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PITTSBURGH ACADEMY OF MEDICINE

322 NORTH CRAIG STREET,

PITTSBURGH, PA.

ANALYTICAL COMPENDIUM

OF

M E D I C A L S C I E N C E .

50722

Entered, according to Act of Congress, in the year 1848,

BY LEA & BLANCHARD,

In the Clerk's Office of the District Court for the Eastern District of  
Pennsylvania.

C. SHERMAN, PRINTER,

19 St. James Street.

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## P R E F A C E.

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THE great progress of the Medical Sciences, and the increasing number and size of the standard text-books in the various departments of Medicine and Surgery, have created a necessity for "Compendis," or "Manuals," to assist the student in the prosecution of his labours, and the practitioner in refreshing his recollection of former studies.

The present work has been prepared solely to meet this want. No one could pretend to compress into so limited a space all the information necessary to the student or practitioner: but we hope to have succeeded in embodying in its pages the elements of medical science; as much, indeed, as is compatible with its character as an analysis. While, therefore, the volume is not offered as a substitute for the ordinary text-books, or to lessen the necessity of regular attendance on lectures, or close office study, we trust that it may be found of practical use in facilitating the acquisition of knowledge by the student.

The very plan of the work excludes all pretensions to originality of matter. As an ANALYTICAL COMPENDIUM, its highest claim is to be considered a faithful digest of recorded facts and opinions. We ask for it nothing more, and, to obtain this, we have freely used the standard text-books of the day, gleaning from them whatever seemed useful to our purposes, even in some instances to the use of language as well as ideas, and to them we own our indebted-

ness. We also acknowledge with pleasure the valuable assistance afforded us, in the departments of *Materia Medica* and Chemistry, by Dr. Reese, Lecturer in the Medical Institute of Philadelphia.

In preparing this compendium, the ordinary form of question and answer has been avoided, as incompatible with the character designed for the volume, and as occupying, with meagre questions, space that might be more advantageously employed. It is hoped that the arrangement adopted will be found at once concise and intelligible, while we feel assured that the mechanical execution of the work, its copious illustration, and neat, cheap, and convenient form will prove all that can be desired by the student and practitioner.

Philadelphia, August 1848.

A  
HANDBOOK  
OF  
ANATOMY.

THE OTHER PORTIONS OF THIS SERIES ARE

PHYSIOLOGY,

WITH FORTY ILLUSTRATIONS.

SURGERY,

WITH FIFTY ILLUSTRATIONS.

OBSTETRICS,

WITH THIRTY-SEVEN ILLUSTRATIONS.

MATERIA MEDICA AND THERAPEUTICS,

WITH TWENTY-NINE ILLUSTRATIONS.

CHEMISTRY,

WITH NINETEEN ILLUSTRATIONS,

AND

PRACTICE OF MEDICINE.

ANY ONE OF WHICH MAY BE HAD SEPARATELY, DONE UP IN A  
WRAPPER FOR MAILING.

A  
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ANATOMY:  
WITH ONE HUNDRED AND FIFTY-SEVEN ILLUSTRATIONS.  
BEING A PORTION OF  
AN ANALYTICAL COMPEND  
OF THE  
VARIOUS BRANCHES OF MEDICINE.

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# A N A T O M Y.

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*Anatomy* is the science which investigates the structure and organization of living beings.

By the term *Special Anatomy* or *Descriptive Anatomy* is meant the consideration of each organ or part of the human body, including its size, weight, colour, shape, &c.

*General Anatomy* investigates the different tissues or structures out of which organs are formed, independently of the particular organs.

*Surgical Anatomy* or *Regional Anatomy* is the study of the relation of one part to another, and is one of the most important applications of anatomy to the practice of medicine and surgery.

*Physiological Anatomy* considers the uses and functions of organs in a healthy state.

*Pathological Anatomy* regards the different parts and organs as altered by disease.

This is a compendium principally of special anatomy; and is divided into seven sections :

1. Bones.
2. Ligaments.
3. Muscles.
4. Viscera.
5. Vessels.
6. Nerves.
7. Special Senses.

## SECTION I.

## BONES.

## GENERAL CONSIDERATIONS OF BONE.

THE bones of the *skeleton* are two hundred and eleven in number, of which twenty-two belong to the head, fifty-six to the trunk, sixty-nine to the superior and sixty-four to the inferior extremity; when held together by ligaments and cartilages they form a natural skeleton, when by other means an artificial skeleton. They are hard, white, and inflexible; and more numerous in childhood than in old age.

They are *classified* into long, thick, and flat bones. The body or shaft of a long bone is called Diaphysis; its articulating extremities, Epiphyses; its processes and projections are called Apophyses. The small foramina on the surface of bones are for the transmission of nutritious vessels, the largest of which enters about the middle.

Bones are composed of two *structures*, *compact* and *cellular*, which are external and internal. The cells communicate with each other and contain marrow. The compact structure consists of small fibres arranged in laminæ; each of these fibres has a canal running through its length called the canal of Havers, transmitting vessels; it communicates with small lenticular excavations called *corpuscles of Purkinje*, by radiating tubes. The cellular structure increases the strength without increasing the weight, and also diminishes the effect of concussion.

*Composition of Bones.*—Bones are chemically composed of animal and earthy matters, united in the proportion of two parts of earthy to one of animal, or, more accurately, consist of thirty-two parts of gelatine, one part of insoluble animal matter, fifty-one parts of phosphate of lime, eleven of carbonate of lime, two of fluuate of lime, one of phosphate of magnesia, and one of soda and muriate of soda; the earthy matter is most abundant in bones of the cranium; the animal matter in the cellular structure. Combustion will remove the animal matter, and dilute acids will remove the earthy matter.

The *Periosteum* is a fibrous membrane investing the external surface, adhering less firmly in infancy, and becoming ossified in old age. It is vascular, insensible in health, assists in the secretion of the external laminæ, restrains ossification within proper limits, receives the insertion of muscles, tendons, &c. &c., and protects the bone from suppuration in the vicinity.

*Marrow* is contained in a fine vascular membrane, lining the medullary canals and cells of bones called the *Internal Periosteum*. It resembles fat, but consists of finer granules; in consumption, dropsy, &c., it is absorbed and its place is supplied with serum.

*Formation and growth of bones.*—There are three stages of ossification in the embryo. The first is the mucous or pulpy, which continues for one month; the second is the cartilaginous, and the third the osseous, commencing at the third month. The colour of the cartilage deepens and then a vessel conveys red blood to a central point, which first receives calcareous particles and is called *punctum ossificationis*. Bones increase in length by continued deposit at their extremities between the Diaphysis and the Epiphyses, as is proved by Hunter's experiment of placing two shot in the tibia of a young pig; after the animal had reached full size, the shot were found at their original distance from each other. Bones increase in thickness by external deposit and by secretion from the periosteum, which is proved by disease and the experiment of feeding a young pig with food coloured with madder. Various laminæ of white and coloured bone can be produced by suspending and resuming this mode of feeding. While deposit is taking place upon the surface of a bone, absorption is going on internally; this is proved by Duhamel's experiment of surrounding a long bone of a young animal with a metallic ring; after the animal is fully grown, the ring was found in the medullary canal, which increases in size by this constant deposit and absorption.

*Callus.*—When bones are fractured, the process of reparation resembles that of the formation of a bone. Blood is effused, lymph is thrown out, causing a swelling; the blood is absorbed, lymph coagulates and ossifies in the form of a ring, surrounding the seat of fracture, and also in the form of a pin in the medullary canal. The fractured extremities begin to unite and coalesce, after which the superfluous ring and pin of bone which acted as splints are absorbed. Whilst this process is going on, it is important that the parts should be maintained at rest, else the process of ossification is arrested, and a false joint results.

## BONES OF THE TRUNK.

The trunk consists of the Spine, Pelvis, and Thorax.

### S P I N E.

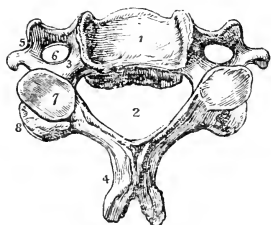
It extends from the head to the coccyx at the posterior part of the trunk, having several curvatures in its extent. In the neck it is convex anteriorly, in the thorax concave, in the loins convex, and in the pelvis concave. It contains an osseous canal for the spinal marrow, and is formed of 28 or 29 separate bones called vertebræ,

24 of which are classified as *true vertebræ*, on account of their mobility, and the 5 remaining are called *false vertebræ*. The true vertebræ are divided into 7 *cervical*, 12 *dorsal*, and 5 *lumbar*; the false vertebræ consist of the sacrum, and 3 or 4 coccygeal bones.

A vertebra consists of a body, 7 processes, and a spinal foramen. The *body* is in front and is the thickest part; its upper and lower surfaces articulate with a contiguous vertebra by means of a cartilage; it is convex anteriorly from side to side. The *processes* are, one *spinous*, of a triangular shape, and situated behind for the attachment of muscles; two *transverse*, one projecting horizontally on either side for the attachment of muscles and ligaments; and four *oblique* processes, two of which are superior and two inferior, which are for the purpose of articulation. The *spinal foramen* is in the middle, and constitutes a portion of the spinal canal. The intervertebral foramen is formed on each side by a groove upon the upper and lower surface of each vertebra, and transmits a spinal nerve.

#### CERVICAL VERTEBRÆ.

Fig. 1.



The *bodies* are small and flattened in front; the superior surfaces<sup>1</sup> are concave laterally, the inferior, are concave antero-superiorly; they gradually increase in size. The *spinous processes*<sup>4</sup> are short, thick, horizontal, and bifid. The *oblique processes* are flat, oval, and short; the *superior*<sup>7</sup> look upwards and backwards, and the *inferior*<sup>8</sup> downwards and forwards at an angle of forty-five degrees. The *transverse processes*<sup>5</sup> are broad, perforated at their base by a

foramen<sup>6</sup> for the transmission of the vertebral artery. The *spinal foramen*<sup>2</sup> is very large.

The *first cervical vertebra* is called the *atlas*; it has no body, and resembles a ring. In place of a body, there is an arch which has a tubercle in the middle of its anterior surface; in the corresponding part of its posterior surface is an articular fossa for the *processus dentatus* of the second vertebra. The posterior arch has a tubercle instead of the spinous process. The *superior oblique processes* are large, oblong, and concave, adapted to the condyloid processes of the occiput; and admit of flexion and extension. The *inferior oblique processes* are round, flat, and horizontal, adapted to the rotatory motion of the head. The transverse process is extremely long. On the inner side of the oblique processes is a tubercle for the attachment of the transverse ligament. The *spinal foramen* is the largest. The *second* is called *dentata*, from its tooth-like process projecting from the upper surface of the body; the tip of which is rough for

the middle straight ligament, and on the sides of the tip there is a flatness for the attachment of the moderator ligaments. This process is smooth in front where it touches the arch of the atlas and also behind where the transverse ligament plays. Upon this process the head rotates. The *superior oblique process* is circular and slightly convex. The *spinous process* is long and bifid.

The *sixth* has a long and pointed *spinous process*.

The *seventh* is the largest and resembles a dorsal. The spinous process is the longest and tuberculated. The foramen at the base of the transverse process does not transmit the vessels.

#### DORSAL VERTEBRÆ.

These are twelve in number. The *bodies*<sup>1</sup> are cylindrical, and their transverse diameter decreases from the first to the third and then increases. The upper and lower surfaces are flat, and the sides have articular marks<sup>2</sup> for the heads of the ribs. Each fossa is formed by two contiguous vertebræ. The *oblique processes* are vertical, the superior<sup>8</sup> looking backwards and the inferior<sup>9</sup> looking forwards. The *transverse processes*<sup>7</sup> are long, and their extremities are enlarged; in front there is an articular face for the tubercle of the rib. The *spinous processes*<sup>5</sup> are long and triangular, broad at the base, sharp-pointed and overlap each other. The spinal foramen is small and round.

The *first* has a complete fossa for the head of the rib upon its side. The *eleventh* and *twelfth* have also complete fossæ for the heads of the ribs. Their transverse processes are short, directed backwards, and do not articulate with the ribs.

#### LUMBAR VERTEBRÆ.

Their number is five. The *bodies* are large and oval, the transverse diameter being the longest. The spinal foramen is triangular and large. The groove forming the intervertebral foramen is also large. The *oblique processes* are vertical; the superior<sup>7</sup> looking inwards and the inferior<sup>8</sup> looking outwards; the *transverse processes*<sup>6</sup> are long and at right angles, are short, thick, quadrangular, and horizontal.

Fig. 2.

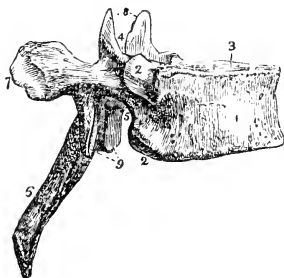
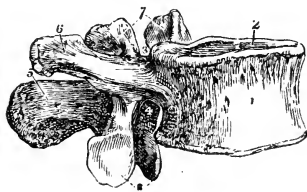


Fig. 3.

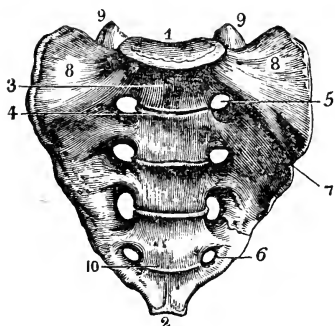


The *first* is the smallest; the *third* has the longest transverse process; the *fifth* has a wedge-shaped body.

## SACRUM.

Is triangular, and originally consisted of five pieces; its *anterior surface* is concave, and

Fig. 4.



has four funnel-shaped holes<sup>5 6</sup> on each side transmitting the anterior branches of the sacral nerves. Its *posterior surface* is rough and convex, and contains the representations of spinous and oblique processes. A fissure usually exists in place of the fourth and fifth spinous processes. There are four foramina on each side, smaller than those in front, for the transmission of the posterior branches of the nerves. The *base* has a

large oval articular mark<sup>1</sup> upon which rests the last lumbar vertebra, two grooves completing the intervertebral foramina; and has also two oblique processes.<sup>9</sup> The *apex*<sup>2</sup> is blunt and has a transverse articular surface<sup>3</sup> for the coccyx. The *sides* are rough, broader above than below, having a large articular mark for the innominata; behind this surface arise muscles of the back, and below it the sacroiliac ligaments. The *sacral canal* runs through the length of the sacrum. It is triangular and larger above than below; is continuous with the spinal canal and contains the cauda equina; with it communicate the foramina transmitting the nerves.

## COCCYX.

The coccyx is flat and triangular, having its base upwards. It consists of three or four bones united usually in the same curve as that of the sacrum. The pieces are frequently united with each other and the sacrum.

Fig. 5.



The *first* piece is the largest, and has two articular marks; behind, it has two *cornua*<sup>2, 3</sup> on its side are grooves<sup>4, 5</sup> which with the sacrum complete the canal for the fifth sacral nerve. The *last piece*<sup>6</sup> is a mere tubercle.

The sides of the coccyx give origin to muscles and ligaments.

## PELVIS.

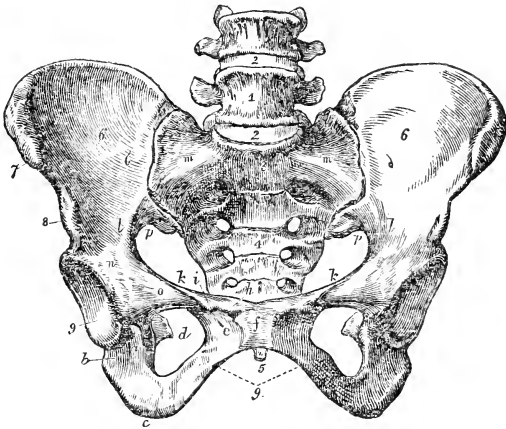
The pelvis consists of the *sacrum*, *coccyx*, and the *two innominata* or hip bones.



## INNOMINATUM.

This is a large flat bone forming the haunch or hip of common language, resembling in some measure the figure 8. In youth it

Fig. 6.



consists of three different parts, united in the acetabulum, viz. the ilium, ischium, and pubes.

*Ilium.*—This is the largest piece, and forms the wall of the upper pelvis. Its *external* surface is convex and rough, with a semicircular ridge crossing it; above this ridge arises the gluteus medius, and below it the gluteus minimus muscle; the posterior part of this surface is the roughest, and gives origin to the gluteus maximus.

The *internal surface*<sup>b</sup> or *costa*, is concave; the anterior portion is smooth, and gives origin to the iliacus internus; the posterior is rough and has a large articular mark for the sacrum, behind which arise muscles and ligaments. The *edge* or *crista* is arched and curved like the italic *f*. In front there are two eminences, one of which is called the *anterior superior spinous process*,<sup>7</sup> giving origin to the sartorius and tensor vaginæ muscles and Poupart's ligament; the other is the *anterior inferior spinous*<sup>8</sup> process, and gives origin to the rectus muscle; the space between the two gives origin to the gluteus medius. Below these processes is a large prominence<sup>a</sup> called *ilio-pectineal*; in the groove above this passes the iliacus internus and psoas magnus muscles. Behind these are the posterior *superior* and *inferior spinous* processes. The *crista* has three lips, from the internal of which arises the transversalis muscle, from the middle arises the internal oblique, and into the external is inserted the external oblique. The inferior border of the ilium presents a *notch*,<sup>p</sup> called *sciatic*.

*Ischium*.—This is the most inferior part of the innominatum. It consists of a body and branch; the external surface of the body<sup>b</sup> is rough; the internal surface is smooth, and is called the plane of the ischium. The posterior border presents a projection called the *spine*, into which is inserted the lesser sacro-sciatic ligament, and beneath the spine is a groove in which plays the tendon of the obturator internus muscle. The inferior portion of the body is called the *tuberosity*,<sup>c</sup> from which arise the semi-membranosus, semi-tendinosus, biceps, and adductor muscles; in front there is a ridge into which is inserted the greater sacro-sciatic ligament.

The *ramus* or branch is short and thick, and ascends forward and inward, joining the ramus of the pubes, and forming a portion of the pubic arch;<sup>g</sup> externally it is rough, and internally it is smooth, whence arises the crus of the penis.

*Pubes*.—It forms the anterior boundary of the pelvis,<sup>g</sup> and consists of a *body* and descending *ramus* or *branch*.

The *body* articulates with its fellow by a vertical surface,<sup>f</sup> called the *symphysis*. The superior portion of the body at right angles with the symphysis is *horizontal*,<sup>h</sup> and limited externally by a projection<sup>i</sup> called the *spinous process*; from this process there diverge two ridges; the posterior,<sup>k</sup> is called the *crista of the pubes*, or *linea pectinea*, and to it is attached a portion of Poupert's ligament; the anterior is sometimes called *linea innominata*. Between these ridges is included a triangular space,<sup>o</sup> the base being the ilio-pectineal eminence,<sup>n</sup> and the apex the spinous process; from this space arises the pectineus muscle, and over it pass the femoral vessels.

