani is placed. The meatus externus, and membrana tympani, are lined by a mucous membrane which separates after birth.

In this stage of existence certain glandular bodies are developed, the uses of which are still unknown, but which continue large and vascular till towards puberty, and afterwards shrink and waste. The *thymus gland* is one of these ; it is situated in the upper part of the thorax, between the laminæ of the anterior mediastinum, and over the pericardium ; processes of this gland always ascend on each side, as far as the neck. It abounds with a milky fluid ; but it has never yet been observed to have any excretory duct ; nor has the use of the fluid or of the gland yet been ascertained. Part of the thymus gland remains during youth, but it usually disappears altogether in old age. The *supra-renal capsules* of the fœtus are large, when compared to their diminished capacity in after life.

As the *lungs* have not commenced their functions, their appearance is extremely different from what it is after they have been inflated by the inspiration of air : they are proportionally much smaller, their color is darker, their substance denser, and their specific gravity is so much greater that they sink in water.

The *heart*, in the fœtus, is proportionally larger than in the adult, and the Eustachian valve is more distinct ; it is supposed to direct the current of blood, coming from the abdomen, through the passage immediately to be mentioned, existing in the septum of the auricles : —

This opening is denominated the *foramen ovale ;* it is situated obliquely in the partition which separates the right and left auricles ; it is nearly of the dimensions of the orifice of the cava, and it is bounded by a muscular margin, termed *annulus foraminis.* The greater part of the blood which arrives from the inferior cava, is poured into the left auricle, during the diastole of the ventricles. A falciform valve, placed over the foramen, prevents its return, and appears likewise to preclude its course into the left auricle, during the systole of the auricles. The blood passing through the foramen ovale keeps up the balance of the circulation between the sides of the heart, till the lungs are ready to receive it. The foramen is then generally soon obliterated.

The pulmonary artery divides into three branches ; the right and the left of which proceed to the lungs, while the middle one, termed *ductus arteriosus*, (Fig. 303, *m*,) which is larger than both the other branches, passing in an oblique direction to the beginning of the descending aorta. The ductus arteriosus is therefore another temporary passage for carrying a part of the blood of the right ventricle into the aorta, without passing the circuitous route through the lungs ; it thereby assists the foramen ovale, in keeping up the communication required between each side of the heart, till the child has breathed; and by these means also the aorta receives the force of both ventricles, to move the blood through the umbilical arteries; without this joint action it is probable the blood would not reach the placenta, and again return to the heart.

According to this disposition of the circulating apparatus of the fœtus, it is evident that the motion of the blood must be different from that in the adult. The blood from the placenta passes through the umbilical vein as far as the liver; then one part of the blood proceeds into the liver, and the other into the vena cava; from these two parts it arrives at the heart, and rushes into the right auricle, by the inferior cava, and into the left by the foramen ovale. The contraction of the auricles succeeds their dilation, and the blood is compressed into the ventricles; these in their turn contract and propel the blood into the aorta, except a very small portion, which goes to the lungs. By the united influence of the two ventricles, the stream of blood is forced through all the divisions of the aorta, and returns to the heart by the venæ cavæ. Lastly, it is transmitted to the placenta by the umbilical arteries, and returns to the fœtus by the vein of the funis.

The motions of the heart in the fœtus are very rapid; they generally exceed one hundred and twenty in a minute; the circulation necessarily possesses a proportionate rapidity.

The abdomen is proportionally larger; and the stomach is rounder than in the adult, and commonly contains a small quantity of gelatinous matter. The omentum has a very small quantity of fat between its laminæ. From the remarkable mode of nutrition of the fœtus, it is clear that its alimentary canal and the chylopoietic system must be very peculiar. The valvulæ conniventes of the small intestine are scarcely perceptible. The appendix vermiformis is very large, and is inserted into the extremity of the colon, which at this time does not project to form a proper cæcum. The large intestine very nearly resembles the small, its longitudinal muscular bands being very indistinct. The colon contains a blackish green fæces, of a viscid consistence, termed *meconium*, which appears to be a mixture of bile, with secretions from the intestines.

The liver is so large as to occupy both hypochondriac regions, and to extend some distance below the margin of the thorax. The gall-bladder is filled with bile of an extremely dark color.

The umbilical vein passes from the umbilicus, in a duplicature of the peritonæum, behind the recti muscles, to the fossa umbilicalis of the liver, and thence to the left branch of the vena portæ, and transmits the blood from the placenta to the liver. From the umbilical vein, where it terminates in the liver, a branch called *ductus venosus*, (Fig. 303, *h*,) proceeds in a somewhat waving direction, and joins the left vena hepatica, where that vein enters the cava. The ductus venosus transports part of the blood of that vein directly to the heart, without the inrervention of the hepatic circulation. The reason for this distribution of the umbilical vein is not understood.

The pancreas and other glandular organs are large in their relative dimensions. The kidneys are formed of lobes, in number nearly corresponding with the papillæ.

The pelvis of the fœtus is commonly so small, that the principal parts of the organs, afterwards situated in it, are at this time contained in the cavity of the abdomen. The urinary bladder is of a long form, and extends almost to the umbilicus.

The *urachus* is a solid fibrous substance ; it is attached to the fundus of the bladder, between the umbilical arteries, and, passing behind the linea alba to the umbilicus, disappears by degrees in the umbilical cord. In some instances it is hollow in a part or through the whole of its extent.

The common iliac arteries divide, on each side, into a small external, and a large internal branch ; the umbilical arteries arise from the internal iliacs, are directed over the sides of the bladder, attach themselves to the urachus, pass out of the abdomen by the umbilicus, and are distributed to the placenta.

Soon after parturition the foramen ovale, ductus arteriosus et venosus, with the umbilical vein and arteries, begin to contract, and are in general completely closed ; the vessels appearing like ligaments within a year after birth.

In the very young male fœtus, the testes are situated in the cavity of the abdomen, over the psoæ muscles, and a little below the kidneys, so that they constitute a part of the abdominal organs, and in a similar manner with them, are connected to the body by a process of peritonæum, which subsequently forms the tunica albuginea. Between the testis and scrotum a fibrous and vascular substance is extended, called by HUNTER, *gubernaculum*, which he considered as a principal agent in directing the course of the testis in its descent. This remarkable passage of the testis from the abdomen, through the ring into the scrotum, is limited to no period, but it usually occurs about the last month of gestation. No satisfactory explanation has ever been offered as to the cause of this singular transit of an important organ to a distant situation. It has been adduced by BLUMENBACH, as a striking illustration of a vita propria, without the peculiar influence of which, so remarkable and unique a movement, similar to no other function in the system, cannot even be imagined.

Fig. 303, is a representation of the manner in which the fœtal circulation is carried on.

a, the placenta.

b, portion of the amnion which covers the placenta.

c, the chorion.

d, the umbilical vein.

e, branches of the umbilical vein going to the liver.

f, the vena portæ.

g, hepatic branches of the preceding.