The *ramus* descends to join that of the ischium, and form a part of the pelvic arch; externally it is rough for the origin of the abductor muscles; internally it is smooth, and from it arises the crus of the penis.

The *acetabulum*,<sup>g</sup> is a deep hemispherical concavity upon the outer side of the bone for the articulation of the head of the femur. The brim of this cavity is notched on the lower edge. In the bottom of the cavity is a rough depression occupied by a mass of fat, commonly called a gland of Havers. Immediately beneath the acetabulum is a groove, in which plays the tendon of the external obturator muscle.

The *obturator* or *thyroid foramen*, is that large opening in the front and lower part of the bone, which is filled up by a membranous ligament, with the exception of a groove at its upper part, through which pass the obturator vessels and nerve. Its shape is oval, but rather triangular in males.

## T H O R A X.

This cavity is formed by the dorsal vertebræ, ribs, and sternum; its figure is conoidal, flattened in front, and concave behind; the

apex presents a cordiform opening, and the opening at the base has a large notch in front.

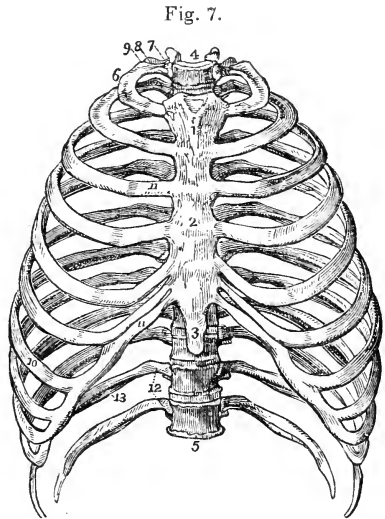
#### STERNUM.

Is an oblong, slightly curved bone, placed in front of the thorax. Usually it consists of three pieces, but in advanced life of but one.

The *first* or superior bone,<sup>1</sup> is the thickest, and resembles in shape a triangle with the corners cut off, the base being upwards; on the superior edge is a concavity for the benefit of the movements of the trachea; on each side is a large concavity for the articulation of the clavicle, and below are two smaller ones for the articulation of the first, and part of the second rib.

The *second* bone<sup>2</sup> is longer and narrower than the first, increasing in breadth in its lower extremity; its sides present pits for the articulation of part of the second, the third, fourth, fifth, sixth, and part of the seventh ribs.

The *third* bone,<sup>3</sup> is very frequently cartilaginous, and called xiphoid or ensiform; its shape varies; sometimes being pointed, and sometimes bifurcated; upon its side is a depression for a portion of the seventh rib.



#### RIBS.

These are twenty-four in number, twelve on either side; those that articulate with the sternum are called *true* ribs, and are seven in number; the five below them are called *false* ribs: in some rare instances there have been thirteen or eleven ribs on one side. They are parallel, and directed obliquely downwards and forwards; each having a parabolic curve, and gradually increasing in size until the eighth, afterwards gradually diminishing.

The *anterior* or *sternal* extremity is larger and flatter than the *posterior*; the *posterior* or *vertebral* extremity presents a spherical head, having two articular surfaces separated by a ridge; surrounding the head, the rib is very narrow and called the *neck*, the upper edge of which is sharp for the insertion of the *internal* transverse liga-

ment ; about one inch from the head is the tubercle, a prominence with an articular face, for the transverse process of the vertebra ; just beyond this is a smaller tubercle, for the insertion of the *external* transverse ligament.

Each rib is twisted and bent ; this bend constitutes the *angle* of the rib ; upon the external surface is a mark, showing the insertion of the sacro-lumbalis muscle. The *lower* edge of the rib is thin and cutting, and just within it is a groove,<sup>43</sup> running two-thirds of its length, and containing the intercostal vessels and nerve. The *upper* edge is rounded for the insertion of the intercostal muscles.

The *first* rib is small and semicircular, its surfaces looking superiorly and inferiorly ; the superior surface has upon its middle a slight fossa, for the subclavian artery ; in front of this is a roughness for the insertion of the scalenus anticus muscle, behind it another for the insertion of the scalenus medius ; the head has a single articular surface, its angle is at the tubercle, and it has no intercostal groove.

The *eleventh and twelfth*,<sup>42</sup> are called *floating* ribs, because they are not connected with the others ; they have no tubercles, and their heads have but a single articular surface ; the twelfth is very short, but slightly curved, and has no intercostal groove.

## BONES OF THE HEAD.

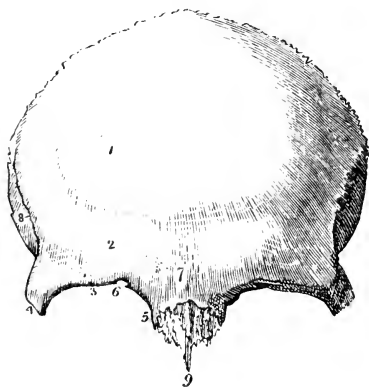
These are twenty-two in number, and are divided into those of the cranium, which are eight in number ; and those of the face, which are fourteen.

### C R A N I U M.

#### FRONTAL BONE.

This forms the forehead of common language ; it is usually a single, symmetrical bone, though occasionally divided by a suture into two parts ; its shape resembles that of a shell.

Fig. 8.



The *external surface* is convex, and about the middle upon each side there is the *frontal protuberance*,<sup>1</sup> being the original centre of ossification ; below this and nearer the median line is an oblique ridge, called the *nasal* or *superciliary protuberance*.<sup>2</sup> The inferior edge of the bone is formed on either side by the *orbital ridge*,<sup>3</sup> forming the anterior bound-

dary of the orbit of the eye; this ridge is terminated outwardly by the external angular process,<sup>4</sup> just within which is a depression for the lachrymal gland, and inwardly by the internal angular<sup>5</sup> process; between the internal angular processes is a prominence called the *nasal spine*,<sup>9</sup> which serves as an abutment for the nasal bones. Upon this orbital ridge, half an inch distant from the internal angular process, a small depression exists, upon which plays the tendon of the superior oblique muscle; to the outside of this depression is a notch or foramen, for the transmission of the supra-orbital artery and nerve.<sup>6</sup>

The *frontal sinus* opens near the internal angular process, and is formed by the separation of the tables over the orbital ridge; its capacity varies and there are no means of determining it in the living being; it empties into the infundibulum of the ethmoid.

The *internal surface* is concave and has numerous depressions corresponding with the convolutions of the brain; in the middle is a fossa for a superior longitudinal sinus, and a ridge for the attachment of the dura mater; at the bottom of this ridge is the *foramen cæcum*, transmitting a vein, which forms the commencement of the sinus.

The *orbital processes* are two horizontal plates, forming the roofs of the orbits, separated by a large space, which is occupied by the ethmoid bone. The *internal edges* of these processes have two grooves, which are converted into foramina, called ethmoidal or orbital, by the articulation of the ethmoid. The *anterior* transmits the internal nasal nerve.

Laterally the bone articulates with the parietal and sphenoid, inferiorly with the bones of the face and the ethmoid.

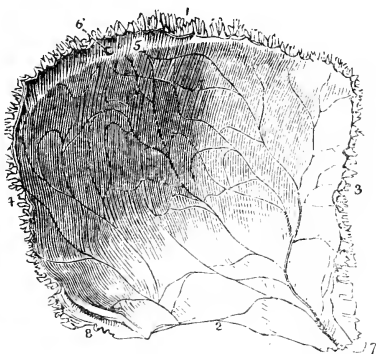
#### PARIETAL BONES.

These occur in pairs, and form the middle and lateral portions of the cranium; they are quadrangular and flat, externally convex and internally concave.

The *external surface* has in its middle the parietal protuberance, the centre of ossification; below this is the semicircular ridge indicating the attachments of the temporal fascia and muscle.

The *internal surface* is concave, with numerous depressions for the convolutions of the brain, and is also traversed by furrows showing the course of the middle artery of the dura mater. The *superior edge*<sup>1</sup> is the thickest and much dentated;

Fig. 9.



when adjusted with its fellow, it forms a deep groove for the longitudinal sinus.<sup>5</sup> The parietal foramen,<sup>6</sup> transmitting an emissary of Santorini, opens in this groove. The *inferior* edge is short, concave, and squamous, articulating with the temporal. The anterior inferior angle<sup>7</sup> is long and pointed; the posterior inferior<sup>8</sup> angle is very obtuse, and deeply grooved on its internal surface for the lateral sinus.

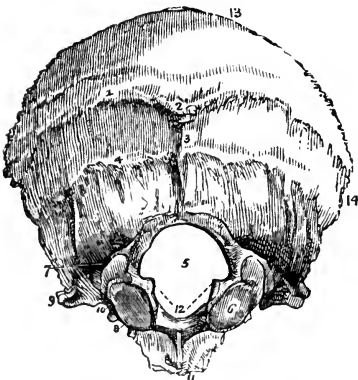
#### OCCIPITAL BONE.

Placed at the posterior and inferior part of the head, is of an oval or trapezoidal shape.

The *external surface* is convex and rough in some parts; near its middle is a prominence called the *external occipital cross*,<sup>9</sup> from which there proceeds on each side a semicircular ridge,<sup>1</sup> to which is inserted the sterno-cleido mastoideus muscle, and from which arise the trapezius and occipital frontalis. About one inch below is another semicircular ridge<sup>4</sup> for the insertion of the superior oblique muscle. Between this ridge and the foramen magnum, the space is occupied by the recti postici muscles. Reaching from the external occipital cross is a vertical ridge<sup>3</sup> extending to the foramen magnum, into which is inserted the ligamentum nuchæ. A space between the superior and inferior semicircular ridges is occupied by the insertion of the splenius and complexus muscles.

The *foramen magnum*<sup>5</sup> is oval, its antero-posterior diameter being the largest; it transmits the medulla oblongata, spinal accessory nerves, and vertebral vessels. On either side of the foramen is the *condyloid process*,<sup>6</sup> an oblong convex surface converging towards its fellow, by which the head articulates with the atlas. The *anterior condyloid foramen*<sup>8</sup> transmits the hypoglossal or ninth nerve, the *posterior condyloid foramen*<sup>7</sup> a vein to the lateral sinus.

Fig. 10.



In front of the foramen magnum is the *basilar process*,<sup>11</sup> the extremity of which articulates with the sphenoid; the inferior surface receives the insertion of the recti postici and superior constrictor muscle of the pharynx; the superior surface is concave and contains the medulla oblongata.

The *internal surface* is concave and about its middle has an *internal occipital cross*, which is more prominent than the external; from it there diverge three grooves, containing the two lateral and the superior longitu-

dinal sinuses; inferiorly there proceeds a ridge to the foramen magnum to which is attached the falx cerebelli. The concavity is thus divided into four; the two superior, containing the posterior lobes of the cerebrum, and the two inferior the hemispheres of the cerebellum.

The two superior edges are deeply dentated and articulate with the parietal; the two inferior articulate with the temporal. On each edge is a prominence called the *jugular eminence*,<sup>9</sup> in front of which is a fossa converted into the *posterior foramen lacerum*,<sup>10</sup> by articulation, through which pass the internal jugular vein and the eighth pair of nerves. Upon the inferior surface of this eminence is inserted the *rectus capitis lateralis*.

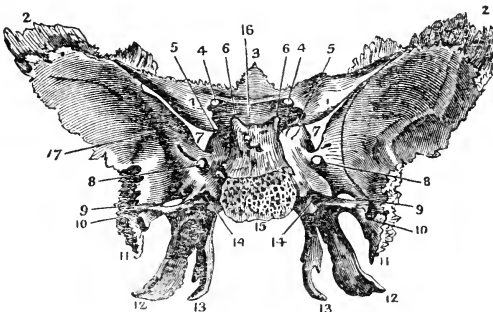
#### SPHENOID.

*Position.* In the middle and anterior part of the base of the cranium. *Shape.* Resembles a bat; consists of a body and four wings; a large and small one being placed on each side, besides two vertical processes directed downwards.

The *body* is in the centre and cuboidal in its shape. On its *superior* surface is a deep pit called *sella turcica*,<sup>16</sup> which contains the pituitary gland. This depression is overhung posteriorly by the *posterior clinoid process*;<sup>6</sup> on either side are two grooves called *sulci carotici*, for the carotid arteries, and in front there is a prominence called *processus olivaris*, upon which is a transverse groove indicating the position of the chiasm of the optic nerves.

On the anterior view of the body are the orifices of the two sphenoidal cells, separated by a ridge, upon which articulates the nasal lamella of the ethmoid bone; they empty into the post. eth. cells and do not exist in infancy. The inferior surface of the body has an elevation in the middle line called the *processus azygos*, by which it articulates with the lower two projections. Posteriorly, the surface is

Fig. 11.



rough for articulating with the cuneiform process of the occipital bone.

The *small wings*<sup>1</sup> are placed in front of the large. They are triangular, flat, and narrow. Their posterior extremities constitute the anterior clinoid processes, which are perforated by the *optic foramina*,<sup>4</sup> through which pass the optic nerve and ophthalmic artery. They articulate in front with the frontal bone.

The great wings are separated from the small by the *sphenoidal fissure* or *foramen*,<sup>7</sup> which transmits the third, fourth, first branch of the fifth, and the sixth nerves.

This wing has three surfaces. The *cerebral* is concave and has numerous depressions for the convolutions of the middle lobe of the cerebrum which lodge in this concavity. It has three foramina. The foramen *rotundum*<sup>8</sup> transmits the second branch of the fifth pair. Behind it, is the *foramen ovale*,<sup>9</sup> through which passes the third branch of the fifth pair. The posterior angle of this surface is the spinous process, which is perforated by the *foramen spinale*,<sup>10</sup> by which the middle artery of the dura mater enters the cranium. Projecting from the inferior surface of this process is another called *styloid*,<sup>11</sup> which gives origin to muscles.

The external surface is the *temporal*, which is divided by a ridge, and has a process in front; it is covered by the temporal and external pterygoid muscles. The *anterior* surface is called the *orbital*, forming a large portion of the orbit of the eye. On the superior surface is a large, triangular, serrated surface, for articulating with the frontal bone; laterally it articulates with the temporal.

*Pterygoid processes*.—These project downwards on either side, and articulate with the palate bones in front. Posteriorly, there is a fossa called pterygoid, which terminates in a notch, and divides the process into an *external* and *internal plate*. The *external*<sup>12</sup> is the broader, and gives origin to the external pterygoid muscle; the *internal*<sup>13</sup> is the longer, and terminates in a hook-like process, called the *hamulus*, over which plays the tendon of the circumflexus palati muscle. The internal plate gives origin to the internal pterygoid muscle, which occupies a portion of the fossa.

The base of the pterygoid process has a groove upon it, showing the course and connexion of the cartilaginous portion of the Eustachian tube. The *pterygoid foramen*<sup>14</sup> perforates the base of the process, and transmits the vidian or recurrent nerve.

#### TEMPORAL BONES.

These are placed on either side of the cranium below the parietal bone. They consist of three portions, squamous, petrous, and mastoid.

The *squamous*<sup>1</sup> is thin and shell-like. The *external* surface is slightly convex, has grooves for the deep temporal artery, and is covered by the temporal muscle. Projecting from the lower part of



this surface is the *zygomatic process*,<sup>6</sup> which forms a part of the zygomatic arch. The base of this process is triangular, and has beneath it a cavity called *glenoid* for the articulation of the lower jaw. This cavity is separated by the *Glaserian fissure* from another behind it, containing a portion of the *parotid gland*. Through this fissure pass the *chorda tympani nerve* and the *laxator tympani muscle*, attached to the *processus gracilis* of the *malleus*. The *internal surface* has a distinct groove<sup>4</sup> for the *middle artery of the dura mater*. The edge is thin and cutting and has *flat serrations*<sup>5</sup> for the *parietal bone*.

The *mastoid*<sup>2</sup> portion is behind, and nipple-like. It is thick and cellular; the cells being lined by a thin membrane. Externally it is rough, and has a large *process* called *mastoid*, into which are inserted the *sterno-cleido-mastoid* and *trachelo-mastoid muscles*. Beneath this process is the *digastric fossa*,<sup>7</sup> which gives origin to the *digastric muscle*. Internally is a deep *sulcus*<sup>8</sup> containing a part of the *lateral sinus*. The edges are thick and dentate. Near the upper edge is the *mastoid foramen*, which transmits a vein, one of the *emissaries of Santorini*.



Fig. 12.

The *petrous*<sup>3</sup> portion is pyramidal and directed obliquely forwards and inwards. Its structure is extremely dense and brittle.

The *base* has a large oval opening externally, between the zygomatic and mastoid, called the *external meatus*, which is surrounded by a rim called the *auditory process*, to which is attached the cartilaginous portion of the ear. In the foetus it is a ring. The *apex* is obtuse and is perforated by the *carotid canal* and *foramen lacerum*. In the angle between the apex and squamous portion, is the bony portion of the *Eustachian tube*, and above it a canal for the *tensor tympani muscle*.

The *inferior surface* presents a large process, *styloid*,<sup>14</sup> projecting from a ridge called *vaginal process*. Behind it, is the *stylo-mastoid foramen*,<sup>15</sup> the orifice of the *Fallopian canal*, which transmits the *facial nerve* and *stylo-mastoid artery*. Inwards from the *styloid process* is the *jugular fossa*, which is converted into the *posterior foramen lacerum* by the articulation of the *occipital bone*; this foramen transmits the *internal jugular vein* and the *eighth pair of nerves*. The *tympanic canal*, containing *Jacobson's nerve*, opens in this fossa; its other orifice is near the *Eustachian tube*. Before the *jugular fossa* is the opening of the *carotid canal*,<sup>16</sup> which contains

the carotid artery and the ganglion of Laumonier. Upon the septum between the jugular fossa and carotid canal, is the entrance to the *aqueduct of the cochlea*.

The anterior surface presents a groove leading to a foramen called hiatus Fallopii, which transmits the superficial petrous nerve, a branch of the vidian; behind this is the eminentia arcuata, made by the prominence of the labyrinth. At the edge is a groove for the superior petrosal sinus, and near the apex a semilunar depression for the ganglion of Casser.

The *posterior* surface has a large opening near the middle, *internal meatus auditorius*; it is not deep, and the base is cribriform. Immediately above it, is a foramen or fissure for the dura mater and a small vessel; behind it is a ridge produced by the inferior semi-circular canal, and half an inch behind it is the aqueduct of the vestibule, concealed by an osseous lamella.

#### ETHMOID.

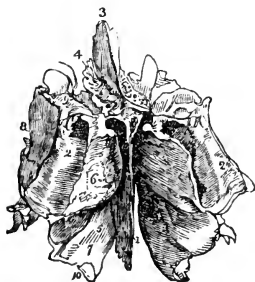
Is so called from its resemblance to a sieve. It is placed in the median line, at the base of the skull, in front of the sphenoid bone, and between the orbital processes of the frontal. Is cuboidal in shape and cellular in structure.

The *superior* surface is called the *cribriform plate*,<sup>4</sup> which is perforated with holes for the transmission of filaments of the olfactory nerve; the most anterior hole is the largest, and transmits the internal nasal nerve. From the median line is a narrow, triangular, hollow process called the *crista galli*,<sup>3</sup> and to it is attached the falx cerebri. In front of this is sometimes the foramen or groove called foramen cæcum, which admits of the passage of a small vein from the nose.

The bone is divided longitudinally into two halves by the vertical plate of bone called the *nasal lamella*;<sup>1</sup> this can best be seen by examining the inferior surface. It articulates below with the vomer, and behind with the crista sphenoidalis.

The *lateral surfaces* of the bone are called the *ossa plana*.<sup>5</sup> The

Fig. 13.



os planum is extremely thin and papyraceous, forming a large part of the orbit of the eye. On its upper edge are two grooves, which are converted into two *foramina*, called *internal orbitary* or *ethmoidal*; the anterior transmits an artery, vein, and the internal nasal nerve; and the posterior transmits an artery and vein. The inferior edge articulates with the superior maxillary bone. When the bone is viewed from behind, there will be seen two scrolls or shells on either side of the nasal la-

mella, but attached to the internal face of the os planum. They are the *superior*<sup>6</sup> and *middle turbinated bones*,<sup>7</sup> placed one above the other, and separated by a fissure. This fissure is the *superior meatus*<sup>8</sup> of the nose. The middle meatus is a space observed in an articulated head between the middle and inferior turbinated bones. The anterior cells of the ethmoid bone empty into the middle meatus; the most anterior of these cells is funnel-shaped (*infundulum*), and receives the fluid from the frontal sinus; from the inferior part of these cells there proceeds a hook-like process. The posterior ethmoidal cells and the sphenoidal sinus empty in the superior meatus.

In children there is attached to the ethmoid bone, on each side, a hollow triangular process, called the pyramid of Wistar, or cornu Bertini. The base is connected with the superior turbinated bone, the posterior edge of the cribriform plate, and the posterior edge of nasal lamella. The apex lies under the body of the sphenoid bone, on each side of the processus azygos. These pyramids are detached from the ethmoid in after life, and become the sphenoidal sinuses.

The ethmoid articulates with the frontal, sphenoid, inferior turbinate, upper jaw, nasal, lachrymal, palate bones, and vomer.

### BONES OF THE FACE.

These are fourteen in number, and exist in pairs with the exception of two, the lower jaw and the vomer.

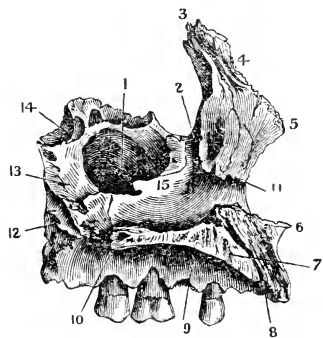
#### SUPERIOR MAXILLARY BONE.

This with its fellow constitutes the upper jaw. It articulates with all the bones of the face with the exception of the lower jaw. It has an irregular cubical body and four processes. The *body* is hollow and has four surfaces.

The anterior or *facial* surface is bounded above by the inferior margin of the orbit, beneath which is the *infra-orbital foramen*, transmitting the infra-orbital nerve, artery, and vein. Contiguous to this foramen is a depression, called the canine fossa, which gives origin to the levator anguli oris muscle. The posterior or *temporal* surface is rounded. The most prominent part is called the *tuber*,<sup>13</sup> which is rough and perforated by several small foramina which transmit the posterior dental nerve, artery, and vein, to the floor of the antrum.

The superior or *orbital surface* is triangular, and traversed by the

Fig. 14.



infra-orbital groove leading to the foramen of that name. The internal or *nasal surface* has a large opening of the *antrum High-morianum*,<sup>1</sup> which is a pyramidal cavity with thin walls; the walls are grooved, indicating the passage of the dental nerves. The opening is diminished by the articulation of the palate, inferior turbinate, and unguiform bone to a small orifice which opens into the middle meatus of the nose.

The *nasal process*<sup>4</sup> arises from the superior and anterior part of the bone. It is broad and thin below; externally it gives origin to the levator labii superioris alæque nasi muscle, internally is a transverse ridge for the inferior turbinated bone. The anterior edge articulates with the nasal bone, the superior with the frontal, and the posterior edge has a deep groove, which is converted into a bony canal by the articulation of the os unguis, to contain the lachrymal sac.<sup>2</sup>

The *malar process* is a rough process upon the external and superior part of the bone for articulation with the malar bone.

The *alveolar process* contains the sockets for eight teeth which are larger behind. The anterior nasal spine is best seen when the bone is articulated with its fellow; immediately behind this is the *foramen incisivum* for the naso-palatine nerve and ganglion.

The *palate process*<sup>7</sup> is the horizontal roof of the mouth and floor of the nose; uniting behind with the horizontal part of the palate bone,<sup>10</sup> and on the side with its fellow, from which latter junction or suture there arises the *nasal crista*, for the articulation of the vomer. The anterior extremity<sup>6</sup> is the anterior nasal spine.

#### PALATE BONE.

Situated on each side between the superior maxillary and the sphenoid bone; the figure is irregular and consists of three parts.

The *horizontal part*<sup>1</sup> is quadrilateral in its shape and assists in forming the floor of the nostril and roof of the mouth. The suture between it and its fellow forms a part of the nasal crista for the articulation of the vomer, and posteriorly is elongated into the posterior nasal spine; from which arises the azygos uvulæ muscle.

The ascending or *vertical portion*<sup>2</sup> is divided in its internal or nasal face by a ridge,<sup>6</sup> for the articulation of the inferior turbinated bone; externally it has a rough articular surface for the maxillary bone; upon this surface is a groove, converted into the posterior palatine foramen or canal by this articulation, which transmits the palatine nerve and artery. Posteriorly there is an elongated triangular process called *pterygoid*,<sup>3</sup> this process has three grooves, the middle of which forms a part of the pterygoid fossa, and those on each side receive the external<sup>10</sup> and internal<sup>11</sup> plates of the pterygoid process.

Fig. 15.



The upper extremity of this vertical or nasal portion is formed by two processes separated by a notch which is converted into a foramen, called speno-palatine,<sup>7</sup> by articulation with the sphenoid bone, and transmits the speno palatine artery and nerve. The anterior process is called *orbital*,<sup>8</sup> forming a small part of the orbit between the ethmoid and superior maxillary. The posterior is the *pterygoid apophysis*,<sup>9</sup> extremely thin, inclines inwards and fits upon the base of the body of the sphenoid.

#### MALAR BONE.

Is quadrangular in shape, and forms the prominence of the cheek. It consists of a body and processes. The *body* has three surfaces, the external or facial of which, has numerous small perforations for arteries<sup>7</sup> and nerves; the internal or orbital is smooth and has a notch which limits the speno-maxillary fissure or foramen lacerum inferius of the orbit; the posterior forms the anterior boundary of the temporal or zygomatic fossa.

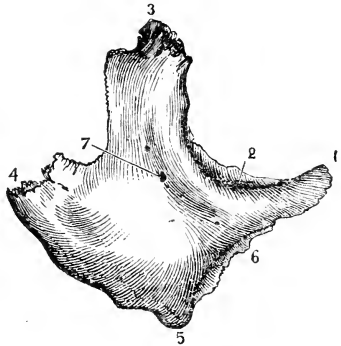
The *superior process* is the *frontal*,<sup>3</sup> articulating with the external angular process of the frontal bone. The *temporal process*<sup>4</sup> projects backwards to unite in forming the zygomatic arch. The *maxillary*,<sup>5 6</sup> is triangular and rough for articulating with the malar process of the superior maxillary bone. The bone has also three edges. The superior<sup>2</sup> is curved and continuous with the orbital ridge, the inferior gives origin to the zygomatic and masseter muscles, and the posterior has the temporal fascia connected with it.

The malar bone sometimes contains a cavity called the sinus jugalis, especially in Mongolians and Malays.

#### NASAL BONE.

These bones unite with each other<sup>2</sup> and are placed between the nasal processes of the superior maxillary bones. The shape is a long quadrangle. The superior extremity is narrow and thick, articulating with the frontal bone. The inferior is thinner and broader, having the cartilage of the nose attached; the internal edge articulates with its fellow, and the external has a spiral groove, whereby it is overlapped by the nasal process of the superior maxillary above, and overlaps the process below. The anterior surface has numerous foramina for nutritious vessels; the posterior contains a groove for the internal nasal nerve.

Fig. 16.



## UNGUIFORM BONE.

Called so from its resemblance to a finger nail (*unguis*), also called lachrymal. It is quadrangular, flat, and small, extremely thin and often cribriform. The external surface<sup>1</sup> forms a portion of the orbit of the eye, and has a groove in front,<sup>2</sup> which completes the canal for the lachrymal sac. From its inferior edge there projects a triangular process<sup>7</sup> which articulates with inferior turbinated bone. The edge<sup>4 5 6</sup> articulates with the frontal, ethmoid, and superior maxillary bone.

Fig. 17.



## INFERIOR TURBINATED BONE.

This is a porous scroll, placed at the inferior part of the nasal cavity below the ethmoid. Its posterior end is the more pointed. Its *internal surface* is convex and looks towards the nose; the *external surface* has a broad hook, *processus maxillaris*,<sup>3</sup> which enters the antrum Highmorianum, and partly closes it. The superior edge has a triangular process called *lachrymal*, which articulates with the unguis. The portions of the edge in front and behind this process rest upon ridges of nasal process of the superior maxillary and palate bone; there is frequently a process upon this edge which unites with the ethmoid bone.

## VOMER.

A single bone, forming a large portion of the nasal septum, consisting of two plates of compact structure. It is a flat bone with four edges. The superior is the thickest, having a deep groove between two lips (*alæ*) for the reception of the *processus azygos* of the sphenoid. The inferior is the longest, articulating with the nasal crista of the palate suture. The anterior unites with the nasal lamella of the ethmoid, and the posterior is thin, sharp, and concave, separating the posterior openings of the nose.

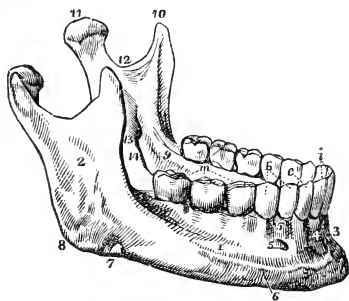
## INFERIOR MAXILLARY.

Is also single, having a parabolic curve; placed at the inferior portion of the face. It consists of a body and two rami. The body is convex in front and presents in its middle the *anterior mental tubercle* or spine, which in youthful life is a suture. On either side of this is a large hole, called the anterior mental<sup>5</sup> foramen, transmitting a part of the inferior alveolar artery and nerve. The posterior is concave and has the posterior mental tubercle in its middle, upon which are two marks on each side, for the *genio-hyoglossus* and *genio-hyoid* muscles; on either side of this tubercle or spine is a fossa for the insertion of the *digastricus*. Extending backwards from this is a ridge<sup>9</sup> called *mylo-hyoid*, for the muscles of that name; above this ridge in front is a shallow fossa for the sublingual gland;

below it and behind, a larger one for the submaxillary gland. The upper edge is the alveolar process, with sockets for sixteen teeth. The inferior edge is the base, thicker in front, with two corners in front giving a squareness to the chin, which is that portion included between the anterior mental foramina.

The ramus<sup>2</sup> is square, and at right angles to the body in manhood, in youth and old age oblique; externally it is rough for the masseter muscle, anterior to which is a groove for the facial artery.<sup>7</sup> The internal face has a foramen, posterior mental,<sup>13</sup> for the entrance of the inferior alveolar artery and nerve. To the edge of this foramen is attached the internal lateral ligament; near it is a groove<sup>14</sup> transmitting the mylo-hyoidean nerve; below, is the surface for the insertion of the internal pterygoid muscle. The angle<sup>8</sup> is rough, has attached to it the stylo-maxillary ligament. The anterior edge of the ramus is continued into the external oblique ridge.<sup>6</sup> The superior part of the ramus has two processes separated by<sup>12</sup> the sigmoid notch. The *coronoid* process is in front,<sup>10</sup> triangular and thin; it has inserted into its apex the temporal muscle; in front there is a groove for the buccinator muscle. The posterior is the condyle<sup>14</sup> articulating in the glenoid cavity of the temporal bone. The neck is narrow, and on the inside of it is a fossa for the insertion of the external pterygoid muscle.

Fig. 18.



## OF THE HEAD IN GENERAL.

*Sutures.*—The principal sutures of the head are the *coronal*, which unites the parietal and frontal bones; *sagittal*, which unites the two parietal bones in the adult, and in a child extends to the root of the nose; *occipital*, which joins the parietal and occipital bones; *squamous*, uniting the squamous part of temporal and parietal. Besides these there are others uniting the bones of the face. That part of the suture between the mastoid and parietal bones, is called *additamentum suturæ squamosæ*; and that suture between the mastoid and occipital, called *additamentum suturæ occipitalis*.

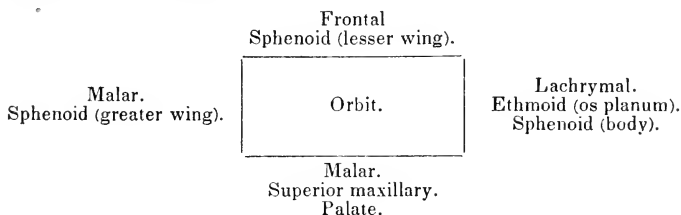
*Fontanels.*—These are the deficiencies in the bones peculiar to the foetal head. The *anterior* is large and quadrangular, situated at the junction of the coronal and sagittal sutures. The anterior angle is the most elongated. The *posterior* is small and triangular, situated at the junction of the lambdoidal and sagittal sutures. Besides

these there are two smaller fontanels on either side; one is in the angle of the temporal, parietal, and occipital bones, and the other is at the junction of the temporal, parietal, and sphenoid bones.

*Ossa Wormiana* or *Triquetra*, are small, irregular in shape and number, sometimes found in the sutures, particularly about the middle of the lambdoidal. They have a distinct point of ossification.

The *diploe* is the cellular bony structure between the external and internal or vitreous tables; it is traversed by channels lined by a venous lining which empty into the emissaries of Santorini. The *cavity of the cranium* is about six and a half inches in length, five in breadth and five in height. When the calvaria or arch of the cranium is removed, three deep fossæ are observed at the base on each side. The anterior is formed by the frontal, sphenoid and ethmoid bones, and contains the anterior lobes of the brain; the middle, formed by the sphenoid and temporal bones, lodges the middle lobe; the posterior, formed by the occipital and temporal bones, is for the cerebellum.

*Orbital cavity*.—Is formed on each side by seven bones represented in this manner:



The cavity is conical, the apex being formed by the optic foramen, the base looks outwards and is somewhat quadrangular. The sphenoidal foramen or fissure opens into the orbit, and is also called *foramen lacerum superius*; a slit or fissure between the sphenoid and maxillary bones being the *foramen lacerum inferius*. Besides these there are other openings into the orbit already mentioned in the description of each bone.

*Nasal Cavity*.—This is an irregular cavity, separated from its fellow by the nasal septum. It has three distinct passages or *meatuses*. The *superior* is between the superior and middle turbinated bones, and has opening into it the posterior ethmoidal cells, the sphenoidal cells, and the sphenopalatine foramen: the middle is between the middle and inferior turbinated bones, and has opening into it the frontal sinus, anterior ethmoidal cells, and the antrum, usually. The inferior is the largest, and between the inferior turbinated bone and the floor of the cavity. Into it opens the nasal duct. The opening into the nasal cavity in front is called the *anterior nares*; the opening behind *posterior nares* or *clivance*.



*Zygomatic fossa*, also called temporal, is the large fossa on either side of the head, formed by the parietal, sphenoid, temporal, and frontal bones, and bounded externally by the zygoma. The temporal muscle occupies nearly the whole.

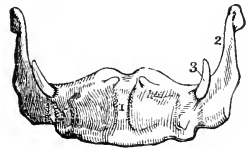
*Pterygo Maxillary Fossa* or *Fissure*.—This is at the bottom of the zygomatic fossa, and formed by the sphenoid, palate, and superior maxillary bones. It is triangular, and the base is upwards. The ganglion of Meckel is contained in it, which gives off branches going through the foramina which open upon this fossa. It is continuous with the foramen lacerum inferius or speno-maxillary slit.

*Facial Angle*.—This is formed by drawing a straight line from the lower part of the frontal bone to the anterior nasal spine, and intersecting at this latter point by another drawn through the external meatus auditorius. It establishes a relation between the cranium and the face. The smaller the angle the more inferior is the conformation. By comparing the heads of the great races of the world, it is found to be  $80^{\circ}$  to  $85^{\circ}$  in Europeans,  $75^{\circ}$  in the copper-coloured or Mongolians, and  $70^{\circ}$  in Negroes.

#### HYOID BONE.

This bone is isolated in the neck, connected with the root of the tongue and upper part of the larynx. It is shaped like the Greek  $\nu$ , the convexity being in front. It consists of a body and four cornua. The *body*<sup>1</sup> is quadrilateral, convex in front, and concave behind. The front surface gives origin and insertion to muscles, and has a well-marked projection. The *great cornua*<sup>2</sup> are about an inch in length, and generally united to the body by means of cartilage and ligaments; they are flattened, project backwards, and terminate in a head or tubercle. They give origin and insertion to muscles. The *lesser cornua*,<sup>3</sup> are attached at the junction of the body and great cornu; it is cartilaginous usually, and of a few lines in length. To it is attached the stylo-hyoid ligament.

Fig. 19.



#### UPPER EXTREMITY.

The upper extremity may be divided into the shoulder, arm, and forearm.

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

*Scapula*.—The shoulder blade of common language. Placed on the back part of the thorax between the second and seventh ribs. It is thin, flat, and triangular; has two surfaces, three edges, and three angles.

The *anterior face* is a concavity called *costa* or *venter*, divided by ridges, and giving origin to the subscapular muscle. The posterior face is the *dorsum*, divided by the spine into two fossæ; the fossa supra-spinata, containing the supra-spinatus muscle, and the fossa infra-spinata for the infra-spinatus muscle.

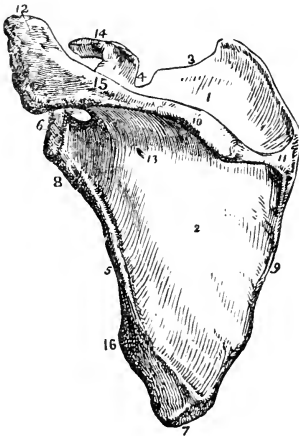
The spine is a rough ridge running obliquely across the dorsum, and terminating in the acromion process, which is flat and triangular, has a small articular mark in front for the clavicle. The edge of the spine gives origin to the deltoid, and insertion to the trapezius muscles; near the base of the scapula the spine has a small triangular surface,<sup>11</sup> over which plays the trapezius tendon.