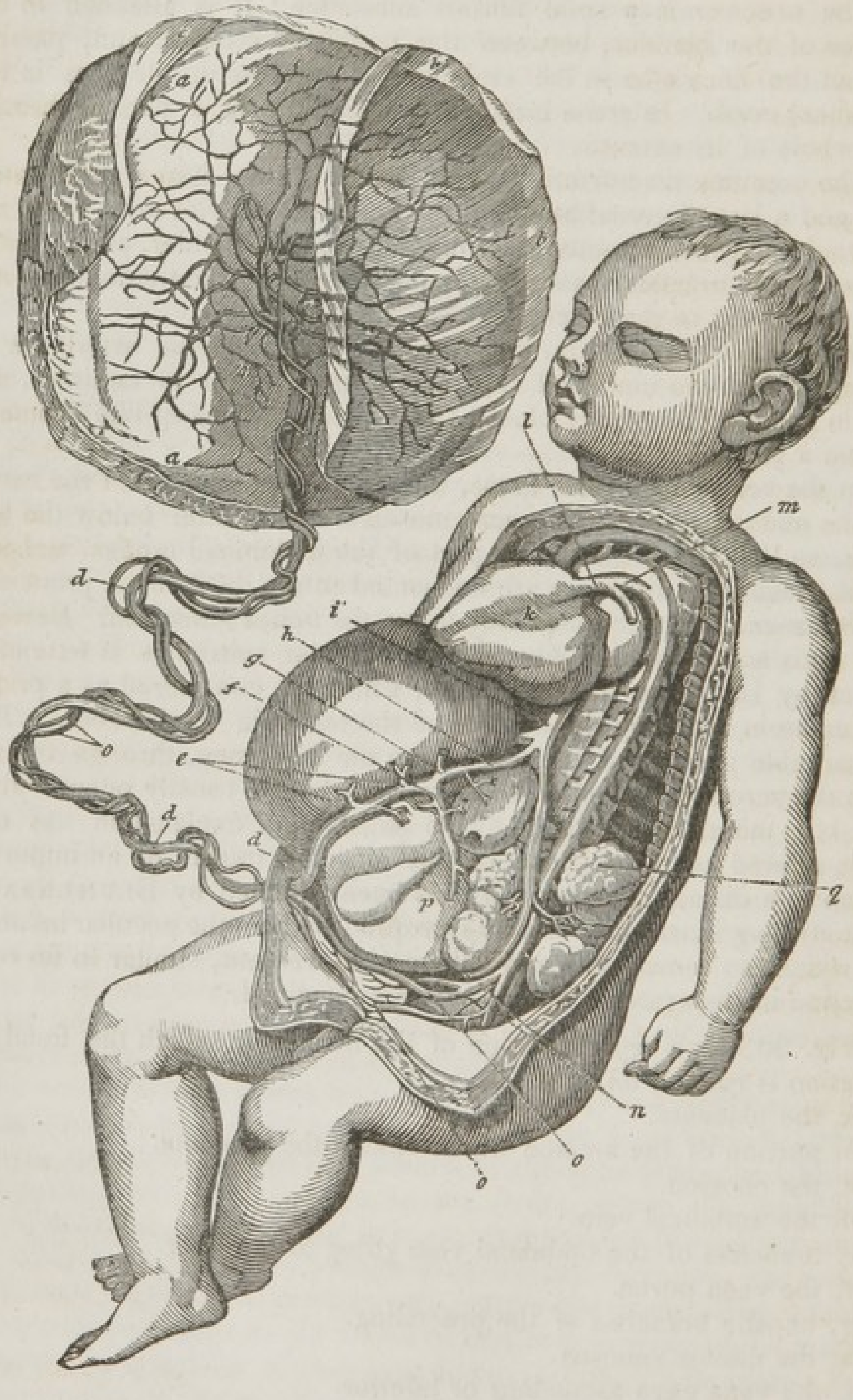
h, the ductus venosus.

i, the vena cava ascendens or inferior.

k, the heart turned to the right.

l, pulmonary artery.
m, the ductus arteriosus.
n, the iliac arteries, the internal giving off
o, *o*, the two umbilical arteries going to the placenta.
p, the liver turned to the right side in order to show the veins beneath it.

Fig. 303



ART. XVI.

SEROUS SYSTEM, AND CELLULAR TISSUE.

THE PLEURA AND THE PERITONÆUM.

Although, in the description of the contents of the thorax and the abdomen, we have frequently had occasion to advert to the serous membrane covering the several organs, still the serous membranes in general, and the pleura and peritonæum in particular, claim a more extended notice ; indeed, the two latter can be studied with greater advantage, after an acquaintance with the anatomy of those organs which they invest.

The serous system occupies the exterior of the major part of those organs, which are lined by the mucous membranes ; such as the stomach, the intestines, and the lungs. It is found round all those parts which are essential to life, as the brain, the heart, and the abdominal viscera. It also lines the sides of the cavities of the chest and abdomen, so that the organs are not in contact with the sides, or with the adjoining organs, except by the intermediation of the peritonæum.

The serous membranes present generally an envelope investing the organs so as not to be contained within, and which, if it were possible to dissect these organs from their respective surfaces, would be removed perfectly entire. This envelope, in this respect, has been compared to a double night-cap placed on the head, a trifling simile, but which, however, conveys a correct idea of the manner in which these membranes are situated. From this disposition, it is easily conceived, that the serous membranes are not perforated by the vessels and nerves of their respective organs, but that by doubling they provide a sheath for those organs.

The internal surface of this membrane, although in apposition with, completely separates the adjoining organs over which these membranes are spread, forming, as it were, an integument to the internal organs, which may be compared to the skin investing the exterior of the body.

The external surface of the serous membranes adheres to the adjacent organs : these membranes are rarely found unconnected on both surfaces. The tunica arachnoides, at the base of the brain, and a few others, are exceptions ; and where serous membrane is adherent it is perfectly distinct from the organ it invests : there is no connexion between their reciprocal organizations ; they are merely united by a loose cellular tissue.

All the serous membranes are composed of a single sheet, which, where it is thick, may be separated into cellular laminæ; it only differs from the cellular tissue in being more condensed. By inflating the tissue beneath, the cellular structure is rendered very apparent. No fibres are met with in its structure (a distinctive character of other organs), it is therefore similar to the cellular tissue.

The *pleura* is one of the class of serous membranes, one portion of which forms the investing tunic of the lungs, while the other is attached to the inner surface of the ribs, the upper surface of the diaphragm, the mediastinum, and the intercostal muscles. The pleura, covering the lungs, is termed *pleura pulmonalis:* the reflected portion, *pleura costalis*, *pleura diaphragmatica*, or *pleura pericardiaca*, in reference to the surface to which it adheres.

The surface of the heart is invested by a similar serous membrane, and it is reflected so as to form a sac, termed *pericardium*, which contains the heart.

The *peritonæum* is the most extensive of the serous membranes: it is thin and transparent; it has a very complicated course; not only does it invest the inner surface of the parietes of the abdomen, but it forms several remarkable folds in that cavity, and is prolonged under the form of an envelope over most of the abdominal organs.

It is usual to describe the peritonæum as presenting a sac without aperture, enveloping those organs, whose external appearance is smooth and glossy, but in reality, it is covered by fine villosities. It is everywhere in contact with itself. I have stated that it is an imperforated sac; but, in the female, there is a slight exception, for it is found to be perforated by the fimbriated extremity of the Fallopian tube, the mucous membrane of which seems to be continuous with the peritonæum.

In the umbilical region, the peritonæum lines the posterior part of the linea alba, closes the posterior orifice of the umbilicus, and is extended behind the wide muscles of the abdomen. On the right, it meets the ascending colon; on the left, the descending colon; and forms around this intestine two folds, which are named the *lumbar mesocolon*, and which serves to attach the intestine to the posterior part of the abdomen. The peritonæum passes before the kidneys, being separated from them by a greater or less quantity of fat and cellular tissue; then covering the uterus, the spermatic and renal vessels, the vena cava and the aorta, it advances on each side towards the vertebral column, before which it is reflected to form the mesentery, or that immense fold which supports and envelopes the small intestine.