*Internal edge or base.*—Is the longest, and nearly parallel<sup>9</sup> with the vertebral column, has an external lip for the insertion of the rhomboid muscles, and an internal one for the serratus anticus.

*External edge.*—Is thick,<sup>5</sup> and contains a fossa giving origin to the teres minor muscle. At the upper part of this fossa is the origin<sup>8</sup> of the long head of the triceps.

*Superior edge.*—Is thin and small,<sup>3</sup> has a notch called coracoid,<sup>4</sup> which is converted into a foramen by a ligament, and transmits the supra-scapular artery and nerve. Near this notch arises the omohyoid muscle.

Fig. 20.



*Superior angle.*—Almost a right angle, and has the levator anguli muscle inserted into it.

*Inferior angle.*—Most pointed,<sup>7</sup> and gives origin by its posterior surface to the teres major muscle and is connected with the latissimus dorsi.

*External angle.*—Presents a large articular cavity<sup>6</sup> called *glenoid* upon a narrow neck. This cavity is oval and shallow, and at its summit is a mark showing the origin of the long head of the biceps muscle.

*Coracoid process.*—This projects forwards and outwards from the neck,<sup>14</sup> in a curved manner. Its tip has marks for the pectoralis minor, coraco-brachialis and short head of the biceps. Its base has a tubercle for the conoid ligament.

## CLAVICLE.

A long bone placed transversely at the upper and anterior part of the thorax, resembling in shape the italic *f*. It articulates

with the sternum and scapula. The sternal two-thirds is convex anteriorly, and the humeral third concave anteriorly. The upper surface has a depression near the sternal extremity showing the origin of the sterno-cleido-mastoid muscle. The inferior surface has a roughness near the sternal extremity for the rhomboid or costo-clavicular ligament, and near the humeral extremity a tubercle and ridge for the coraco-clavicular ligament; the space between these two marks is for the subclavius muscle. The *anterior* edge gives origin by its sternal two-thirds to the pectoralis major, and by its humeral third to the deltoid. The *posterior* edge has a foramen for the nutritious artery.

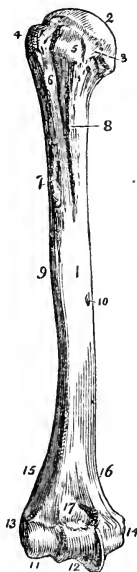
The *sternal extremity* is thick and triangular, with a surface for articulations with the sternum; the posterior and inferior corner of it is elongated, which contributes to the strength of the articulation. The *humeral* extremity is flat and spongy with an articular face for the acromion process of the scapula.

In the male the bone is shorter, thicker, and more curved than in the female.

## HUMERUS.

The arm-bone is cylindrical, and reaches from the shoulder to the elbow. The superior extremity presents a hemispherical *head*<sup>2</sup> for articulation with the glenoid cavity of the scapula, separated by a deep groove, the *anatomical neck*<sup>3</sup> from the shaft of the bone. Below this groove are two tuberosities, the greater,<sup>4</sup> is the external, and has three facets for the insertion of supra and infra-spinatus, and teres minor muscles; the lesser on the inner side<sup>5</sup> is for the insertion of the subscapularis. These tuberosities are separated from each other by a groove,<sup>6</sup> called *bicipital*, in which plays the tendon of the long head of the biceps muscle. The anterior or *external edge*<sup>7</sup> of this groove has the pectoralis major muscle inserted into it, and the posterior<sup>8</sup> receives the latissimus and teres major muscles. The *surgical neck* is between the insertion of these muscles and the anatomical neck of the humerus. About the middle of the shaft, and upon its outer side, is a triangular roughness<sup>9</sup> for the insertion of the deltoid; on the inner side and a little below is a ridge for the coracobrachialis:<sup>10</sup> below this ridge is the nutritious

Fig. 21.



foramen, and above it is a shallow spiral groove for the musculo-spiral nerve and profunda major artery.

The inferior extremity is flat and broad; anteriorly it is covered by the brachialis anticus muscle, and posteriorly by the triceps. Externally, there is a ridge<sup>16</sup> leading to the *external condyle*,<sup>13</sup> from which arise the supinator and extensor muscles. Internally a ridge<sup>16</sup> leads to the *internal condyle*,<sup>14</sup> which is more prominent than the external, and from which arise the flexor muscles of the forearm.

The articular surface for the elbow consists of a hemispherical head<sup>14</sup> for the radius, and an irregular cylinder<sup>12</sup> for the ulna. Above this articular surface, and in front, is a fossa,<sup>17</sup> called the *lesser sigmoid cavity*, which receives the coronoid process of the ulna in extreme flexion; behind is a larger fossa, the greater sigmoid, for the olecranon in extreme extension.

#### ULNA.

The forearm consists of two bones—Radius and Ulna. The ulna is the longer and is placed on the inner side, reaching from the elbow to the wrist.

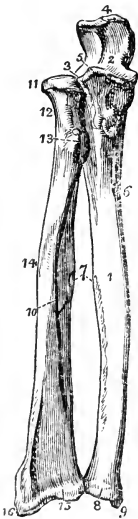
The upper extremity is the larger, and has a hook-like process behind<sup>4</sup> called *olecranon*, to which is inserted the triceps extensor cubiti. In front, is the *coronoid process*,<sup>5</sup> the base of which has a roughness for the insertion of the brachialis anticus muscle. Between the olecranon and coronoid processes, is the greater sigmoid cavity,<sup>2</sup> for articulation with the humerus; continuous with this is the lesser sigmoid cavity,<sup>3</sup> upon the outside of the coronoid process, for the articulation of the head of the radius. Behind the lesser sigmoid cavity, is a triangular, uneven surface, for the insertion of the anconeus muscle. This surface is limited by a ridge giving origin to the supinator radii brevis muscle.

The *body* is prismatic; the anterior surface<sup>1</sup> is occupied in its upper three-fourths by the flexor profundus, and in the lowest fourth, by the pronator quadratus muscle. The posterior surface is occupied by the extensors of the thumb and the indicator muscle.

The external edge<sup>7</sup> is the sharpest, for the attachment of the interosseous ligament.

The lower extremity, has a small rounded head,<sup>8</sup> the outer side of which has a smooth articular surface for the radius. From the inner side, there projects<sup>9</sup> the *styloid process*, to which is attached the internal lateral ligament; behind this process is a groove, in which glides the tendon of the extensor carpi ulnaris muscle.

Fig. 22.



## RADIUS,

Placed on the outer side of the ulna, is slightly curved and prismatic.

The *superior extremity* has a rounded *head*,<sup>11</sup> the rim of which is smooth, and partly plays in the lesser sigmoid cavity. The upper surface of the head has a cup-like depression for articulation with the humerus. Beneath the head is the *neck*,<sup>12</sup> the narrowest part of the bone. Below the neck, and on the inner side, is the *tubercle*,<sup>13</sup> a prominence, rough below and smooth above, for the insertion of the biceps muscle.

The body is prismatic; *anteriorly*, the surface gradually increases in breadth,<sup>10</sup> giving origin to the flexor longus pollicis, and receiving the insertion of the pronator quadratus muscle. The *posterior surface* is occupied by the extensor major of the thumb and the indicator muscle. The *external surface* is curved, and has a roughness about the middle for the insertion of the pronator radii teres muscle, above which and below the tubercle is the space occupied by the insertion of the supinator radii brevis muscle.

The *inferior extremity* is thick and triangular. The surface of the extremity<sup>15</sup> is concave and divided by a ridge. It articulates with the scaphoid and lunare. Continuous with this articular surface, is a smaller one on the internal aspect of the extremity for articulation of the ulna. Externally there is a *styloid process*,<sup>16</sup> for the connexion of the external lateral ligament.

Into a ridge contiguous to the palmar surface of the bone is inserted the supinator radii longus. Upon the dorsal view of this extremity, are three large grooves, each divided into smaller ones. The groove near the supinator ridge transmits the tendons of the extensor ossis metacarpi pollicis and the extensor minor pollicis; the groove in the middle is the broadest and most shallow, transmitting the tendons of the radial extensors; and the groove nearest the ulna transmits the tendons of the extensor communis, indicator, and extensor major pollicis. The portion of the groove occupied by the latter is very deep.

## H A N D.

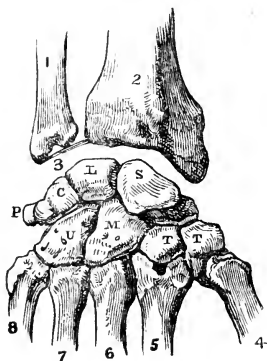
The hand consists of the carpus, metacarpus, and digiti.

The **CARPUS** or wrist is oblong, the greatest diameter being transverse. The dorsal surface is convex, and the palmar surface is concave with four prominences. This concavity transmits the flexor tendon.

It consists of *eight* bones arrayed in two rows. The bones of the *superior* row are the *scaphoid*, *lunare*, *cuneiform*, and *pisiform*. Those of the *inferior* row are the *trapezium*, *trapezoides*, *magnum*, and *unciform*.

*Scaphoid*, is on the radial side, and resembles a boat; has a large convex surface superiorly for the radius, and inferiorly a deep concavity for the magnum. It articulates in front with the trapezium and trapezoides, and on the inside with the lunare.

Fig. 23.



*Lunare*, of a crescentic figure, has a convex surface superiorly for the radius, and a concavity in front for the magnum, articulates on the inside with the cuneiform.

*Cuneiform*.—Wedge-shaped, or pyramidal. Inferiorly it articulates with the unciform. Distinguished by a circular facet on its palmar surface for the pisiform.

*Pisiform*.—Pea-like bone, forms one of the prominences in the palm of the hand, has the flexor carpi ulnaris muscle inserted into it, and has but one articular mark, which is for the cuneiform. It is the smallest bone of the carpus.

*Trapezium*, has the most surfaces and angles. The largest articular surface is for the thumb; two others, joining each other, are for the scaphoid and trapezoides. On the palmar surface is a ridge and a deep groove for the flexor carpi radialis tendon.

*Trapezoides*, is the smallest bone of this row—is a four-sided pyramid with its apex towards the palm; its dorsal surface is the base and inclines inwards.

*Magnum*.—The largest bone of the wrist. Has a rounded head looking backwards; the body is quadrilateral.

*Unciform*.—Distinguished by a hook-like process resembling a nail on its palmar surface, which gives origin to the flexor brevis minimi digiti.

#### METACARPUS

Consists of five bones, each having a head, shaft, and base.

The *head* is rounded, articulating with the phalanx; a roughness on each side indicates the attachment of the lateral ligament.

The *base* is the superior extremity, rough, and quadrilateral, having articular marks on the extremity and either side.

The *body* or *shaft* is prismoid, having impressions on its sides for the interossei muscles.

*First*, is short and thick, for the thumb. Its base has but one articular surface, and that is for the trapezium. Its head is not very spherical, its palmar surface articulates with the sesamoid bones.

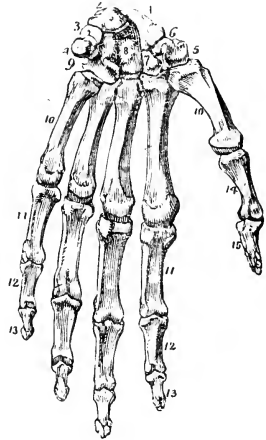
*Second*, is the longest, for the index finger; has a *notch* at its base for articulating with the trapezoid; a lateral articular mark upon one side only, and a mark upon its dorsal surface for the extensor carpi radialis longior.

*Third*, has a *triangular* base, with an articular mark on each side, and on its dorsum, one for the extensor carpi radialis brevior.

*Fourth*, is much smaller. The external lateral surface of its base is double.

*Fifth*, the smallest. Its base has but one lateral surface, and that is external and single. Internally a tubercle at the base for the extensor carpi ulnaris.

Fig. 24.



## DIGITI.

The fingers contain three bones called *phalanges*: the thumb has but two.

*First row*.—The *phalanges* of this row are the largest, convex on their dorsal, and flat on the palmar surface. The superior extremity has a single concavity for the head of the metacarpal bone. The inferior has two convexities separated by a groove. A roughness on either side of this extremity, indicates the attachment of the lateral ligament. The ridges extending from one extremity to the other, are for the theca of the flexor tendons.

*Second row*.—These are smaller. The superior extremity has two concavities, separated by a ridge; the inferior two convexities, separated by a groove. The ridge on either side of the body has the theca and tendon of the flexor sublimis attached to it.

*Third row*.—These are the smallest, and differ much from the other rows, having but one articular extremity, which is the superior, having two concavities and a ridge. The inferior extremity is flattened, thin, and rough.

The middle finger (*impudicus*) is the longest. The ring finger (*annularis*) is the next in size. The forefinger (*indicator*) is thicker than the last. The little finger (*auricularis*) is the smallest.

*Sesamoid bones*.—These are four in number—two being placed upon the palmar side of the lower extremity of the metacarpal bone of the thumb, in connexion with the short flexor tendon.

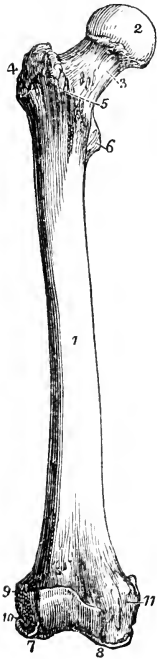
## LOWER EXTREMITY.

## FEMUR.

The *femur* is the longest bone in the body, reaching from the acetabulum to the knee.

The superior extremity presents a spherical *head*,<sup>2</sup> which has a depression upon it for the ligamentum teres. The part between the head and shaft is the *neck*,<sup>3</sup> which is shorter and more horizontal in old persons and in females. Externally is the *trochanter major*, a large process having an oval mark in front for the gluteus minimus; and above a double mark for the gluteus medius; the tip has the pyramiformis inserted into it, and behind the tip is the *digital fossa*, into which are inserted the gemelli and obturator muscles. Below and on the inner side is the *lesser trochanter*, into which is inserted the psoas magnus, and iliacus internus muscles. A ridge between the trochanters behind, indicates the insertion of the quadratus femoris, and a corresponding one in front, which is less distinct, serves for the connexion of the capsular ligament.

Fig. 25.



The *inferior extremity* is broader than the upper, and is divided by a fossa in front, and a notch behind, into two *condyles*. The *internal condyle* seems to be the longer;<sup>8</sup> its internal and posterior surfaces<sup>11</sup> give origin to the internal lateral ligament and gastrocnemius muscles; its external surface assists in forming the notch, and has a roughness in front for the posterior crucial ligament.

The *external condyle* contributes by its internal surface to form the notch, and has a roughness behind for the anterior crucial ligament. Its external and posterior surfaces give origin to popliteus, plantaris, and gastrocnemius muscles, and external lateral ligament. The *fossa* in front, is unequally divided between the condyles, the larger and flatter portion belonging to the external.

The shaft of the bone is curved *anteriorly*, and is covered in front by the origin of cruræus muscle. Posteriorly there is a rough ridge called *linea aspera* (Fig. 26), which consists of two lips having a tendency to separate above and below. The inner lip shows the insertion of the pectineus muscle,<sup>p</sup> of the adductor brevis,<sup>ab</sup>



and of the adductor magnus.<sup>am</sup> This last insertion occupies this inner lip in nearly its whole length, so also does the origin of the vastus internus. The outer lip has inserted into it the gluteus maximus<sup>sm</sup> and also gives origin to the vastus externus, and the short head of the biceps flexor cruris.<sup>b</sup>

## P A T E L L A .

The patella is the largest sesamoid bone in the body, and commonly called the knee-pan. It is flat and triangular; thick and broad above, and thin and pointed below. The *anterior surface* is covered by integument; the *posterior* is a smooth articular surface divided by a ridge unequally—the external portion is the larger and flatter, adapted to a corresponding surface of the femur.

The *superior edge* is thick, and has the tendon of the rectus inserted into it. The inferior is pointed, and to it is attached the ligament of the patella.

## T I B I A .

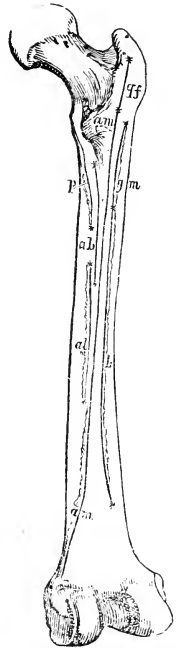
The tibia is longer and thicker than the fibula, and placed on the inside of the leg, and commonly called the shin-bone. The superior extremity, or *head*, is large and thick, presenting an oval articular surface for the femur. This surface is divided by a pyramidal eminence, the *spinous process*,<sup>4</sup> into two, both of which are oval, but the internal is longer and deeper; to the base of this spinous process are attached anteriorly and posteriorly the *crucial ligaments*; in a depression upon its summit is fastened the posterior end of the external semilunar cartilage. (Fig. 26.)

An enlargement upon either side of the head are called *tuberosities* or *condyles*; upon the posterior part of the *external condyle*<sup>3</sup> is a small articular face, looking downwards, for the head of the fibula; upon the posterior part of the *internal condyle*<sup>9</sup> is a depression for the insertion of the semi-membranosus tendon.

Below the head, and in front, is a prominent *tubercle*<sup>6</sup> for the insertion of the ligament of the patella, and above it a smoothness corresponding with its bursa; below the head, and behind, is a triangular surface, occupied by the poplitæus muscle, limited by an oblique ridge<sup>6</sup> (Fig. 28), which gives origin to the soleus muscle.

The *body* is prismatic. Its internal surface<sup>6</sup> (Fig. 27) is smooth and covered by the skin; the external surface gives origin to the

Fig. 26.



tibialis anticus and extensor communis digitorum; from the posterior surface arise the tibialis anticus, and flexor communis digitorum.

The *anterior* edge<sup>4</sup> (Fig. 27) is sharp and superficial, generally curved with some resemblance to the italic *f*; the *external* has a ridge for the attachment of the interosseous ligament, and the *in-*

Fig. 27.

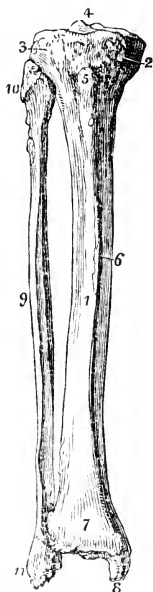
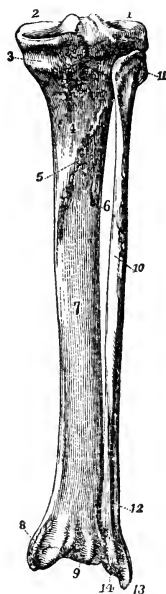


Fig. 28.



*ternal* is rounded, having the sartorius, gracilis, and semi-tendinosus inserted into it at its upper part.

The inferior extremity is smaller than the superior, and four-sided. Over the *anterior* surface pass the extensor tendons; *posteriorly* is a slight fossa<sup>9</sup> (Fig. 28) for the tendon of the flexor longus pollicis; *externally*, is a rough triangular fossa for the articulation of the fibula; and *internally* is a large process, called the *internal malleolus*<sup>s</sup> (Fig. 28), behind which is an oblique fossa, transmitting the tendons of the tibialis posticus. The inferior extremity of the malleolus is notched for the attachment of the internal lateral ligament; its internal surface is superficial; its external surface is continuous with the quadrangular concavity at the extremity of the bone, for the articulation of the astragalus.

## FIBULA.

The fibula is a long thin bone placed upon the outside of the leg,

and somewhat posteriorly at the upper part (Fig. 27<sup>a</sup>, Fig. 28<sup>10</sup>). It is somewhat twisted in its appearance, and has a slight convexity backwards. The superior extremity or head is thick and large, and depressed upon the upper part by a concave surface, which articulates with the external condyle of the tibia. External to this surface, is a mark for the attachment of the external lateral ligament of the knee-joint, terminated behind by a styloid process, for the insertion of the tendon of the biceps.

The body is prismatic, and has three surfaces, the external of which is the broadest, and commencing upon the anterior part of the bone above, curves around it, so as to terminate upon its posterior side below. The upper two-thirds of this surface gives origin to the peroneus longus and brevis; the lower third terminates in a groove, which indicates the course of the tendons of these muscles. The internal face looks towards the tibia, and is divided longitudinally by a ridge, to which is attached the interosseous ligament, the space in front of which gives origin to the extensor proprius pollicis, and the extensor communis digitorum; and the space behind gives origin to the tibialis posticus. The posterior surface is also spiral, and gives origin to the soleus, and the flexor longus pollicis muscles.

The inferior extremity terminates in the *external malleolus*, which is longer and flatter than the internal. Its external surface is superficial and triangular; its internal has a smooth articular surface for the astragalus. The extremity is pointed, and often called the coronoid process, immediately within which is a rough depression for the external lateral ligament.

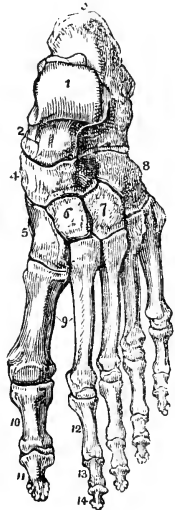
### FOOT.

It consists of the tarsus, metatarsus, and phalanges. The *TARSUS* consists of seven bones.

*Os Calcis*.—This is the largest of the tarsal bones, and constitutes the *heel* of common language. Its figure is longitudinal. The *superior surface* has two articular convexities for the astragalus, separated by a deep groove, in which is fastened the interosseous ligament. The posterior is the larger of the two.

The *internal surface* has a deep concavity, called the *sinuosity*, for the tendons, vessels, and nerves of the sole of the foot. The *external surface* is covered by the skin, and has two grooves for the tendons of the peroneus longus and brevis. The *inferior surface* has two tuberosities behind, of which the internal is the broader and larger; and also one in front.

Fig. 29.



These tuberosities give origin to muscles and ligaments. The *posterior* extremity<sup>3</sup> is rough and prominent in its inferior half, into which is inserted the tendo-achillis; the superior half is smooth, corresponding with the bursa. The *anterior* extremity presents two processes, called the greater and lesser apophyses; the *greater* is external and below, and has a flat triangular articular surface for the cuboid bone, surmounted by a rough projection, which is a surgical guide in Chopart's amputation of the foot. The *lesser apophysis* (*sustentaculum tali*), is a blunt hook projecting forwards and upwards, having an articular concavity above, constituting a portion of the superior surface of the bone, which articulates with the astragalus; upon its inferior surface is a groove for the tendon of the flexor longus pollicis.

*Astragalus*.<sup>4</sup>—Is next in size to the os calcis. It consists of a body and a head. The *superior* surface of the *body* presents a large articular convexity for the tibia; continuous with this, on either side, is an articular surface for the mallcoli; *inferiorly* is a concavity, divided by a deep rough groove for the interosseous ligament; *posteriorly*, is a slight groove for the flexor longus pollicis.

The *head* is upon the anterior portion of the bone. It presents a large anterior convexity, the horizontal diameter of which is the greatest. On the internal side of the head is a small triangular surface, which rests upon the calcaneo-scaphoid ligament. The head is united to the body by a narrow portion called the neck, which has a depression superiorly and inferiorly.

*Scaphoid*.<sup>4</sup>—Is oval, thicker above than it is below; *posteriorly*, it has a deep concavity for the head of the astragalus; *anteriorly*, an articular convexity, divided by ridges into three triangular facets for the cuneiform bones. *Internally*, is a tubercle for the insertion of the tibialis posticus tendon; and *externally*, there is sometimes a small articular face for the cuboid.

*Internal Cuneiform*.<sup>5</sup>—Is the largest of the three cuneiform bones. It is wedge-shaped, and is placed upon the inner side of the foot. The small extremity of the wedge looks upwards. Its internal surface is convex, and immediately beneath the skin; its external surface is concave, and has articular marks for the second cuneiform and the second metatarsal bones; *anteriorly*, is the largest articular surface, for the metatarsal bone of the big toe; *posteriorly*, is a triangular articular cavity, with the base downwards. The *inferior* surface of the bone, or the base of the wedge, is rounded into a tuberosity; upon the inner side, is inserted the tendon of the tibialis anticus.

*Middle Cuneiform*.<sup>6</sup>—Is the *smallest* of the three, and placed with the base of the wedge upwards; *anteriorly*, it articulates with the second metatarsal bone; *posteriorly*, it is slightly concave, and arti-

culates with the scaphoid; *internally*, it articulates with the internal cuneiform, and *externally*, with the external cuneiform bone.

*External Cuneiform.*<sup>7</sup>—Intermediate in size between the two last. It is wedge-shaped and base upwards. Anteriorly it articulates with the third metatarsal bone; *posteriorly* there is a quadrangular facet for the scaphoid; *internally* it has two articular surfaces, the posterior of which is the larger, and for the internal cuneiform bone; the anterior is for the second metatarsal. Externally is an angular projection, in front of which is a small facet for the front metatarsal bone, and behind which is an articular surface for the cuboid bone.

*Cuboid.*<sup>8</sup>—Placed at the outer portion of the foot, is somewhat cuboidal in shape; *superiorly*, it is rough and convex; *inferiorly*, is a prominent ridge for the calcaneo-cuboid ligament, and in front of this ridge is a groove, commencing at the external edge, and running obliquely forward, in which plays the tendon of the peroneus longus; *internally*, it articulates with the external cuneiform; *anteriorly*, with the fourth and fifth metatarsal bones; *posteriorly*, is a semi-spiral surface for the greater apophysis of the os calcis.

#### M E T A T A R S U S,

Consists of five parallel long bones,<sup>9</sup> whose heads articulate with the toes, rough on each side, and whose bases articulate with each of the three cuneiform and cuboid bones. The necks are narrow.

*First.* On the inside of the foot; easily recognised, being the shorter and thickest of the set. Its base is large and articulates with the internal cuneiform bone, and has a tubercle below for the peroneus longus. The head is spherical, articulating with the first phalanx in front, and below with the sesamoid bones.

*Second.* Is the longest. Its base articulates with the middle cuneiform, and on the inside with the internal cuneiform, and on the outside with the third metatarsal and external cuneiform.

*Third.* Is distinguished by the external surface of its base, having two articular facets for the fourth metatarsal. The base articulates also with the external cuneiform and second metatarsal.

*Fourth.* Its base articulates with the cuboid, and on either side with the contiguous metatarsal bone. The internal lateral face of the bone is distinguished by having two articular marks.

*Fifth.* Is the smallest and readily recognised by the large tubercle projecting backwards and outwards from the base, into the superior part of which is inserted the peroneus tertius, and into the extremity the peroneus brevis. This process is a surgical guide in Hey's amputation of the foot. The base articulates with the cuboid and fourth metatarsal.

## TOES.

There are five on each foot. Each consists of three *phalanges*, with the exception of the first or great toe, which, like the thumb, has but two.

The *first row*<sup>13</sup> of phalanges are smaller than those of the fingers, and readily distinguished by the narrowness of their bodies. The bases have a single concavity; the anterior extremities have two convexities, separated by a groove.

The *second row*.<sup>13</sup>—These phalanges have hardly any body; the posterior extremities have two concavities, separated by a ridge; and the anterior, two convexities separated by a groove.

The *third row*.<sup>14</sup>—These phalanges are very small; their bases have two concavities and a ridge. The anterior extremity is flat and rough.

*Sesamoid Bones*.—These are two small sections of a sphere of bone, imbedded in the tendon of the flexor brevis pollicis of each foot. The flat surface plays on the inferior part of the head of the metatarsal bone of the great toe.

## SECTION II.

## ARTICULATIONS.

## LIGAMENTS.

An articulation or joint is the connexion of one bone with another. If motion be intended, it is necessary that *cartilage, ligaments, and synovial membranes* should be employed in the mechanism.

*Cartilage*.—Is white, flexible, elastic and hard. Its chemical composition is, gelatine 44·5; water 55; phosphate of lime 0·5. By boiling it becomes yellow, swells, and the gelatine is dissolved. It resists mortification and putrefaction longer than any tissue except bone. When dried it becomes hard and contracted, and semi-transparent, resembling common glue. Soaking in water restores its appearance. It contains no red blood-vessels, nor can nerves nor lymphatics be traced in it. Old age disposes it to ossify, particularly in the ribs and larynx.

*Perichondrium* is the fibrous investing membrane of cartilage corresponding to the periosteum of bone.

*Articular cartilages*.—These cover the extremities of bone and obviate or equalize pressure. Those lining the cavity are thicker on the edges; those covering a convexity are thicker in the middle. *Inter-articular cartilages* are free and movable in the joint, not covering a bony surface, and held in their places by connexion with ligaments: they are called menisci, from their shape.

*Fibro-cartilage*.—Is stronger and tougher than cartilage; it is

partly ligament and partly cartilage; found in the ear, at the symphysis pubis, and between the vertebræ.

*Ligaments* consist of *fibrous* tissue, of which there are two kinds, *white* and *yellow*; an example of the white is found in tendons, fasciæ, and most of the ligaments; the yellow is found in the ligamentum nuchæ, and in many vessels and ducts. It is elastic.

Ligaments are called *capsular* when they are bag-like, as at the shoulder and hip; *funicular*, when cord-like, and membranous when like a riband.

*Synovial membranes* are thin, transparent, closed serous sacs, lining capsular ligaments, and secreting an albuminous fluid called *synovia*, which resembles in appearance the white of an egg. It lubricates the joints, and prevents attrition. Masses of fat outside of the synovial membranes are usually called *glands of Havers*. They do not secrete, however, but serve a mechanical purpose in the mechanism, filling up spaces which would otherwise be formed in many articulations during the performance of certain movements. The synovial fringes are nothing but folds of this membrane including small portions of fat.

The principal kind of articulations are termed:

**SYNARTHROSIS**, implying immobility; and including

*Sutura*.—Bones of the skull.

*Harmonia*.—Superior maxillary bones.

*Schindylesis*.—Vomer with processus azygos.

*Gomphosis*.—Teeth with alveoli.

**AMPHIARTHROSIS** implies partial motion, and is exemplified in the symphyses and bodies of vertebræ.

**DIARTHROSIS** is a movable articulation, and includes—

*Arthrodia*.—Tarsal and carpal bones.

*Ginglymus*.—Elbow—wrist—hinge-like.

*Enarthrodia*.—Hip, shoulder, ball and socket.

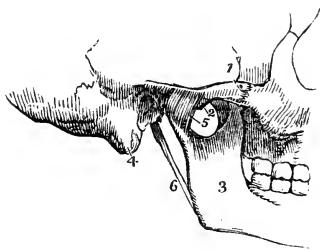
#### ARTICULATION OF LOWER JAW.

*Capsular Ligament*.—Extends from the border of the glenoid cavity of the temporal bone, and surrounds the neck of the condyloid process of the lower jaw.

Fig. 30.

*External Lateral Ligament*.<sup>b</sup>  
—Is broad and triangular, covering the outside of the joint, extending from the tubercle at the root of the zygoma to the outside of the neck of the condyle—(Fig. 30).

*Internal Lateral Ligament*.—Properly speaking, not a ligament but a fibrous band or sheath



for the protection of vessels or nerves from the contraction of the pterygoid muscles, between which it passes from the spinous process of the sphenoid to the spine at the margin of the posterior mental foramen.<sup>4</sup> (Fig. 31.)

*Stylo Maxillary*,<sup>6</sup> (Fig. 31), is an extremely thin fibrous band extending from the styloid process of the temporal bone to the angle of the lower jaw.

Fig. 31.

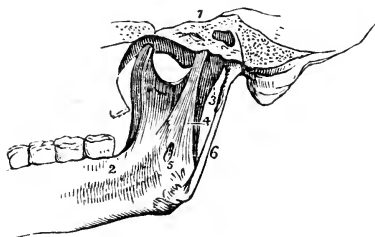
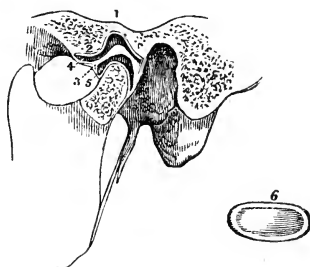


Fig. 32.



*Internal Articular Cartilage*<sup>3</sup> is a thin oval plate, dividing the joint into two cavities. It is partly concave above and below, thick at the edges. (Fig. 32.)

*The Two Synovial Membranes*.<sup>4 5</sup> (Fig. 32.) One is reflected between the glenoid cavity and the interarticular cartilage; the other between the cartilage and the condyle of the jaw. When the cartilage is perforate, the two cavities are lined by one synovial membrane.

## LIGAMENTS OF THE VERTEBRÆ.

### BODIES.

*Intervertebral Substance*.—The bodies of the vertebræ are united by fibro-cartilaginous disks, which are twenty-three in number, consisting of concentric rings; toward the centre there is a yellow jelly-like mass, in a state of compression; it is whiter and more abundant in infancy. On this account persons are stiffer in old age, and are shorter in the evening than they are in the morning.

*Anterior Vertebral Ligament*<sup>1</sup> is in front of the bodies of the vertebræ (Fig. 35<sup>1</sup>); extending from the second vertebræ of the neck to the first of the sacrum; it is thin and gradually increases in breadth.

*Posterior Vertebral Ligament*.—It lies upon the posterior surface of the bodies of the vertebræ, and extends from the occiput to the os-coccygis; it is narrow and thick in the thorax, adheres closely to the intervertebral substance, and its edges present a serrated appearance.

*PROCESSES*.—*Oblique*.—These are surrounded by capsular ligament, lined by a synovial membrane.



*Spinous*.—The spaces between the processes are filled by the *inter-spinal ligaments*. In the back they are triangular, in the loins quadrangular, and in the neck deficient or wanting. The free edge of the ligament is thick and cord-like.<sup>1</sup>

*Ligamentum Nuchæ*.—Continuation of the last, reaching from the seventh cervical vertebra to the vertical ridge on the occiput.

*Yellow Ligaments* are between the bony bridges of the vertebræ—twenty-three pairs; the first is between the second and third vertebræ. They are remarkable for their elasticity and colour.

#### ATLAS AND OCCIPUT.

*Anterior Ligament* is a strong, broad ligament, extending from the superior edge of the anterior arch of the atlas to the basilar process of the occiput. The middle portion connected with the tubercle of the atlas is thick.

*Posterior Ligament*, is thin, broad and loose, extending from the posterior arch of the atlas to the corresponding edge of the foramen magnum occipitis. It is perforated by the vertebral artery.

*Capsular Ligament* surrounds the superior oblique process of the atlas and the condyloid process of the occiput. Thicker and stronger in front.

#### ATLAS AND DENTATA.

*Transverse Ligament* stretches across the atlas from one tubercle to the other, dividing it into two rings,<sup>2</sup> (Fig. 33), and has an appendix above,<sup>3</sup> connecting it with the occiput, and one below,<sup>4</sup> connecting it with the dentata.

*Moderator Ligaments* are short and thick; extending from the sides of the apex of the processus dentatus<sup>5</sup> to a fossa on the inner side of each condyle. They limit rotation of the head.

*Middle or Straight Ligament*, reaches from the tip of the apex of the processus dentatus to the anterior edge of the foramen magnum.

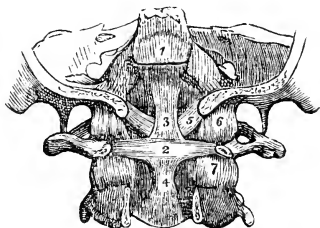
*Capsular Ligament* of the oblique process of the atlas and dentata is very loose.

*Lacerti Ligamentosi* are ligamentous bands extending from the occiput to the posterior part of the body of the dentata.

#### LIGAMENTS OF THE PELVIS.

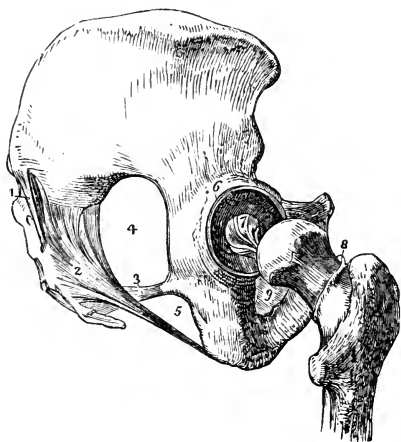
*Sacro-Iliac Symphysis*.—The articular surfaces are covered by cartilage and united by short, thick, strong fibres, which are with dif-

Fig. 33.



faculty divided. A yellow fluid is sometimes interposed, and in children and pregnant women a synovial membrane.

Fig. 34.



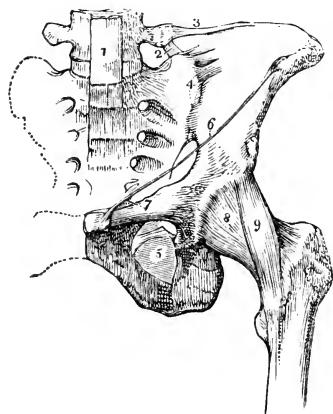
*Anterior Sacro-Iliac Ligament*; short ligamentous fibres passing from bone to bone in front of the joint.

*Posterior Sacro-Spinous Ligament*; numerous strong fibres, passing from the superior and inferior spinous processes to the transverse processes of the third and fourth sacral vertebræ.

*Greater Sacro-Sciatic Ligament*, extends from the posterior inferior spinous process of the ilium, margin of the sacrum and of the first bone of the coccyx, to the inner margin of the tuberosity and ramus of the ischium.

*Lesser Sacro-Sciatic Ligament*; in front of last; arises from the side of the sacrum<sup>3</sup> (Fig. 34), and coccyx; inserted into the spine of the ischium.

Fig. 35.



These two ligaments form the posterior and lateral boundaries of the pelvis, converting the sacro-sciatic notch, into two foramina,<sup>4 5</sup> (Fig. 34).