In the hypogastric region, the peritonæum descends from the umbilicus to the pubes, and covering the urachus and the umbilical arteries, it is directed over the summit and the posterior part of the bladder. It presents, however, differences according to the sex: in the male, it invests the base of the vesiculæ seminales, and is reflected over the rectum, constituting the mesorectum. In the female, the peritonæum is extended from the bladder in front of the vagina; it then invests the anterior and posterior surface of the uterus, and is prolonged, laterally, so as to form the broad ligaments.

In the lateral parts of the hypogastric region, it is first reflected upon the parietes of the abdomen, over the illiac fossa, covering part of the iliac and psoæ muscles, embracing, to the left, the sigmoid flexure of the colon, by means of the *iliac mesocolon*, and, to the right, the cæcum and its appendix, by means of the *mesocæcum*. From thence it ascends forwards behind POUPART's ligament, and forms two depressions on each side, termed the inguinal fossæ, which are separated from each other by the fold of membrane which supports the remains of the umbilical artery. The external fossa is generally widest, and its peritonæum dips a little into the orifice of the inguinal canal: posterioly, the peritonæum is continued from the iliac fossa to the lumbar mesocolon.

The epigastric portion of the peritonæum, to the left, invests a considerable part of the inferior surface of the diaphragm, and sinks into the most retired parts of the region of the hypochondrium, as far as the vertebral column, whence it is reflected over the surface of the spleen, and the posterior surface of its vessels. At the cardiac extremity of the stomach, it is continued into the anterior lamina of the great omentum. The laminæ of peritonæum, which are comprised between the spleen and the stomach, are called the *gastro-splenic omenta*. In the centre, the peritonæum passes from the diaphragm, upon the anterior surface of the stomach, descends over the intestines to the most dependent part of the abdomen, and is reflected from below upwards, as far as the convex edge of the colon, thus contributing to form the *great omentum*. It then invests the inferior arch of the colon, forms the inferior lamina of the transverse mesocolon, and is continuous with the lamina of the mesentery.

On the right, the peritonæum is reflected over the liver, and forms foldings which constitute its ligaments.

Under the neck of the gall-bladder we find a triangular aperture, the foramen of WINSLOW, through which is seen the laminæ of the peritonæum, constituting the hypogastric omentum, or the *capsule* of GLISSON; which contains in its duplicature the hepatic and pyloric vessels, the coronary vessels of the stomach, and the cystic and hepatic ducts, together with the ductus communis choledochus. This lamina is then directed over the posterior surface of the stomach, covers the upper surface of the mesocolon, and the concave surface of the right lobe of the liver.

OMENTA, OR EPIPLOA.

The omenta are composed of folds of the peritonæum, connected together by cellular tissue, containing fat. Although I have referred to them in the preceding description of the peritonæum, still it is an advantage to the student to have before him a succinct and methodical arrangement of them.

The *hepato-gastric omentum*, or the *smaller omentum*. The peritonæum passes off double from the liver to the lesser curvature of the stomach. It is limited, on the right, by the large hepatic vessels and biliary ducts, which are inclosed in the capsule of GLISSON; and, on the left, by the œsophagus and the cardiac orifice of the stomach. Behind the capsule, just named, we find an aperture large enough to admit a finger, which was first described by WINSLOW, and has been called the foramen of WINSLOW: this foramen maintains a communication between the large sac of the omentum, and the common cavity of the abdomen. The two peritonæal laminæ of the smaller omentum separate from each other and invest the stomach, and, by their continuation, form the anterior lamina of —

The *great omentum*, a large fold of peritonæum: it is free and floating upon the front of the convolutions of the small intestine.* It is irregularly quadrilateral: it is attached, anteriorly, to the great curvature of the stomach; and, posteriorly, to the arch of the colon. It is formed of two laminæ, each composed of two lamellæ of peritonæum. The anterior lamina is a continuation of the serous covering, from the superior and inferior surfaces of the stomach: it extends, laterally, as far as the commencement of the duodenum and the inner surface of the spleen, to both of which it is connected. The posterior lamina has its origin in a similar manner from the serous membrane of the surfaces of the colon. At the opposite side of the colon, the laminæ unite to form the mesocolon. By the membrane thus continued, a large irregular sac is formed, of which the smaller omentum, stomach, and anterior portion of the great omentum, constitute the anterior, and the posterior portion of the great omentum, the colon, and mesocolon, the posterior part of the sac. In young subjects, the parietes of the sac is so complete, that it may be inflated from the foramen of WINSLOW; but in old and emaciated persons, the laminæ of which it is composed become reticular in consequence of absorption.

We find, between the laminæ of the great omentum, a considerable quantity of fat and blood-vessels.

The *colic omentum* is situated behind the great omentum; it consists of a fold of peritonæum, which exists on the right side only, nearly filling the angle formed by the union of the right and transverse portions of the colon. Frequently it extends as far as the cæcum or to the spleen. Its two laminæ are separated by arteries and veins belonging to the colon.

The *gastro-splenic omentum* is formed in a similar manner by the peritonæum, which, from the fissure of the spleen, proceeds over the cardiac extremity of the stomach. It contains in its substance the splenic vessels and vasa breviora.

The omenta, as well as the internal surface of other serous membranes, are constantly moistened with a fluid nearly resembling the serum of the blood. This fluid is incessantly poured out by the exhalents, and constantly taken up by the absorbents. Its quantity varies; in the natural state it is mere a dew, but in dropsies of the

* See page 235, Fig. 197, *i*, *i*, *i*.

abdomen it amounts to several gallons. Indeed the quantity of serous fluid varies astonishingly in the different acute and chronic diseases; and the exhalent surfaces pour out more or less of this fluid, according as they may be primarily or sympathetically affected.

The serous exhalations give a facility to the due actions of the respective organs, by permitting them to move on each other without injury. The great omentum is supposed to preserve the intestines from the ill effects which might result from violent exertions; it serves to retain their temperature, and to receive the superfluous depositions of fat.

CELLULAR TISSUE, ETC.

The cellular tissue is distributed throughout the animal system; it is composed of a very fine web, formed of a great number of thin plates, which crossing in an endless variety of directions, have between them interstices or cells, which communicate together and serve for the reception of fat or serum. The cellular system, examined in respect to the organs, presents, 1st, an envelope or outward limit to the organs; 2d, it enters freely into the texture of each organ, and constitutes a part of its structure.

In many parts the cellular tissue is very elastic, and capable of extension, but in other parts it is more dense and resistant. In some instances the cellular tissue adheres to one of the surfaces of an organ, as, for instance, the skin; in others it entirely envelopes it, as in parts where it is universally connected with the adjacent parts. The skin universally exhibits, wherever you examine it, a subjacent cellular stratum. This subcutaneous cellular tissue varies considerably in its texture; its density in the scalp is remarkable, which on this account is not easily separated from its aponeurotic and muscular connexion. In the face it is very loose, and extremely abundant: it is equally lax in almost all parts of the thorax, and in the extremities, and therefore accommodates itself easily to the motions of the muscles. It is only in the palm of the hand and the sole of the foot, that its texture, increasing in density, forms a stronger adhesion to the fascia and the skin. This arrangement is highly favorable to to the uses of these two parts, which must accommodate themselves to bodies, particularly enabling the hand to seize, grasp, and hold them.

The texture of the subcutaneous cellular tissue is dense about the capsular ligaments, for which reason the adhesion of the skin is stronger; hence, the contractions we observe at those parts in the extremities of infants, very little fat being admitted into the condensed tissue.