*Ilio-Lumbar Ligament*, passes from the transverse process of the last lumbar vertebra to the posterior part of the crest of the ilium.<sup>3</sup> (Fig. 35).

*Lumbo-Sacral Ligament*, arises from the transverse process of last lumbar vertebra, and is inserted into the upper part of the sacrum.<sup>2</sup> (Fig. 35).

*Anterior Coccygeal Ligament*.—Its fibres are indistinct, often wanting—runs in front of the whole length of coccyx from the last bone of the sacrum.

*Posterior Coccygeal Ligament*, arises from the inferior margin of the sacral canal, and terminating at the second bone of the coccyx.

*Obturator Ligament*<sup>5</sup> (Fig. 35).—Fills up the thyroid foramen; is membranous and thin, perforated at its upper part for the transmission of the obturator vessels.

*Sub-Pubic Ligament*.—A thick, triangular ligament, rounding the apex of the circle of the pubis; reaching from one bone to the other.

*Symphysis Pubis*.—The bones are connected by fibro-cartilage, resembling intervertebral substance; sometimes there is a synovial membrane. A few transverse fibres in front and behind are sometimes called anterior and posterior ligaments.

## THORAX.

### VERTEBRÆ WITH THE RIBS.

*Anterior or Radiated Ligament*.—Short fibres radiating from the head of the rib, to the two contiguous vertebræ and the substance between them.

*Capsular Ligament*.—Surrounds the head of the rib; thickest above and below.

*Inter-articular Ligament*.—A thin band passing from the ridge on the head of a rib to the intervertebral substance, dividing the cavity into two parts, each of which has a distinct synovial membrane. The first, eleventh and twelfth are exceptions to this rule.

The tubercle of the rib is connected to the transverse processes by a *capsular* ligament, and also the *internal costo-transverse ligament*<sup>3</sup> passes from the inferior edge of the transverse process, and is inserted in the sharp edge of the neck of the rib below.

*External costo-transverse Ligament*.<sup>4</sup>

—Is quadrangular, extending between the transverse process and the contiguous rib.

*Middle costo-transverse Ligament*.—A collection of short irregular fibres mixed with reddish adipose tissue, passing directly from the transverse process to the rib.

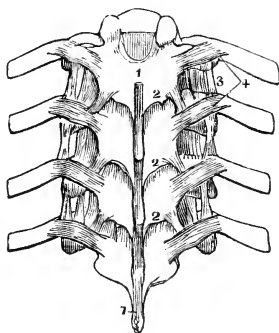
### RIB WITH STERNUM.

Anterior extremity of ribs.

*Anterior radiated Ligament*<sup>5</sup> (fig. 37).—Consists of a number of fibres, reaching from the cartilage of the true ribs to the sternum, and blending itself with the periosteum.

*Posterior radiated Ligament*.—Not so distinct as the last, passing in the same direction.

Fig. 36.



*Costo-xiphoid Ligament.*—Reaches from the cartilages of the sixth and seventh ribs, to the ensiform cartilage.

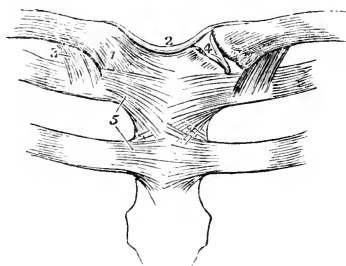
A synovial membrane and ligamentous fibres are found between the sixth and seventh, and eighth and ninth, sometimes.

## UPPER EXTREMITY.

### SHOULDER.

The clavicle and sternum have interposed a wedge-shaped *inter-articular cartilage*, dividing the joint into cavities, and the whole is surrounded by a strong *capsular ligament*<sup>1</sup> (Fig. 37), which is fibrous and thick, looser before than it is behind.

Fig. 37.



*Inter-clavicular Ligament.*<sup>2</sup>—A ligamentous cord stretching from the end of one clavicle to the other.

*Rhomboid Ligament.*<sup>3</sup>—A strong, thick ligament, proceeding from the upper surface of the cartilage of the first rib obliquely upwards and outwards to the inferior and sternal end of the clavicle.

### CLAVICLE AND SCAPULA.

*Capsular Ligament.*<sup>1</sup>—Surrounds the acromion process of the scapula, and the external extremity of the clavicle. The fibres upon the upper and lower surface are very distinct.

*Coraco-clavicular Ligament*<sup>2</sup> (Fig. 38).—Consists of two parts, one of which is called *conoid*; it is triangular, vertical, commencing at the root of the coracoid process, and expanding as it ascends, is fastened to the tubercle at the inferior extremity of the clavicle; the other is called *trapezoid*; it is in front of the last, arises at the internal edge of the coracoid process, and proceeds obliquely upwards to a ridge on the lower surface of the external end of the clavicle.

*Bifid Ligament.*—Is an aponeurotic expansion, commencing at the coracoid process, terminating upon the inferior surface of the clavicle, and also upon the cartilage of the first rib. It protects the inferior portion of the subclavius muscle.

*Coraco-acromial Ligament*<sup>3</sup> (Fig. 38).—Is thick and triangular; the base commences upon the outer edge of the coracoid process, and the apex is fastened to the acromion; it prevents a dislocation of the humerus upwards.

*Coracoid Ligament*<sup>4</sup> (Fig. 38).—Is a small transverse fasciculus,

stretched across the coracoid notch, and converting it into a foramen for the supra-scapular artery and nerve.

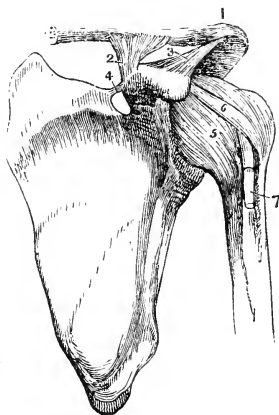
#### HUMERUS AND SCAPULA.

*Capsular Ligament*<sup>5</sup> (Fig. 36).—Surrounds the glenoid cavity and the neck of the humerus; it is loose and perforated by the tendon of the long head of the biceps.<sup>7</sup> It is deficient behind; this deficiency is supplied by the tendons of the surrounding muscles, particularly the sub-scapularis.

*Coraco-humeral Ligament*.<sup>6</sup>—Is sometimes called *adscitium*; is a thick fasciculus of the capsular ligament, proceeding from the coracoid process, which holds the head of the bone on a level with the glenoid cavity.

*Glenoid Ligament*.—A prismatic ring of fibro-cartilage, attached to the edge of the glenoid cavity, and increasing its depth. The synovial membrane is very extensive, and communicates with the bursæ of tendons.

Fig. 38.



#### ELBOW JOINT.

*Capsular Ligament*.—It surrounds the extremities of the humerus, radius, and ulna. It is strengthened by the

*Internal lateral Ligament*<sup>2</sup> (Fig. 39), which, commencing at the internal condyle, has two insertions, one into the coronoid, and the other into the olecranon process of the ulna.

*External lateral Ligament*<sup>4</sup> (Fig. 40).—Is triangular, commencing at the external condyle, and terminating in the annular ligament.

*Coronary or annular Ligament*<sup>5</sup> (Fig. 41).—Is strong and dense, surrounding three-fourths of the head of the radius; its extremities are fastened on either side of the lesser sigmoid cavity.

*Interosseous Ligament*<sup>5</sup> (Fig. 39).—Is a ligamentous membrane, filling up the space between the radius and ulna throughout their length. It is perforated at its upper part, for the transmission of the posterior interosseal artery; this deficiency is compensated for by the *ligamentum teres*<sup>4</sup> (Fig. 39), whose fibres are oblique and

in an opposite direction to those of the interosseous ligament. It commences at the coronoid process, and terminates below the tubercle of the radius.

Fig. 39.



Fig. 40.



Fig. 41.



*Sacciform Ligament.*—Is a loose capsular ligament, proceeding from the lower extremity of the ulna with the lesser sigmoid cavity of the radius. This is strengthened by the anterior radio-ulnar ligament<sup>2</sup> (Fig. 42), which passes obliquely between the two bones, and the *posterior radio-ulnar ligament*.

#### WRIST JOINT.

This joint is formed by the greater sigmoid cavity of the radius, and the scaphoid, semilunar, and cuneiform bones; and is surrounded by the capsular ligament, which is strengthened by an *anterior ligament*<sup>3</sup> (Fig. 42), a broad membranous layer; an *internal lateral ligament*,<sup>5</sup> reaching from the styloid process of the ulna to the cuneiform and pisiform bone; an *external lateral ligament*,<sup>4</sup> reaching from the styloid process of the radius to the scaphoid bone; and a *posterior ligament*, which is thin and loose, passing between the posterior surface of the radius, semilunar, and cuneiform bones.

Fig. 42.

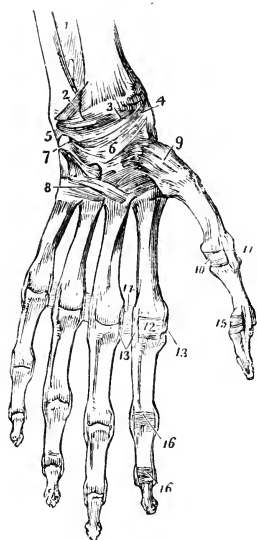
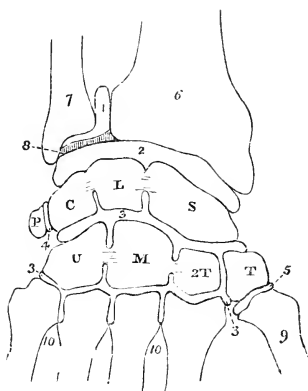


Fig. 43.



The *carpal* bones are held together by *dorsal* and *palmar* ligaments. The *pisiform* bone has a distinct *capsular ligament*. The arrangement of the synovial membrane is represented by fig. 43.

The bases of the *metacarpal* bones are secured to the second row of the carpal bones by fibrous bands called *dorsal* and *palmar* ligaments. That of the thumb has a true *capsular ligament*.

#### FINGER JOINTS.

The joint between the metacarpal bones and the first row of phalanges, is a ball-and-socket joint. It is secured by an internal and external lateral ligament<sup>13</sup> (Fig. 40), which are very thick in proportion to the size of the bone; *anterior or palmar ligament*,<sup>12</sup> the extensor tendon taking the place of a *posterior ligament*. The heads of the metacarpal bones are also connected by transverse ligaments.<sup>14</sup>

The second and third joints of the finger<sup>16</sup> are arranged upon the same principle as the first, with the exception of the transverse ligament.

#### LOWER EXTREMITY.

##### HIP JOINT.

*Capsular Ligament*<sup>8</sup> (Fig. 35).—Is the largest and strongest capsule in the body, surrounding the acetabulum and the neck of the

femur. It is thicker and longer in front than it is behind, and is strengthened by a bundle of fibres,<sup>9</sup> called ilio-femoral.

*Cotyloid Ligament*<sup>6</sup> (Fig. 34).—Is a thick prismatic ring of fibro-cartilage, surrounding and deepening the acetabulum.

*Ligamentum teres*<sup>7</sup> (Fig. 34).—Is attached to a pit upon the head of the femur, and divides into two fasciculi, which are inserted into the corners of the notch of the acetabulum and the cotyloid ligament. The synovial membrane is extensive, and the Haversian mass is large.

#### KNEE JOINT.

This joint is surrounded by an expansion of the fascia lata of the thigh, called the *involutum generale*.

*Anterior Ligament*.—Is the ligament of the patella<sup>3</sup> (Fig. 44); it is the strongest ligament of the body. It is a continuation of the tendon of the quadriceps muscle,<sup>1</sup> in which the patella<sup>2</sup> is developed, previous to its insertion into the tubercle of the tibia.

*Posterior Ligament*.—Is the ligament of Winslow<sup>1</sup> (Fig. 45). It is a broad ligament passing obliquely from the external condyle of the

femur to the posterior part of the internal tuberosity of the tibia. Its strongest fasciculi are derived from the semi-membranosus tendon.<sup>2</sup>

*Internal Lateral Ligament*.—Is broad, thin, and membranous, extending from the external condyle of the femur to the lower part of the internal tuberosity of the tibia.<sup>5</sup>

*External lateral Ligament*.—Is a strong cord-like ligament<sup>6</sup> reaching from the external condyle

to the superior extremity of the fibula.

*Semilunar Cartilages*.—Are two prismatic rings of fibro-cartilage, deepening the articular surfaces of the tibia. The external<sup>7</sup> (Fig. 46) is the smaller and more circular. The internal<sup>6</sup> is the larger and a semicircle. The extremities are attached to the spine of the tibia. A small transverse ligament<sup>4</sup> connects them behind.

*Crucial Ligaments*.—These cross each other. The *anterior*<sup>2</sup>

Fig. 44.

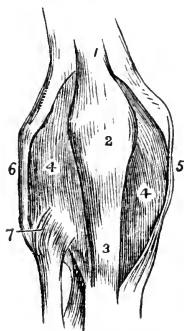
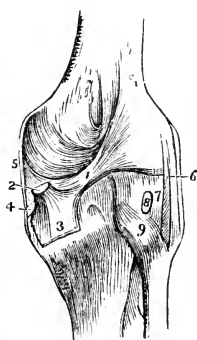


Fig. 45.





(Fig. 46), arises from a roughness in front of the spine of the tibia, and is inserted into the posterior part of the internal face of the external condyle. The *posterior*,<sup>3</sup> commences at a roughness behind the spine of the tibia, and is inserted at the anterior part of the external face of the internal condyle of the femur.

The synovial membrane is the most extensive in the skeleton; it forms folds in the interior of the joint, one of which is called the *ligamentum mucosum*, which is triangular in shape, passing from the condyloid notch to a mass of fat in front of the tibia. The *alar ligaments* are fringed folds of the synovial membrane, containing masses of fat on each side of the patella.

The tibia and fibula are connected above by the

*Anterior Superior Ligament*<sup>7</sup> (Fig. 44).—A short, strong ligament, extending obliquely between the heads of the two bones in front.

*Posterior Superior Ligament*<sup>9</sup> (Fig. 45).—Passes obliquely between the heads of the two bones behind. The synovial membrane of this articulation is generally distinct from that of the knee-joint.

*Interosseous Ligament*<sup>11</sup> (Fig. 46).—Is stretched between the tibia and fibula throughout their entire length, and opening at its upper part, transmits the anterior tibial artery.

*Anterior Inferior Ligament* (Fig. 48).—Is a broad band passing obliquely between the two bones in front, and at their lower extremity.

*Posterior Inferior Ligament*.—Is somewhat similar, passing obliquely between the lower extremities of the two bones. Besides these, the tibia and fibula are united by short strong fibres, passing from the contiguous surface of the two bones.

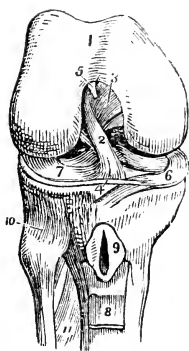
#### ANKLE JOINT.

It is the most perfect hinge in the body.

*Internal Lateral or Deltoid Ligament*<sup>6</sup> (Fig. 47).—Is triangular; its apex is attached to the internal malleolus, and its base to the os calcis, astragalus and calcaneo-scaploid ligament. The tibialis posticus runs in a trochlea upon it.

*External Lateral Ligament*<sup>6 7 8</sup> (Fig. 48).—Consists of three parts, which arise from the external malleolus; the *anterior* passes forwards, and is inserted into the astragalus; the *middle* descends, and is inserted into the os calcis; the *posterior* passes backwards, and is fastened to the astragalus. The synovial membrane is large

Fig. 46.



and loose, and is reflected upon some condensed cellular tissue in front, which is sometimes called the anterior ligament.

Fig. 47.

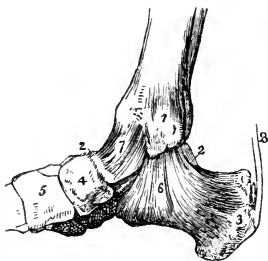
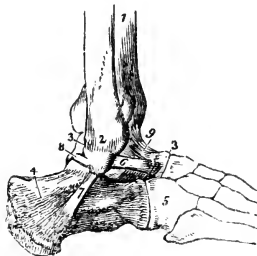


Fig. 48.



### ARTICULATIONS OF THE FOOT.

The *astragalus* and *os calcis* are united by a strong, thick, interosseous ligament, passing from the groove on the upper surface of the *os calcis* to the corresponding one of the *astragalus*.—*Posteriorly* there is a short ligament, called the *posterior* ligament, upon which plays the tendon of the *flexor longus pollicis* muscle.

The *os calcis* and *scaphoid* are united by the *superior calcaneo-scaphoid* ligament, which passes from the inside of the greater apophysis of the *os calcis* to the outside of the *scaphoid* and the *inferior calcaneo-scaphoid*, which occupies the triangular interval between the lesser apophysis of the *os calcis* and the tubercle of the *scaphoid*. Upon this rests a portion of the head of the *astragalus*.

The *os calcis* and *cuboid* are united by the *superior calcaneo-cuboid* ligament, which is a very thin flat band of fibres extending directly forwards from the *os calcis* to the *cuboid* and the *inferior calcaneo-cuboid*, which consists of two planes of fibres, of which the superficial or inferior layer is a strong band of pearly-white fibres, extending from all the under surface of the *os calcis* to the groove of the *cuboid*. The deeper-seated or superior layer, extends from the anterior tuberosity of the *os calcis* obliquely to the ridge of the *cuboid*.

The *astragalus* and *scaphoid* are united by a thin semicircular ligament, consisting of parallel fibres, extending from the neck of the *astragalus* to the margin of the concavity of the *scaphoid*.

*Cuneiform Bones*.—They are united to each other and the *scaphoid*, by dorsal, plantar, and interosseal ligaments.

*The Bases of the Metatarsal Bones*.—That of the first is united by a strong capsular ligament with the internal cuneiform bone, having a distinct synovial membrane. Those of the second and third are united with the middle and external cuneiform bone, by dorsal and

plantar ligaments ; those of the fourth and fifth by dorsal and plantar ligaments with the cuboid.

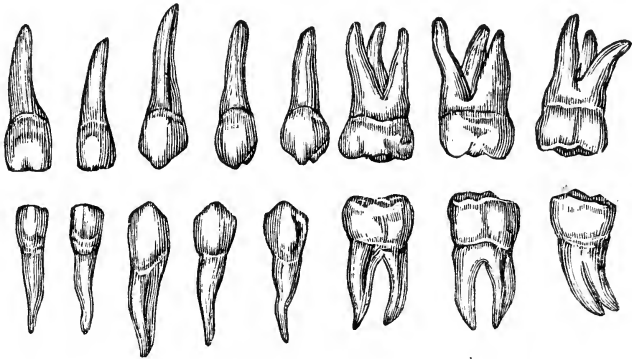
The heads of the metatarsal bones are united to each other by a strong transverse ligament : and to the phalanges by two lateral, the plantar, and an expansion of the extensor tendon.

The phalanges.—Their ligaments are arranged similarly to those of the hand.

### TEETH.

The teeth are placed in the alveolar processes of the upper and lower jaw, and are the hardest portion of the human body. The permanent teeth are thirty-two in number, sixteen in each jaw ; they are divisible into four classes. On each side of each jaw there are two *incisors*, one *cuspid*, two *bi-cuspid* and three *molars* ; each tooth consists of a body or crown, which is the part exposed above the gum ; the neck, a narrow portion surrounded by the gum ; and a root or fang which is contained within the alveolus. The roots are surrounded by a periosteum, and perforated at their extremities by a foramen for the transmission of an artery and nerve.

Fig. 49.



*Incisors*.—Are next to the median line ; their edge is bevelled, and in early life serrated ; the root is single and conoidal ; those of the upper jaw are larger than those of the lower jaw.

*Cuspid*, or *Canine*.—Is next to incisors. Its body is conoidal, and it has the longest root. Those of the upper jaw are sometimes called eye-teeth, those of the lower jaw stomach-teeth.

*Bi-cuspid*.—Are next in size to the molars. The body has two grinding points, of which the external is the larger. The root is sometimes bifid and grooved upon either side. The anterior is the smaller.

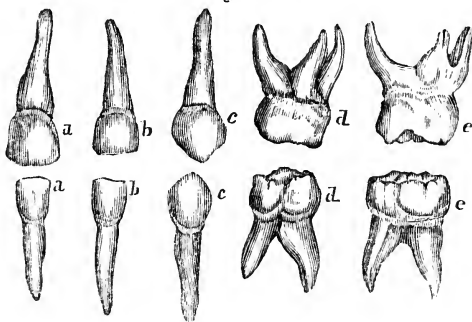
*Molars*.—They have large quadrilateral bodies, with four or five

grinding points. In the upper jaw they have three divergent roots, two of which are external, and one is internal. In the lower jaw they have but two roots, which are anterior and posterior. The third molar or wisdom-tooth is smaller, and less perfectly developed than the other two, and does not appear until manhood.

*Structure.*—Each tooth has three textures, the *ivory* or bony portion, the *enamel*, and the *cementum*. The *ivory* forms the largest portion of the body, neck, and root; it consists of radiating fibres, the particles of which are not absorbed as in bone. It contains no vessels or nerves, and consists of phosphate of lime, gelatin, and water. The *enamel* is the hardest portion; it encrusts the body; it is white, brittle, and semi-transparent, thicker upon the grinding surface, and terminates by a thin edge at the neck. Its structure consists of radiating fibres, and it possesses neither vessels nor nerves. The *cementum* forms a thin coating over the root of the tooth, from the apex to the enamel. It resembles bone in structure. It increases with the advance in age, making the teeth of old persons appear to project.

A *cavity* exists in the roots of the teeth, which is filled by a *pulp*, principally composed of an artery, vein, and nerve, which enter at the small orifice at the point.

Fig. 50.



An infant gum contains the rudiments of fifty-two teeth, in separate cavities; twenty of them appear between the sixth month and second year of age, and fall out between the sixth and twelfth year; they are therefore called the *deciduous* or milk teeth, of which there are *two incisors*, *one cuspid*, and *two molars* on either side of each jaw. The order of the eruption is irregular, but the average is as follows: seventh month, two middle incisors; ninth month, two lateral; twelfth month, first molar; eighteenth month, canine; twenty-fourth, two last molars. The teeth of the lower jaw precede those of the upper by a short interval.

## INTEGUMENTS, ETC.

## CELLULAR TISSUE.

The cellular or areolar tissue is that substance found so universally distributed throughout the body. It serves for the purpose of connecting muscles and organs, and forming a protection, being particularly abundant beneath the skin. When parts are torn in a subject it is very distinct, and its characters can then be best observed. It will be found to be white in colour usually, and to consist of a number of cells which freely communicate, as is manifested in anasarca, emphysema, and ecchymosis. It is elastic and tough when fresh, when dried it is opaque and crisp; long boiling converts most of it into gelatine. Its *toughness* is due to one set of fibres, which are white, inelastic, and straight; of such most ligaments are formed. Its *elasticity* is due to another set of fibres, which are yellow, elastic, and curling; of such the ligamentum nuchæ and middle coat of arteries are composed.

It is very vascular, though most of its vessels do not contain red blood in health, as may be seen in inflammation produced by the air or any other stimulus. Its moisture is due to serum.

## FAT.

Fat is found in almost every part of the body, with the exception of the penis, ear, eyelid, and ball, interior of cranium, &c. &c., but in great abundance under the skin around the serous membranes. It is of a yellowish colour, and in life is in a semi-fluid condition. It consists of three elements, stearine, margarine, and elaine, which are contained in vesicles aggregated in lobules. In women fat is more abundant; and in infants it is upon the surface of the body, rather than in the cavities.

It is of use in diminishing pressure upon the hands and feet; retains heat, being a bad conductor, and assists in nutrition, as is manifested in hibernating animals.

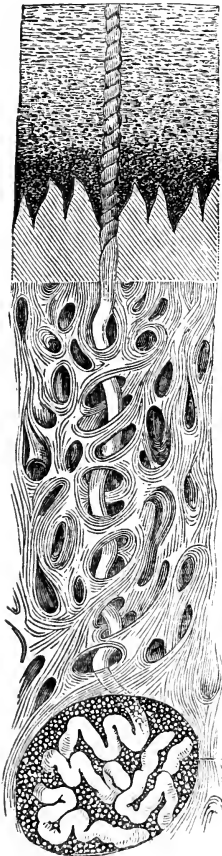
## SKIN.

The skin is an external covering and protection, as well as an organ of touch and excretion. Its colour and thickness vary in different persons and in different parts of the same person. At the orifices of cavities it is converted into mucous membranes. The largest *wrinkles* are produced by the contractions of muscles, and by the flexion of joints; others of an angular variety, owing to the contractile character of the skin, are seen upon the back of the hand; the third variety is spiral.

The skin is perforated by hairs, perspiratory ducts, pits containing sebaceous glands and follicles; these are considered as *appendages*.

The skin consists of two layers, the true skin, also called *cutis vera* or *chorion*, and the *cuticle* or *epidermis*. The *cutis vera*<sup>c</sup> is the thicker and deeper of the two: is white, and semi-transparent in all persons; its internal or inferior surface is much blended with the subjacent cellular tissue, and contains a number of pits or depressions; the external surface has a number of conical projections called *papillæ tactus*,<sup>b</sup> which are particularly numerous in those parts where there is much motion. On the hands and feet they are arranged in spiral and semicircular rows, which occasion a similar wrinkle of the cuticle.

Fig. 51.



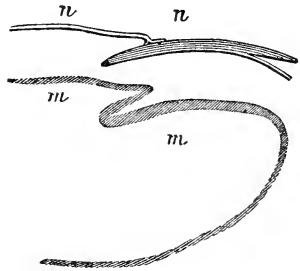
They consist of an artery, vein and nerve; the sensibility of a part is in ratio to their number. The skin itself is formed of condensed cellular tissue, the yellow fibrous element predominating where great elasticity is required, as in the armpit; the white element, where resistance is demanded, as in the sole of the foot. Between the interstices of these fibres, pass innumerable vessels, ducts, &c., &c. It is thickened by pressure; boiling reduces it to gelatine; and tannin converts it into leather.

The *cuticle or epidermis*<sup>a</sup> affords protection to parts most exposed to pressure or friction; its thickness varies with the amount of pressure to which it is subjected; compare the hand of an artisan with that of a delicate female. It is not permeated by vessels or nerves, but consists of particles arranged in different laminæ; those that are deepest are granular, those of the next layer are more compressed, whilst those upon the surface are mere scales. These superficial scales, which are horny, are constantly being shed, and new particles constantly supplied by the moist granules, which are below. The laminated condition makes it easy to divide into different layers, and the inferior layer was formerly called by a distinct name, *rete mucosum*; but it is nothing more than the deepest or most recently formed part of the cuticle, which also contains the colouring matter, very abundant in moles, freckles, and the skin of negroes.

## NAILS.

The *nails* are modifications of the epidermis. Their appearance is too familiar to every one to demand description. That portion which is concealed is called the *root*, that which is free or projecting the *edge*, that attached to the surface of the cutis is the *body*. The *matrix* is that portion of the cutis under the root and body, which produces the nail. The *lunula* is that crescentic, white portion of the matrix near the root, and is owing to a want of vascularity. The nail firmly adheres to the matrix, and is moulded upon it like the epidermis in other situations. The epidermis or cuticle is *continuous* with the nail, and neither passes over or under it; being essentially of the same structure. By maceration the epidermis and nail<sup>m</sup> can readily be removed from the *cutis vera*.<sup>m</sup> The border of the root of the nail is jagged, thin, and soft, and consists of newly-formed substance; the deep surface of the body is also soft, and marked by longitudinal grooves corresponding to the papillary ridges on the surface of the matrix; but the edge and superficial portion of the nail is composed of scales more dense and fibrous.

Fig. 52.



## HAIRS.

*Hairs* are found on all parts of the surface, except the palms of the hands, and soles of the feet; and vary in length, thickness, shape, and colour, according to situation, age, sex, or race. The *shaft* is that portion projecting beyond the surface; the *bulb* is that extremity contained in a follicle of the skin. The cuticular lining of this follicle is continuous with the bulb itself, there being a gradual change in the scales, as they pass from the follicle into the hair; the hair itself grows from the bottom of the follicle, like the nail from the matrix, or the epidermis from the cutis. If the hair is to be coloured, pigment grains are here also developed.

The *human* hair is a *rod*, and not as commonly supposed, a *tube*. The scales in the axis of the hair are softer, and not so closely condensed as those of the surface, and thus they contain a larger amount of pigment in the interstices, which produces that dark appearance which is mistaken for a tube; this loose, porous structure in the middle, is sometimes called the *medulla*, and the condensed, fibrous exterior is termed the *cortex*; the scales of which are imbricated, that is, overlap each other like the shingles of a roof.

Where the hairs are large, and especially where they serve as tactile organs, there may be a papilla furnished with nerves and vessels, in the bottom of the follicle, which projects into the bulb, as in the whiskers of a cat, and the quills of a porcupine; an approach to this papillary projection may be seen in some of the hairs of man, but their size is much overrated.

The hairs maintain a vital, though not a vascular connexion with the body; the moisture is partly due to the sebaceous glands, whose secretion passes through them by capillary attraction. Mental emotion has occasioned the hair to become white in a single night; some account for this by a secretion of fluid acid which percolates the tissue of the hair, and chemically destroys the colour. Ordinary gray hairs resemble other hair in every respect, save that of colour.

The disease called *Plica Polonica*, is a matting together of the hairs by a glutinous matter, probably from the cutaneous glands; the hairs so affected bleed if cut close to the skin, owing to a morbid elongation of the vascular papillæ at their roots.

#### SWEAT GLANDS.

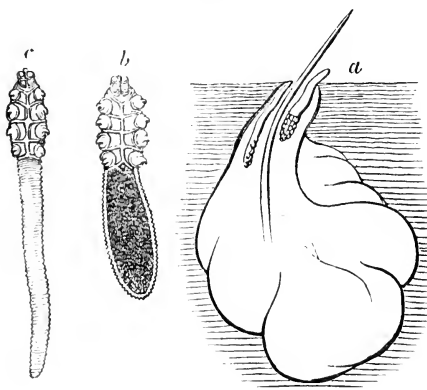
These are found in great number upon the inferior surface of the *cutis vera* generally. In the axilla they form a layer, an eighth of an inch thick, which is mammillated, and of a reddish colour. They are about the size of a pin's head, are soft, and often compressed and surrounded by a network of capillary blood-vessels. They are distinguishable from pellets of fat by their pink colour, and semi-transparent texture. When highly magnified, it is seen to consist of a solitary tube, intricately ravelled, one end of which is closed, and buried within the gland, and the other opens upon the skin. The duct at first meanders through the interstices of the cutis vera,

becomes straight between the papillæ, then assumes a spiral course in perforating the cuticle. (Fig. 51.) The secretion varies in odour in different portions of the body, and in different races.

#### SEBACEOUS GLANDS.

The *sebaceous glands* are found in most parts of the skin, except in the palms and soles; they are most abundant on the scalp and face, especially about the nose. The orifices open into hair follicles, or upon

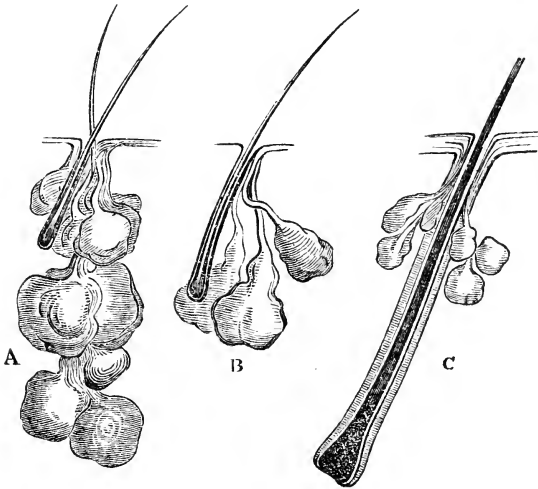
Fig. 53.





the general surface. They consist of a duct, terminating in a blind, pouch-like extremity, lined by an epithelium, in the particles of which are included granules of sebaceous matter. The secretion is subservient for the lubrication of the hair and the skin. There are gene-

Fig. 54.



rally found in their ducts, parasites, of which two specimens are given in *b* and *c*, fig. 53. These animals are found in almost every individual, especially in those possessing a torpid skin; and they multiply in sickness.

The ceruminous glands of the ear resemble the sebaceous glands.

### SECTION III.

#### MUSCLES.

Muscles are formed of that substance usually called *flesh*, which has a peculiar contractile power, producing motion; they consist, independently of the cellular tissue, vessels, and nerves, which enter into their formation, of a special tissue, resembling the middle coat of the arteries. Every muscle is composed of a number of bundles of fibres, each of which consists of filaments; each filament is divisible into fasciculi, and each fasciculus consists of a number of *primitive particles* or *sarcous elements*, held together by a tough, delicate, and elastic membrane called *sarcolemma*. The fibres of the voluntary muscles, as well as the fibres of the heart and some

of those of the œsophagus, are striped; that is, have their fibres arranged in parallel lines; while all other muscles, including those of the alimentary canal, the uterus and the bladder, all of which are involuntary, are unstriped, that is, the fibres cross each other and interlace, and always form the walls of a cavity. The red colour of muscles is not dependent upon the capillary vessels, but upon a peculiarity of colouring matter united with them. After death they become stiff, as the fibrin coagulates, which rigidity is the *rigor mortis*. They are well supplied with vessels and nerves, and can be made to contract by external irritation after death, such as galvanism, &c.,

Every muscle has a belly and two extremities; that which is fixed is called the *origin* or *head*, that which is movable, the *insertion*. Those which have neither origin nor insertion, and surround orifices, are called *sphincters*.

A *tendon* is formed of condensed white fibrous tissue, reaching from the end of a muscular fibre to some structure which it is intended to move.

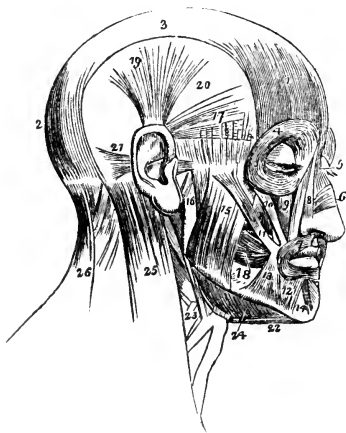
### MUSCLES OF THE HEAD AND NECK.

*Occipito frontalis*.<sup>1 2 3</sup>—Has four bellies.

*Origin*, from the superior semicircular ridges of the occiput.

*Insertion*, into the superior margin of the orbicularis oculi, and corrugator supercillii, and into the internal angular process of the os frontis and os nasi. *Use*; elevates the eyebrows making transverse wrinkles.

Fig. 55.



*Compressor Naris*.<sup>6</sup>—*Origin*, from the root of the ala nasi. *Insertion*, tendinously into its fellow on the dorsum of the nose, and into the lower part of the os nasi. *Use*; it either compresses or dilates the nostril.

*Orbicularis palpebrarum*.<sup>4</sup>—This is a sphincter surrounding the orbits of the eyelids. *Origin*, from the nasal process of the superior maxillary, the os unguis, the internal angular process of the os frontis,

and the internal palpebral ligament. *Insertion*, into the orbital and nasal processes of the superior maxillary, and into the palpebral ligament. *Use*; it closes the eyes.

*Corrugator supercillii*.—A narrow, small, and pointed muscle, beneath the occipito-frontalis. *Origin*: internal angular process of the os frontis.—*Insertion*, into the occipito frontalis and orbicularis. *Use*; makes vertical wrinkles of the forehead.

*Levator Labii superioris alaeque Nasi*.<sup>8</sup>—On the side of the nose. *Origin*, from the nasal and orbital processes of the superior maxillary bone. *Insertion*, into the upper lip and wing of the nose. *Use*; it elevates the wing and sides of the nose.

*Levator anguli Oris*.<sup>9</sup>—Small and concealed by the last. *Origin*, from the superior maxillary bone, below the *infra orbital foramen*. *Insertion*: corner of the mouth. *Use*; elevates the angle of the mouth.

*Zygomaticus minor*.<sup>10</sup>—*Origin*, from the malar bone. *Insertion*, into the upper lip. *Use*; raises the upper lip outwardly.

*Zygomaticus major*.<sup>11</sup>—*Origin*, from the malar bone, behind the last. *Insertion*, into the corner of the mouth. *Use*; draws the mouth obliquely upwards and outwards.

*Depressor Labii superioris alaeque Nasi*.—Very much concealed. *Origin*, from the alveolar processes of the incisor and canine teeth. *Insertion*, into the wing of the nose and upper lip. *Use*; depresses the upper lip and wing of the nose.

*Depressor anguli oris*.<sup>13</sup>—*Origin*, from the base of the lower jaw, outside of the chin. *Insertion*, into the corner of the mouth. *Use*; draws the mouth downwards.

*Depressor Labii Inferioris*.<sup>12</sup>—*Origin*, from the base of the lower jaw, beneath and in front of the last. *Insertion*, into the whole side of the lower lip. *Use*; draws the lip downwards.

*Levator Mentis*.<sup>14</sup>—Is much concealed, and best viewed from the inside of the lip. *Origin*, from the alveolar processes of the lateral incisor and canine teeth. *Insertion*, into the lower lip. *Use*; elevates the lip.

*Buccinator*.<sup>18</sup>—*Origin*, from the coronoid process of the lower jaw, from the tuber of the upper jaw, and alveolar processes of both jaws. *Insertion*, corner of the mouth and lips. *Use*; draws the mouth backwards, and presses the food between the teeth.