There is a submucous cellular tissue: but its texture is more compressed than that of the tissue we have been considering above. Consequently there is a difficulty in dissecting, and separating it distinctly from its connexions.

Under almost every part of the serous system, and likewise in the two preceding situations, we find a cellular layer generally very abundant and very loose.

Around each of the arteries there is a strong, dense, and elastic layer, which is sometimes considered as one of its proper membranes : it arises almost imperceptibly from the adjacent cellular tissue, which becomes condensed, and is so intimately united to the vessel, that it may be wholly detached, and forms a sheath or canal corresponding to that of the artery it surrounds and supports. Veins are provided with an external covering of cellular tissue analogous to that of the arteries.

With the exception we have named, all the organs are completely surrounded by a covering of cellular tissue, more or less extensive, forming a peculiar medium for each ; a medium in which they are entirely immerged, that insulates them from each other. After investing the several organs, the cellular tissue enters into their intimate structure, and forms one of their elements. In those organs which are composed of several parts, these parts are united together by it : thus in the stomach, intestines, etc. the different membranes of which they are composed are connected together by this web. It sends a multitude of processes into the structure of the lungs, between the serous membrane and their parenchyma, between this and the bronchi, and between the bronchi and the mucous surface.

In the muscles and other organs the cellular tissue first attends and surrounds, through their whole course, the vascular and nervous ramifications which are found in their composition ; and afterwards unites the different parts which compose each organ. "Every muscular fasciculus or fibre, or vessel, or nervous filament ; every portion of fascia or ligament ; every glandular particle, is inclosed in a sheath of peculiar cellular tissue, which, in respect to those parts, fulfils the same purpose as the larger envelope does in respect to the whole organ." *

Many fruitless researches have been made to determine the peculiar organization of the cellular tissue, yet but little is known, except that on a minute inspection we find an assemblage of innumerable whitish filaments of extreme tenuity, that are spread over the thin transparent plates that form the cellulæ. Examined in a favorable light, we may distinguish its exquisite delicacy, and when inflated, it may be compared to the air bubbles in a solution of soap.† There is no doubt, however, but some of the filaments which compose this tissue are exhalent and absorbent vessels ; and this opinion is confirmed when we succeed in making a very fine injection ; we then observe a multitude of vessels woven in every direction with each other, changing its white and transparent hue, and converting it into a vascular network.

Nerves are plentifully distributed in the cellular tissue ; but their ramifications are as white as the tissue in which they abound, so that they cannot be satisfactorily distinguished from it.

The plates of the cellular tissue exhale a fluid which has the great-

* Bichat.

† A beautiful preparation may be made of cellular tissue, by inflating, drying, and suspending it in rectified oil of turpentine.

est analogy with that of the serous membranes, and which appears to have the same uses ; namely, to render the friction of the plates easy on each other, and therefore to favor the reciprocal motions of the organs, and even the relative change of the different parts of which they are composed.

FAT.

Besides the serum, a fluid is found in many parts of the cellular tissue of a very different nature, which is the *fat*. This substance is contained in distinct cells that do not appear to communicate with the adjoining ones. The size and form of these cells are not less variable than the quantity which they contain. In some individuals scarcely a few ounces exist, while in others there are one or two hundred pounds.

Human fat is of a yellow color ; inodorous, — becoming solid at 89° F. It is composed of two proximate principles, recently discovered by CHEVREUL, *elaine* and *stearine*.

Some of the offices of the cellular tissue may be collected from the preceding observations : a description of this part of the animal fabric may very properly conclude a work on descriptive anatomy, since the cellular tissue constitutes a bond of union, which, diffusing itself everywhere, connects and preserves the whole natural connexion of each part of the organized structure. The subcutaneous cellular tissue has many other uses ; from it the skin acquires a freedom of motion over the organ it covers, and which is particularly observable in muscular actions. It is also to this tissue, that organs subjacent to the skin partly owe the facility with which they move, in those rapid or powerful contractions of which they are capable.

As fat is a very slow conductor of caloric, it retains animal heat, and consequently is useful in the animal economy by contributing to secure the subjacent parts against the vicissitudes of the atmosphere. In the orbit it forms a sort of elastic cushion upon which the eye moves with facility. In the palms of the hands and the soles of the feet, and about the hips, it forms a layer, which renders pressure upon the skin and other soft parts less severe. But principally this substance is deposited in the cellular tissue, as a store of nourishment intended to supply the exigencies of the animal system ; as in instances where food cannot be obtained, and in often supporting the body under wasting disease, by being absorbed and carried again into the circulation.

Together, the cellular tissue and fat are useful as an elastic vest, which guards the more sensitive parts of the interior mechanism. But in contemplating this as well as every other part of our organization, we cannot but admit the admirable mechanism exhibited in the human structure and economy, and the infinite resources displayed by that WISE and BENEVOLENT BEING, who planned the constitution and preservation of our bodies.

GLOSSARY.

A.

Abdomen, (*abdere*, to hide), the lower venter or belly, containing or hiding the intestines, etc.

Acantha, (ἄκανθα, a spine or thorn), sometimes used for the spine.

Acetabulum, (*acetum*, vinegar), the socket for the head of the thigh-bone, resembling an ancient vessel for holding vinegar.

Acini, (*acinus*, a grape seed), the internal structure of several glands.

Acoustic, (ἀκούω, to hear), a term applied to parts belonging to the ear, or to sound.

Acromion, (ἄκρος, the extremity, and ὦμος, the shoulder), a process of the scapula.

Adenology, (ἀδήν, a gland, and λόγος, a discourse), the doctrine of the glands.

Adeps, fat, an oily matter contained in the cellular tissue.

Adnata, (*adnascor*, to grow to), the external coat of the eye.

Albuginea Tunica. The inner proper coat of the testicle is thus named from its whiteness.

Albumen, an animal substance of the same nature as the white of an egg.

Alveoli, (*alveus*, a cavity), the sockets for the teeth.

Amnion, (ἀμνὸς, a lamb), the soft membrane immediately surrounding the fœtus.

Amphiarthrosis, (ἄμφω, both, and ἄρθρον, articulation,) an articulation admitting of an obscure motion.

Anastomosis, (ἀνά, through, and στόμα, a mouth), the communication of vessels with one another.

Anatomy, (ἀνά, through, and τέμνω, to cut), dissection, or that knowledge of animal bodies acquired by dissection.

Ancon, the elbow, (from ἀγκών), because the bones, being there united, are folded one into another. Hence, also,

Anconeus, a muscle situated there, and,

Anconoid, a process of the cubit, from ἀγκών, the elbow, and εἶδος, shape.

Angeiology, (ἀγγεῖον, a vessel, and λόγος, a discourse), a description of the vessels.

Antagonist, (ἀντὶ, against, and ἀγών, a struggle), an epithet of a muscle acting contrary to another.

Antihelix, (ἀντί, against, and εἴλω, to turn about,) the external part of the ear opposite to the helix.

Antithenar, (ἀντί, against, and θέναρ, the palm of the hand), one of the muscles extending the thumb.

Antitragus, (ἀντὶ, against, and τράγος, a part of the ear), a prominence of the ear opposite to the tragus.

Aorta, (ἀορτή; from ἀὴρ, air, and τηρέω, to keep,) the great artery of the heart.

Aponeurosis, (ἀπὸ, from, and νεῦρον, a nerve,) a tendinous expansion, supposed by the ancients to be that of a nerve.

Apophysis, (ἀποφύω, to spring from), the process of a bone, and a part of the same bone. Epiphysis, a process attached to a bone, and not a part of the same bone.

Arachnoides, (ἀράχνη, a spider's web, and εἶδος, likeness), a cobweb-like membrane, the second covering of the brain.

Arteria, (ἀὴρ, air, and τηρέω, to keep), because the ancients thought that air was contained in the arteries.

Arthrodia, (ἄρθρον, a joint), that kind of articulation which s shallow.

Arytenoides, (ἀρύταινα, an ewer, and εἶδος, shape), two cartilages of the larynx.

Aspera Arteria, (*asper*, rough, and *arteria*, an air-vessel), the trachea or windpipe.

Astragalus, (ἀστράγαλος, a die), a bone of the tarsus: the corresponding bones of some animal were used by the ancients as dice.

Atlas, the first of the cervical vertebræ, so named from supporting the head, as Atlas was supposed to support the world.

Axilla, the arm-pit.

Azygos, (α, without, and ζυγὸς, a yoke), a term applied to any part, not having a corresponding part.

B.

Basilica, (βασιλεύς, a king), an epithet, by way of eminence, given to one of the veins of the arm, to an artery of the brain, and to a process of the occipital bone.

Biceps, (*bis*, twice, and *caput*, a head), composed of two heads.

Brachium, (βραχύς, short), because, in general, from the shoulder to the hand is shorter than from the hip to the foot.

Bregma, (βρέχω, to moisten), the space between the bones of the infant head through which the superfluous humors of the brain were supposed to pass.

Bronchi, (βρόγχος, the windpipe), the ramifications of the trachea.

Buccinator, (*buccina*, a trumpet), a muscle of the cheek, much used by trumpeters.

Bursalogy, (βύρσα, a purse, and λόγος, a discourse), a description of the bursæ mucosæ.

C.

Cæcum, blind: a term applied in anatomy to an impervious canal, or to a part which terminates abruptly in a pouch.

Calcaneum, (*calx*, the heel), the name of the os calcis.

Calvaria, or Calva, (*calvus*, bald), the upper part of the cranium, which first turns bald.

Cancelli, (lattice-work), the spongy substance in bones

Capillary Vessels, (*capillus*, a hair), the small ramifications of the arteries and veins.

Capsule, a membranous production, inclosing a part like a bag.

Caput Gallinaginis, (a woodcock's head), a little eminence in the urethra at the termination of the ductus ejaculatorius.

Cardia, (καρδία, the heart), the superior opening of the stomach, so called from being situated near the heart.

Carnivora, (*caro*, flesh, and *voro*, to devour), animals that live on flesh.

Carotid, (καρόω, to induce sleep), arteries of the head and neck, which if tied, the animal becomes comatose, or has the appearance of being asleep.

Carpus, (καρπὸς), the wrist

Cartilage, gristle, a matter softer than bone, but harder than ligament.

Caruncula. This word is a diminutive from *caro*, flesh.

Cellula, (diminutive of *cella*, a cell), a little cavity or cell.

Cephalic Vein, (κεφαλὴ, the head), the ancients being accustomed to open this vein in disorders of the head.

Ceratoglossus, (κέρας, a horn, and γλῶσσα, a tongue), a muscle running from one of the cornua, of the os hyoides to the tongue.

Cerebellum, dim. of Cerebrum, the brain, (κάρη, the head).

Cervix, the hinder part of the neck, the fore part being called Collum.

Choledochus Ductus, (χολὴ, bile, and δέχομαι, to receive), the common bile-duct.

Chorda, (χορδὴ, a cord or assemblage of fibres), a term applied to a nerve of the tympanum, to the spermatic vessels, etc.

Chorion, (χωρίον, domicilium), the outer membrane involving the fœtus; or χορὸς, a chorus, this membrane being supplied with many blood-vessels in the quadruped.

Choroides, so called on account of its many blood-vessels, resembling the chorion.

Chyle, (χυλὸς, the juice), the milk-like fluid in the lacteal vessels.

Crystalline, (κρύσταλλος.), a term applied to the lens, from its resemblance to ice.

Clavicula, (dim. of *clavis*, a key), the clavicle or collar bone; so called from its resemblance to an ancient key.

Clinoid, (κλίνη, a bed, and εἶδος, shape), processes of the sella Turcica of the sphenoid bone, so called from their resemblance to a couch.

Clitoris (κλείω, to conceal), a part of the female pudendum concealed by the labia majora.

Coccyx, (κόκκυξ, a cuckoo), the lower end of the spine, so called from its resemblance to the beak of that bird.

Cochlea, (κόχλος, a conch), a cavity of the ear resembling the shell of a snail.

Cœcum, the blind intestine.

Cœliaca, (κοιλία, the belly), the name of an artery in the abdomen.

Colon, (κῶλον), the first portion of the large intestine.

Commissura, (*committo*, to join together), applied to parts which unite the hemispheres of the brain.

Concha, (κόγχη, a shell), applied to the hollow of the ear from its resemblance to a shell.

Condyle, (κόνδυλος, a joint, a knuckle, a knot), an eminence in several of the joints.

Conglobate, (*conglobatus*, gathered together in a circle), a gland subsisting by itself, like those of the absorbent system.

Conglomerate, (*conglomeratus*, heaped together), a gland composed of various glands.

Coraco; names compounded with this word belong to muscles which are attached to the coracoid process of the scapula.

Coracoid, (κόραξ, a crow, and εἶδος, resemblance), like the beak of a crow.

Cornu, (a horn, applied to a process resembling a horn.

Coronary, (*corona*, a crown), vessels so called from surrounding the parts like a crown.

Coronoid, (κορώνη, a crown, and εἶδος, shape), a process shaped like a crown.

Corpus Callosum, (*corpus*, a body, and *callus*, hard), part of the medullary substance of the brain, supposed to be firmer than the rest.

Corticalis Substantia, (*cortex*, bark), the exterior or cortical substance of the brain.

Costæ, (*custodio*, to guard), the ribs, because they guard the heart, etc.

Cotyledons, (κοτύλη, a cavity), glands in some animals, dispersed over the chorion.

Cotyloid, (κοτύλη, an old measure, and εἶδος, shape), the cavity for receiving the head of the thigh-bone, resembling the rotuli.

Coxæ, the haunches.

Cranium, (κρανίον, the skull, quasi, καρανίον, from κάρα,) the head.

Cremaster, (κρεμάω, to suspend), a muscle so called, because it suspends the testicle.

Cribriform, (*cribrum*, a sieve), perforated like a sieve.

Cricoid, (κρίκος, a ring, and εἶδος, shape), the annular cartilage of the larynx.

Crista Galli, a portion of the ethmoid bone, so called from its resemblance to a cock's comb. *Crista*, a term applied to other parts which resemble a crest.

Crura, (*crus*, a leg), applied to some parts, from their resemblance or analogy to a leg.

Crypts, (κρύπτω, to hide), mucous follicles which are concealed.

Cubitus, (*a cubando*), that part of the arm from the elbow to the wrist; because the ancients, during meals, used to recline upon it.

Cuboides, (κύβος, a cube, and εἶδος, shape), a bone of the foot, resembling a cube.

Cucullaris, (*cucullus* a cowl or hood), a broad muscle of the scapula, so called from its shape.

Cuneiform, (*cuneus*, a wedge,) wedge-shaped.

Cuticula, (the dim. of *cutis*, the skin), the scarf-skin.

Cutis, the skin.

Cysticus Ductus, (κύστις, a bladder, *ductus*, a duct), the duct leading from the gall-bladder.

D.

Dartos, (δέρω, to excoriate), muscular fibres which contract the scrotum.

Decidua, (*decido*, to fall off), a membrane thrown off from the uterus after parturition.

Deltoid, (Δέλτα, the fourth letter of the Greek alphabet, and εἶδος, shape), resembling the Greek letter Δ.

Dermis, (δέρμα), the more solid skin.

Detrusor Urinæ, (*detrudere*), to thrust or squeeze out of.

Diaphragm, (διαφράσσω, to partition), the transverse muscle which separates the thorax from the abdomen.

Diastole, (διαστέλλω, to relax), the dilatation of the heart, auricles, and arteries opposed to systole, the contraction of the same parts.

Diarthrosis, (διαρθρόω, to articulate), a movable connexion of bones.

Digastric, δὶς, twice, and γαστὴρ, a belly), having two bellies.

Diploe, (διπλόος, double), the spongy substance between the two tables of the skull.

Duodenum, (*duodenus*, consisting of twelve fingers' breadth), the first portion of the small intestine, so called from its general length.

Dura Mater, (*durus*, hard, and *mater*, a mother), the outermost membrane of the brain; the ancients finding it harder than, and supposing to it give origin to, the other membranes of the body.

E.

Elaine, (ἔλαιον, oil), the more fluid part of one of the proximate principles of fat.

Embryo, (ἐν, in, and βρύω, to germinate), the ovum in utero before the fourth month, after which it is called fœtus.

Emulgents, (*emulgeo*, to milk out), the arteries, and veins of the kidneys, so called because, according to the ancients, they strained, and, as it were, milked the serum through the kidneys.

Emunctores, (*emungo*, to wipe away), glands which, according to the ancients, received the excrementitious matter from the noble parts; as the parotids from the brain, the axillary glands from the heart, and inguinal glands from the liver.

Enarthrosis, (ἐν, in, and ἄρθρον, a joint), an articulation of bones, the same as *arthrosis*.

Encephalon, (ἐν, in, and κεφαλὴ, the head), the brain.

Enteric, (ἔντερον, an intestine), belonging to the intestines.

Epicranium, (ἐπὶ, and κρανίον), the integuments and aponeurotic expansion which are extended over the cranium.

Epidermis, (ἐπὶ, upon, and δέρμα, the skin), the cuticle.

Epididymis, (ἐπὶ, upon, and δίδυμος, twins, the testicles), the small oblong body which lies above the testicle.

Epigastric, (ἐπὶ, upon, and γαστὴρ, the stomach), the superior part of the abdomen.

Epiglottis, (ἐπὶ, upon, and γλωττὶς, *lingula*), one of the five cartilages of the larynx, situated above the glottis.

Ephippium, (ἐπὶ, upon, and ἵππος, a horse), part of the os sphenoides, so called from its resemblance to a saddle.

Epiphysis, (ἐπὶ, upon, and φύω, to grow), see Apophysis.

Epiploon, (ἐπὶ, upon, and πλέω, to sail), the omentum, or that serous membrane of the abdomen which covers the intestines, and hangs from the bottom of the stomach.

Ethmoid, (ἠθμὸς, a sieve), so called because it is perforated like a sieve.

F.

Falciform, (*falx*, a scythe), shaped like a scythe.

Fascia, (*fascia*, a band), a membranous expansion of certain muscles like a sheath.

Fasciculus, a little bundle, diminutive of fascis, a bundle.

Fauces, (the plural of *faux*), the top of the throat.

Fibrin, a peculiar organic compound, which is the most abundant constituent of the soft solids of animals.

Fibula, (a clasp), the lesser bone of the leg, which is thus named from being placed opposite to the part where the knee-buckle or clasp was formerly used.

Fimbria, a fringe, a term applied to parts of a fringe-like appearance.

Fœtus, the child in the womb past the fourth month, and fully formed.

Follicle, (*follis*, a bag), very minute secreting cavities.

Frænum, (a bridle), the membranous ligament under the tongue, and the one tying the prepuce to the glans.

G.

Galactophorous, (γάλα, milk, and φέρω, to carry), conveying the milk.

Ganglion, (γάγγλιον,) an enlargement in the course of a nerve.

Gastric (γαστὴρ, the stomach), appertaining to the stomach

Gastrocnemius, (γαστὴρ, the belly and κνήμη, the leg), the muscle forming the thick of the leg.

Gastro-Epiploic, (γαστὴρ, the stomach, and ἐπίπλοον, the caul), belonging to the stomach and omentum.

Gelatine, *(gelu)*, jelly.

Genio, (γένειον, the chin); names compounded with this word belong to muscles attached to the chin.

Gestation, (*gestatio uterina*), the period of pregnancy.

Ginglymus, (γίγγλυμος, a hinge), articulation admitting flexion and extension.

Glandula, (dim. of *glans*), a nut or acorn.

Glenoid, (γλήνη, a cavity), a part having a shallow cavity.

Gliadine, (γλία, glue), one of the constituents of gluten.

Glomer, a convoluted bundle of glands.

Glosso, (γλῶσσα, the tongue); names compounded with this word are applied to muscles attached to the tongue.

Glottis, (γλωττὶς, *lingula*), the superior opening of the larynx.

Gluteus, (γλουτὸς, the buttock), muscles forming part of the buttocks.

Gomphosis, (γομφόω, to drive in a nail), an articulation of bones, like a nail in a piece of wood.

H.

Hæmorrhoidal, (αἷμα, blood, and ῥέω, to flow), a term applied to the vessels of the rectum, because they often bleed.

Harmonia, (ἁρμονία, a close joining), a species of immovable articulation.

Helix, (εἵγω, to turn about), the outer bar or margin of the external ear.

Hepatic, (ἧπαρ, the liver), applied to parts belonging to the liver.

Hyaloid, (ὕαλος, glass), the capsule of the vitreous humor of the eye.

Hymen, (the god of marriage), the membrane situated at the entrance of the virgin vagina.

Hyo; names compounded with this word belong to muscles which are attached to the —

Hyoides, Os, (υ, and εἶδος, shape), a bone of the tongue resembling the Greek upsilon, υ.

Hypochondrium, (ὑπὸ, under, and χόνδρος, a cartilage), the upper region of the abdomen, under the cartilages of the ribs.

Hypogastric, (ὑπὸ, under, and γαστὴρ, the belly), the lower region of the fore part of the abdomen.

Hypoglossus, (ὑπὸ, under, and γλῶσσα, the tongue), parts which lie under the tongue.

Hypothenar, (ὑπὸ, under, and θέναρ, the palm of the hand), one of the muscles contracting the thumb.

I.

Ileum, (εἴλω, to turn), a portion of the small intestine, so called from being found convoluted.

Incisores, (*incidere*, to cut), the fore-teeth.

Incus, (an anvil), a small bone of the internal ear, with which the malleus is articulated.

Index, (*indico*, to point out), the fore-finger.

Infundibulum, (a funnel), a tube leading from the brain to the pituitary gland.

Innominatum, parts which have no proper name.

Interfemineum; *vide* Perinæum.

Interosseous, (*inter* and *os*), a term applied to parts situated between bones.

Iris, (the rainbow), the membrane round the pupil of the eye, deriving its name from its various colors.

Ischium, (ἴσχω, to support), that part of the os innominatum upon which we sit.

J.

Jejunum, (empty), a portion of the small intestine, so called from being generally found empty.

Jugale, Os, the zygoma.

L.

Lacunæ, (little cavities), the excretory ducts of the urethra, vagina, etc.

Lambdoidal, resembling the Greek lambda, Λ.

Lamella, dim. of—

Lamina, a scale or plate. It is used for the foliated structure of bones or other organs.

Larynx, (λάρυγξ), the superior part of the trachea.

Linea Alba, a white line formed by the meeting of the tendons of the abdominal muscles.

Lumbricales, (*lumbricus*, an earth-worm), four muscles of the hand and foot.

M.

Masseter, (μασσάομαι, to chew), a muscle which assists in chewing.

Mastoid, (μαστὸς, a breast), shaped like a nipple or breast.

Maxilla, the jaw.

Meconium, (μήκων, a poppy), the excrements of the fœtus are thus called, because they have some resemblance to opium in color.

Mediana Vena, the middle vein of the arm, between the basilic and cephalic.

Mediastinum, (*medium*, the middle), a portion separating parts from each other.

Medulla Spinalis, the spinal marrow or cord.

Membrana Nictitans, (*nicto*, to wink), a membrane with which birds can occasionally cover the eye.

Meninges, (μῆνιγξ, a membrane,) membranes which inclose the brain.

Mesentery, (μέσος, the middle, and ἔντερον, the intestine), the membrane in the middle of the intestines, by which they are attached to the spine.

Meseraic, (μέσος, the middle, and ἀραιὰ, the small intestine), the same as the last article.

Mesocolon, (μέσος, the middle, κῶλον, the colon), that part of the mesentery in the middle of the colon.

Metacarpus, (μετὰ, after, and καρπὸς, the wrist), that part of the hand between the carpus and fingers.

Metatarsus, (μετὰ, after, and ταρσὸς, the tarsus), that part of the foot between the tarsus and toes.

Mitralis Valvula, (*mitra*, a mitre), valves at the left ventricle of the heart, like a mitre.

Molar Teeth, the double or grinding teeth.

Mucus, (μύξα, the mucus of the nostrils), a transparent, saline, glutinous fluid.

Mylo, (μύλη, a grinder tooth); names compounded of this word belong to muscles that are attached near the grinders.

Myoides Platysma, a muscular expansion on the neck. See Platysma.

Myology, (μῦς and λόγος,), the doctrine of the muscles.

N.

Naviculare, (*navicula*, a small boat), a bone of the carpus, and also of the tarsus.

Neurilemma, (νεῦρον, a nerve, and λέμμα, a coat), the sheath of a nerve.

Neurology, (νεῦρον, a nerve,) the doctrine of the nerves.

Nymphæ, two semicircular glandular membranes in the *pudendum muliebre*, so called because they direct the course of the urine.

O.

Odontoides, (ὀδοὺς, a tooth, and εἶδος, shape), tooth-like.

Œsophagus, (οἴω, to carry, φάγω, to eat), the canal leading from the pharynx to the stomach, carrying what is swallowed into the stomach.

Olecranon, (ὠλένη, the cubit, κρᾶνον, the head), the elbow, or head of the ulna.

Omentum, (*omen*, a guess), the caul, so called because the ancient priests prophesied from an inspection of this viscus.

Omo, (ὦμος, the shoulder); names compounded of this word belong to muscles which are attached to the scapula.

Omo-Plata, (ὦμος, the shoulder, and πλατὺς, broad), the scapula or shoulder-blade.

Ophthalmic, (ὀφθαλμὸς, an eye), relating to the eye.

Organ, (ὄργανον), a part which has a determined office in the animal economy.

Osmazome, (ὀσμὴ, flavor, and ζωμὸς, broth), a peculiar principle obtained from muscular fibre, having the taste and smell of broth.

Osteology, (ὀστέον, bone, and λόγος, a discourse), the doctrine of the bones.

P.

Palpi, (*palpo*, to grope or feel one's way), feelers.

Pampiniformis, (*pampinus*, a vine-tendril, and *forma*, shape). The spermatic vessels form a plexus, which, from its similitude to the tendrils of a vine, is called pampiniformis.

Pancreas, (πᾶν, all, and κρέας, flesh), a gland of the abdomen.

Panniculus Carnosus, (*pannus*, a covering, and *caro*, flesh), a fleshy covering.

Parenchyma, (παρεγχέω, to pour through), a substance connecting the vessels, etc. of the lungs, liver, etc.

Parietalia, (*paries*, a wall), bones of the cranium, serving as a wall to the brain.

Parotid, (παρὰ, near, and ὠτὸς, the gen. of οὖς, the ear), a gland situated near the ear.

Patella, (dim. of *patina*, a pan), the knee-pan.

Patheticæ, (πάθος, passion), the fourth pair of nerves, because by means of these, the eyes express certain passions.

Pelvis, (πέλυξ, a basin), the basin of the kidneys, or the lower part of the abdomen, in which the bladder and rectum (and in women also the uterus) are contained.

Pericardium, (περὶ, around, and καρδία, the heart), the membrane surrounding the heart.

Perichondrium, (περὶ and χόνδρος), synovial membrane covering cartilage.

Pericranium, (περὶ, around, and κρανίον, the cranium), the membrane covering the bones of the cranium.

Perinæum, (περινέω, to flow round, because that part is generally moist), the space between the external parts of generation and the anus.

Periosteum, (περὶ, around, and ὀστέον, a bone), the membrane surrounding the bones.

Peristaltic, (περιστέλλω, to contract), the motion of the intestines.

Peritonæum, (περιτείνω, to extend round), the membrane lining the abdomen, and covering its organs.

Perone, (περόνη), the fibula or small bone of the leg.

Petrosum, Os, (πέτρα, a rock), part of the temporal bone.

Phalanx, (an army), the bones of the fingers and toes are called phalanges, from their regularity.

Pharynx, (φάρυγξ), a membranous bag at the back end of the mouth, leading to the stomach.

Phrenic, (φρένες, the diaphragm, φρὴν, the mind, because the diaphragm was supposed to be the seat of the mind), the name of a nerve, etc.

Physiology, (φύσις, nature), that science which has for its object a knowledge of the actions and functions of the living body.

Pia Mater, the innermost membrane around the brain.

Picromel, (πικρὸς, bitter, and μέλι, honey), the characteristic principle of bile.

Pisiform, (pea-like), a term applied to the fourth bone of the first row of the carpus.

Pituitary, (producing phlegm), a term applied to the membrane of the nose, etc.

Placenta, (πλὰξ, a cake), the after-birth.

Plantaris, (*planta*, the sole), parts situated in the sole.

Platysma-Myoides, (πλατὺς, broad, μῦς, a muscle, and εἶδος, shape), a muscle of the neck.

Pleura, (πλευρὰ, the side), a serous membrane lining the cavity of the thorax.

Plexus, (*plecto*, to weave together), a kind of net-work of blood-vessels or nerves.

Pneumonic, (πνεύμων, the lung), appertaining to the lungs.

Popliteus, (*poples*, the ham), a muscle of the leg.

Prepuce, the fore-skin of the penis, which the eastern nations generally cut off.

Processus, (*procedo*, to start out), an eminence of bone.

Prostate, (πρὸ, before, and ἵστημι, to stand), a gland situated before the *vesiculæ seminales*.

Psoas, (ψόαι, the loins), a muscle so named from its situation.

Pterygoid, (πτερὰ, a wing), a process resembling a wing.

Pterygo-Staphylini, (πτέρυξ, a wing, and σταφυλὴ, a grape), muscles arising from the pterygoid process of the os sphenoides, and inserted into the uvula.

Pudenda, (*pudor*, shame), the parts of generation.

Pupilla, (a little puppet), the round aperture in the iris of the eye.

Pylorus, (πυλωρὸς, the keeper of a gate), the lower orifice of the stomach, guarding the entrance of the bowels.

Pyramidalis, a muscle having the form of a pyramid.

Pyriform, (*pyrus*), a muscle having the form of a pear.

R.

Rachidian, (ῥάχις, the spine,) appertaining to the spine.

Radius, (the spoke of a wheel), the small bone of the fore-arm.

Ranular, like a frog or toad.

Raphe, (ῥάπτω, to sew), a line having the appearance of a seam.

Rectum, the straight gut, the last of the intestines.

Region, a term applied to the respective divisions of the body.

Renal, appertaining to the kidney, from —

Renes, the kidneys, through which the urine flows.

Retina, (*rete*, a net), the net-like expansion of the optic nerve on the inner surface of the eye.

Rhomboides, a muscle so called from resembling a geometrical figure, (ῥόμβος), the sides of which are equal, but not right-angled.

Rotula, (dim. of *rota*, a wheel), the knee-pan.

S.

Sacrum, (sacred), a bone so called because it was offered in sacrifice.

Sagittalis, (*sagitta*, an arrow), a suture in the cranium.

Saliva, the fluid secreted in the mouth.

Salvatella, (*salvo*, to preserve), a vein of the foot, the opening of which was said to preserve health and cure melancholy.

Sanguis, the blood.

Saphena, (σαφὴς, manifest), the most obvious vein of the leg.

Sartorius, (*sartor*, a tailor), the muscle by means of which the tailor lays his legs across.

Scaleni, (σκαληνὸς, a geometrical figure with three unequal sides), muscles of the neck.

Scapha, (σκάφη, a little boat), the depression of the outer ear before the anti-helix.

Scaphoides, (resembling a boat), a bone of the carpus, and also of the tarsus.

Scapula, the shoulder-blade.

Sclerotic, (σκληρὸς, hard), the outermost or hardest membrane of the eye.

Scutiform, shaped like a shield.

Sebaceous, suety; a term appled to glands which secrete an unctuous matter.

Sella Turcica, Sella Equina, Sella Sphenoides, are various names for a part of the sphenoid bone resembling a Turkish saddle.

Septum Cordis, (*sepes*, a hedge), the fleshy substance which separates the right from the left ventricle of the heart.

Sesamoid, (σησάμη, an Indian bean), small bones in the hands and feet resembling the *semen sesami.*

Sigmoid, resembling the Greek ς, sigma.

Skeleton, (σκέλλω, to dry), the articulated dry bones of an animal.

Soleus, (*solea*, sole), a muscle of the leg, having the form of that fish.

Spermatic, (σπέρμα, seed), parts belonging to the testis or ovarium.

Sphenoid, (σφὴν, a wedge), shaped like a wedge.

Sphincter, (σφίγγω, to constrict), the name of several muscles, the office of which is to close the apertures around which they are placed.

Splanchnology, (σπλάγχνον, the viscera), the description of the internal organs.

Splenius, (σπλὴν, the spleen), a muscle so named from its resemblance to that organ.

Squamous, (*squama*, a scale), covering as the scales of fishes do each other.

Stapes, (a stirrup), one of the small bones of the internal ear.

Stearine, (στέαρ, fat), the more solid part of one of the proximate principles of fat.

Stomachus, (στόμα, a mouth, and χέω, to pour), the stomach.

Styloid, (*stylus*, a pencil), a process like a pencil on the temporal and other bones.

Succenturiatus, (*succenturiare*, to supply the place of another).

Suture, (*sutura*, a seam), an appearance which is most obvious in that union of the bones of the skull constituting the dove-tail suture.

Symphysis, (συμφύω, to grow together), the connexion of bones which have no manifest motion.

Synarthrosis, (σὺν, with, and ἄρθρον, a joint), articulation without manifest motion.

Synchondrosis, (σὺν, with, and χόνδρος, a cartilage), articulation by means of intervening cartilage.

Syndesmology, (συνδέσμος, a ligament), the doctrine of ligaments.

Syndesmosis, the connexion of bones by ligaments.

Syneurosis, (σὺν, with, and νεῦρον, a nerve), the connexion of bones by tendon, formerly mistaken for nerve.

Synthesis, (συντίθημι, to put together), the anatomical connexion of the bones of the skeleton.

Syssarcosis, (σὺν, with, and σὰρξ, flesh), the connexion of bones by muscle.

Systole, (συστέλλω, to contract); *vide* Diastole.

T.

Talus, (a die), a bone of the tarsus.

Tarsus, the space between the bones of the leg and the metatarsus.

Temporal; bones, etc. have been so named on account of occupying the region of the head on which the hair generally first begins to turn gray, thus indicating the age.

Tendon, (τείνω, to extend), a fibrous cord at the extremity of a muscle.

Tentacula, (*tento*, to seize), organs by which certain animals attach themselves to surrounding objects.

Teres, (round), the name of a muscle.

Testis, (a witness, *quia est quasi testis virilitatis*), the testicle.

Thalamus, (θάλαμος, a bed), applied to a part of the brain from which the optic nerve takes its origin.

Theca, (a sheath); the spinal canal is often called theca vertebralis.

Thenar, (the palm of the hand), a muscle extending the thumb.

Thorax, (θώραξ, the chest), or that part of the body which contains the heart and lungs.

Thymus, θύμος, a bulbous root), a temporary gland in the thorax.

Thyreo; names compounded with this word belong to muscles which are atached to the —

Thyroid (θυρεὸς, a shield), a cartilage of the larynx compared to a shield.

Tibia, (a pipe or flute), the great bone of the leg.

Tonsils, the round glands placed between the arches of the palate.

Trachea, (τραχὺς, rough), the windpipe.

Tragus, (a goat), a small eminence of the external ear, upon which hair often grows like the beard of a goat.

Trapezoid, like a trapezium.

Trochanter, (τροχάω, to run or to roll), a process of the thigh bone, the muscles inserted into which greatly contribute to the action of running.

Trochlea, (τροχαλία, a pulley), a kind of cartilaginous pulley.

Trochlearis, an articulation where one part moves round another like a pulley.

Tubæ Fallopianæ, two canals at the fundus uteri, of a trumpet form, described by Fallopius.

Tympanum, the drum of the ear.

U

Ulna, ὠλένη, the cubit), one of the bones of the fore-arm.

Umbilicus, (ὀμφαλὸς), the navel.

Urachus, (οὖρον, urine, and χέω, to pour), a ligament of the bladder, occupying the place of the urinary passage of the fœtal quadruped, which goes into the allantois.

Ureter, (οὖρον, urine), the canal that transmits the urine from the kidney into the bladder.

Urethra, (οὐρήθρα), the canal through which urine passes from the bladder.

Uterus, (ὑστέρα, *matrix*), the womb.

Uvea, (*uva*, a grape), the posterior lamina of the iris.

Uvula, the pendulous body which hangs down from the middle of the soft palate.

V.

Valves, (*valvæ*, folding doors), little membranes preventing the return of the fluids in the blood-vessels and absorbents.

Ventricle, (*venter*, the stomach), applied in anatomy to the cavities of the brain and heart.

Vertebræ, (*verto*, to turn), the bones of the spine.

Vesicle, (*vesica*, bladder), a small bladder-like cavity.

Vomer, (a ploughshare), a bone of the nose.

X.

Xiphoid, (ξίφος, a sword), like a sword, a term applied to the cartilage of the sternum.

Z.

Zygoma, (ζυγος, a yoke), the arch formed by the zygomatic processes of the temporal and cheek bones.