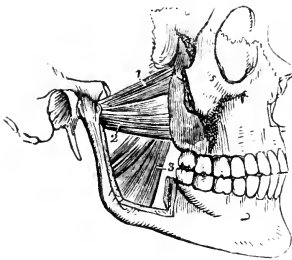
*Orbicularis oris*.<sup>7</sup>—Is a circular muscle surrounding the mouth, has neither bony origin nor insertion, but is much connected with other muscles of the mouth.

*Masseter*.<sup>15 16</sup>—*Origin*, from the superior maxillary and malar bones, and also from the zygoma of the temporal bone. *Insertion*, into the angle and external surface of the lower jaw. *Use*; draws the jaw upwards and backwards; is very strong, and consists of two planes of fibres.

*Temporalis*.—*Origin*, from the temporal fascia, and sides of the temporal, frontal, and parietal bones. *Insertion*, into the coronoid process of the lower jaw. *Use*; draws the jaw upwards.

*Pterygoideus externus*.<sup>1</sup>—*Origin*, from the pterygoid, spinous and temporal processes of the sphenoid, and from the tuber of the upper maxillary bone. *Insertion*, into the neck of the lower jaw. *Use*; draws the jaw forwards.

Fig. 56.



*Pterygoideus internus*.<sup>3</sup> — *Origin*, from the internal pterygoid process, pterygoid fossa of the sphenoid, and from the Eustachian tube. *Insertion*, into the internal surface of the angle of the jaw. *Use*; draws the jaw upwards and inwards.

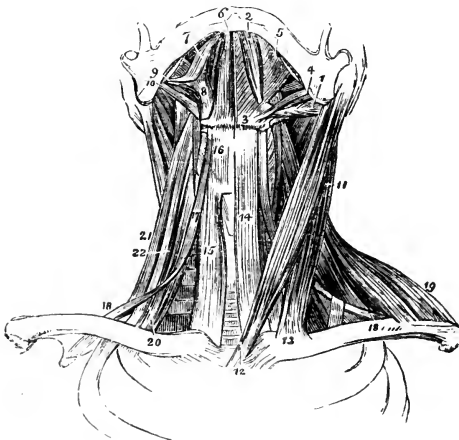
### MUSCLES OF THE NECK.

*Fasciæ*.—There are two fasciæ for the neck; the superficial and deep.

The *superficial fascia* is continuous with that which covers the whole body. It consists of two laminæ, between which are enclosed the platysma myoides muscle.

The *deep fascia* is formed of more condensed cellular tissue, and extends from the ligamentum nuchæ to the larynx in front, including between its laminæ the sterno-cleido-mastoid muscles, and vessels of the neck. A strong process of it exists between the styloid process of the temporal bone and the angle of the jaw, and is called the

Fig. 57.



stylo-maxillary ligament. Inferiorly, it forms a loop, which acts as a pulley to the omo-hyoid muscle, and thence is continued down behind the subclavius muscle into the ligamentum bicomne, forming a portion of the boundary of the thorax.

*Platysma myoides*, is included between two laminæ of the superficial fascia of the neck, is a broad, thin muscle, and not always well developed in man. *Origin*, from the condensed cellu-

lar tissue below the clavicle. *Insertion*, into the muscles upon the side of the face and lower jaw. *Use*; draws the skin of the neck and lower jaw downwards.

*Sterno-cleido-mastoideus*,<sup>11</sup> forms the most prominent feature on the outside of the neck. *Origin*, from the upper part of the sternum, and sternal end of the clavicle. *Insertion*, into the mastoid process of the temporal and into the superior semicircular ridge of the occipital bone. *Use*; acting with its fellow, draws the chin towards the breast.

*Sterno-hyoideus*.<sup>14</sup>—*Origin*, from the sternum, clavicle, and cartilage of the first rib. *Insertion*, into the inferior edge of the os hyoides. *Use*; draws the hyoid bone towards the sternum.

*Sterno-thyroideus*.<sup>15</sup>—*Origin*, from the sternum and cartilage of the first rib. *Insertion*, into the side of the thyroid cartilage. *Use*; draws the cartilage downwards.

*Thyreohyoideus*.<sup>16</sup>—*Origin*, from the side of the thyroid cartilage. *Insertion*, into the body and cornua of the os hyoides. *Use*; it approximates the hyoid bone and thyroid cartilage.

*Omo-hyoideus*.<sup>17 18</sup>—*Origin*, from the superior edge of the scapula, near the coracoid notch. *Insertion*, into the base of the hyoid bone. *Use*; draws the hyoid bone downwards. It is tendinous in its middle.

*Digastricus*.<sup>1 2</sup>—*Origin*, from the fossa, behind the mastoid process of the temporal bone. *Insertion*, into the base of the lower jaw, at the side of its symphysis; its middle is tendinous, and perforates the stylo-hyoid muscle near its insertion. *Use*; elevates the hyoid bone, and opens the mouth, even when the lower jaw is fixed.

*Stylo-hyoideus*.<sup>3 4</sup>—*Origin*, from the middle and inferior part of the styloid processes of the temporal bone. *Insertion*, being perforated: into the junction of the body and cornua of the hyoid bone. *Use*; draws the hyoid bone upwards and backwards.

*Stylo-glossus*.<sup>9</sup>—*Origin*, from the upper and internal part of the styloid process. *Insertion*, into the side of the root of the tongue. *Use*; draws the tongue backwards.

*Stylo-pharyngeus*.<sup>10</sup>—*Origin*, from the inner side of the styloid process near its root. *Insertion*, into the side of the pharynx, between the superior and middle constrictor muscles. *Use*; raises and widens the pharynx.

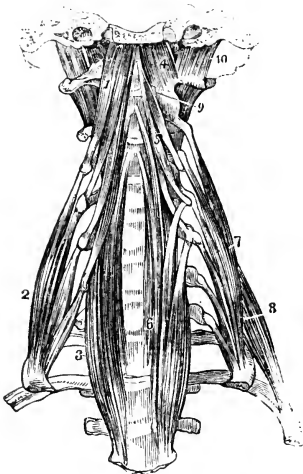
*Mylo-hyoideus*.<sup>5</sup> forms the floor of the mouth. *Origin*, from the mylo-hyoidean ridge of the inside of the lower jaw. *Insertion*, into a white tendinous line, between it and its fellow, and hyoid bone. *Use*; draws the hyoid bone upwards, and projects the tongue.

*Genio-hyoideus*.<sup>8</sup>—*Origin*, from the posterior tubercle, inside of the chin. *Insertion*, into the body of the hyoid bone. *Use*; draws it upwards and forwards.

*Longus colli*.<sup>3 5 6</sup>—*Origin*, from the bodies of the three superior

dorsal vertebræ, and the transverse processes of the five lower cervical.

Fig. 58.



*Insertion*, into the bodies of all the cervical vertebræ. *Use*; bends the neck forwards and to one side.

*Rectus capitis anticus major*.<sup>1</sup>—(See Fig. 58.) *Origin*, from the transverse processes of the third, fourth, and fifth cervical vertebræ. *Insertion*, into the basilar or cuneiform process of the occiput. *Use*; bends the head forwards.

*Rectus capitis anticus minor*.<sup>4</sup>—*Origin*, from the atlas near its transverse process. *Insertion*, into the basilar process of the occiput. *Use*; bends the head forwards.

*Rectus capitis lateralis*.<sup>10</sup>—*Origin*, from the transverse process of the atlas. *Insertion*, between the condyle and jugular eminence of the occipital bone. *Use*; draws the head to one side.

*Scalenus anticus*.<sup>2</sup>—*Origin*, from the transverse processes of the fourth, fifth, and sixth cervical vertebræ, tendinously. *Insertion*, into the upper surface of the first rib in front of the groove for the subclavian artery. *Use*; bends the neck forwards, or raises the first rib.

*Scalenus medius*.<sup>7</sup>—*Origin*, from the transverse processes of all the cervical vertebræ tendinously. *Insertion*, into the upper surface of the first rib, behind the groove for the artery. *Use*; same as last.

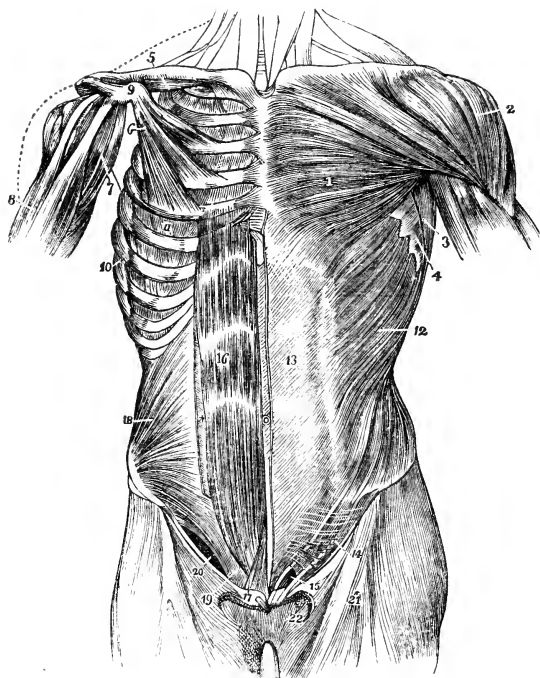
*Scalenus posticus*.<sup>8</sup>—*Origin*, from the transverse processes of the fifth and sixth cervical vertebræ. *Insertion*, into the upper face of the second rib beyond the tubercle. *Use*; bends the neck, and raises the second rib.

## MUSCLES OF THE CHEST.

*Pectoralis major*.—Forms the cushion of the chest. *Origin*, from the two upper bones of the sternum, the sternal two-thirds of the clavicle, the cartilages of the fifth and sixth ribs, and from the tendon of the external oblique muscle. *Insertion*, into the outer edge of the bicipital groove of the humerus. *Use*; draws the arm inwards and forwards.

*Pectoralis minor*.<sup>6</sup>—*Origin*, from the third, fourth, and fifth ribs. *Insertion*, into the inner face of the coracoid process of the scapula. *Use*; draws the scapula inwards and downwards.

Fig. 59.



*Subclavius*.<sup>5</sup>—*Or.* from the cartilage of the first rib. *In.* into the inferior face of the clavicle. *Use.* Draws the clavicle downwards.

*Serratus magnus, or anticus*.<sup>1 10</sup>—*Or.* from the nine upper ribs, five of its heads interdigitating with the external oblique muscle. *In.* into the whole length of the base of the scapula. *Use.* Draws the scapula forwards.

*Intercostales externi*.<sup>11</sup>—There are eleven on each side. *Or.* from the transverse process of the vertebra, and the inferior sharp edge of the rib. *In.* into the superior rounded edge of the rib below. The fibres pass obliquely downwards and forwards.

*Intercostales interni*.—Also eleven on each side. *Or.* from the inferior edge of the rib, and costal cartilages. *In.* into the superior rounded edge of the rib below, the fibres passing downwards and backwards. *Use.* To approximate the ribs.

*Triangularis sterni*.—Situated on the inner wall of the front of

the chest. *Or.* from the ensiform cartilage, and second bone of the sternum. *Ins.* into the third, fourth, fifth, and sixth ribs. *Use.* To depress the ribs.

### MUSCLES OF THE ABDOMEN.

Beneath the skin of the abdomen is the *fascia superficialis abdominis*, a layer of condensed cellular substance, varying in thickness in different individuals, and containing more or less fat. Its laminated character admits of its being dissected into several layers. In the groin it incloses the lymphatic glands, and is traversed at its lower part by the *arteria ad cutem abdominis*; it is thickened over the symphysis pubis, and constitutes the *mons veneris*.

*Obliquus externus.*<sup>12</sup>—*Origin* from the eight inferior ribs, the first head being covered by the pectoralis major; five superior heads interdigitate with those of the serratus anticus, and three inferior, with those of the latissimus dorsi. The fibres pass obliquely downwards and forwards. *Insertion*, into the whole length of the linea alba, tendinously; into the anterior half or two-thirds of the crest of the ilium, by muscular and tendinous fibres; and into the body and crest of the pubis, forming thereby Poupart's ligament. As the tendinous fibres approach the pubes, they split, forming a triangular opening called the external abdominal ring;<sup>13</sup> through which passes in the male the spermatic cord, and in the female the round ligament of the uterus; a portion of the tendon being inserted into the spinous process and body of the pubes; the external or posterior edge of this part constitutes the anterior or internal column of the ring. The other portion is inserted into the crest of the pubes; the internal edge of which constitutes the external or posterior column of the ring. The external edge of this portion of the tendon is called Gimbernat's ligament. This ring is prevented from splitting still further, by some transverse tendinous fibres.<sup>14</sup> (Fig. 59.)

*Use.*—It compresses the viscera of the abdomen, and approximates the pelvis and thorax.

*Obliquus internus.*<sup>15</sup>—*Origin*, from the three inferior spinous processes of the lumbar vertebræ, and from all those of the sacrum, the whole length of the crest of the ilium, and from the outer half of Poupart's ligament. *Insertion*, into the six inferior ribs, into the ensiform cartilage, into the whole length of the *linea alba*, and also tendinously into the pubes behind the external abdominal ring. At the *linea semilunaris*, the tendon splits into two laminæ, which thereby form a sheath for the rectus muscle; in the lower third or fourth of the muscle, both laminæ, however, pass in front, and include between them the pyramidalis.

*Transversalis abdominis.*—Is beneath the last. *Origin*, from the transverse processes of the last dorsal and four upper lumbar vertebræ, from the crest of the ilium, and from the external half of



Poupart's ligament ; it also arises from the cartilages of the six inferior ribs. *Insertion*, into the ensiform cartilage, linea alba, and pubes, in common with the internal oblique tendon behind the external abdominal ring.

*Rectus abdominis*.<sup>16</sup>—*Origin*, from the symphysis and body of the pubes, gradually increasing in breadth. *Insertion*, into the ensiform cartilage, and into the cartilages of the fifth, sixth and seventh ribs. This muscle has several tendinous intersections called *linea transversæ*, which are three or four in number.

*Pyramidalis*.<sup>17</sup>—Is in front of the lower part of the rectus, about three inches in length, not always present. *Origin*, from the body of the pubes. *Insertion*, into the linea alba.

*Cremaster*.—This muscle forms a muscular sheath for the cord and upper part of the testicle ; before the descent of the testicle, it constitutes the inferior edge of the internal oblique and transversalis muscles, which are much blended at this part ; hence its *origin* may be said to be the muscular portion of the lower edge of these muscles, and that its *insertion* is into the conjoined tendon of these muscles.

*Fascia transversalis*.—This fascia covers the abdomen, and lies under the muscles and in front of the peritoneum ; it is continuous with the *iliac fascia*, which surrounds the posterior part of the peritoneum, and the *pelvic fascia*, which surrounds that portion of peritoneum in the cavity of the pelvis. It is thin and tough, and near the groin possesses greater density.

This fascia is an object of study, particularly on account of the *internal abdominal ring* being situated in it. This point is usually much misunderstood, partly from the use of the term *ring*, which gives rise to the idea that it is a hole or opening like the external ring, and partly from the variety and confusion of terms employed in its description. It may be said to be that portion of the fascia transversalis where it ceases to cover the abdomen and commences to cover the cord ; here it is very thin, and an artificial or false dissection readily can form a ring or hole with a well-defined edge. But such does not exist in nature, for the fascia is continued from the abdomen upon the cord.

## INGUINAL HERNIA.

Inguinal hernia is of two kinds ; oblique or indirect, and direct or ventro-inguinal hernia. Oblique is by far the most common ; and in order to understand the anatomy of it, it will be necessary to bear in mind the arrangement of the parts previous to the descent of the testicle, the subsequent and natural condition, and also the state of things as altered by the affection.

*Oblique* inguinal hernia is a protrusion of intestine through a passage originally made by the escape of the testicle from the loins to the scrotum, and afterwards occupied by the spermatic cord. Until the seventh month of foetal life the testicle reposes in the lumbar region beneath the kidney, but not within the cavity of the peritoneum. As yet there is no spermatic cord formed, the constituents, to wit, the artery, vein, duct, &c., each approaching the testicle separately. About this period the testicle ordinarily descends, by means of a contractile structure attached to its inferior extremity, until it is enveloped in the scrotum. In its passage it must come in contact with the various structures forming the parietes of the abdomen, viz., the peritoneum, fascia transversalis, the transversalis, internal and external oblique muscles, the superficial fascia, and the skin. Now each of these structures, with the exception of the external oblique muscle, will be found to form a covering for the testicle and cord, because it does not perforate them, but pushes them before it; although this covering may be modified in some degree, nevertheless there is a representation of every layer of the walls of the abdomen; and this is the case not only in the covering of the testicle and cord, but also in the covering of a hernial protrusion; hence, if a student understands the changes which take place in the descent of the testicle, he must necessarily understand the mode by which a hernial protrusion obtains its coverings.

Here we must caution students from attaching too much importance to words or terms used in description, for they vary with different writers; but let him keep constantly before his mind the thing itself, as if he were making a dissection; for by actual dissection he can understand it thoroughly, although he may not know the name of a single point.

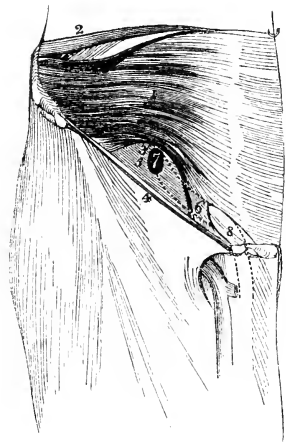
In the first place, by the contraction of the gubernaculum testis, the testicle is brought in contact with the peritoneum, and since it is not in the peritoneal cavity, it must necessarily push before it a doubled lamina of peritoneum. Thus the testicle gets a covering of serous membrane arranged as serous membranes always are; that is, one lamina covers the testicle, and the other lines the cavity in which it is contained, and it is called the *peritestis* or *tunica vaginalis testis*. The communication between the peritoneum and peritestis is obliterated, otherwise the bowel could readily pass down; and when this does occur, it constitutes a variety of hernia, termed *congenital*. As the testicle descends, the spermatic artery, vein, and vas deferens descend with it, and thus the cord is formed; the components are held together by means of cellular tissue, formerly the canal of peritoneum, connecting the peritoneum and peritestis. Organs that have been of use in the system are never entirely absorbed, but converted into another which serves a different purpose—as in the case of an artery when tied for aneurism, it becomes a cord; the umbilical vein becomes the ligamentum teres.

Now, the next structure with which the testicle comes in contact, is the fascia transversalis; let us follow this in its descent with the testicle, and observe the changes which it undergoes. It is not perforated as most pictures represent, but pushed before the testicle, covering it and the cord. The point where this protrusion takes place, is midway between the anterior superior spinous process of the ilium and the pubes, and about an inch and a half above Poupart's ligament, and is called the *internal abdominal ring*; but there is no hole or opening unless made with a scalpel. The fascia is continuous from the abdomen upon the cord, although that portion covering the abdomen is tougher and thicker than that of the cord. If the cord is stretched, this portion of the fascia will resemble a funnel, and hence some call it the *infundibuliform fascia*. That portion which covers the testicle, *assists* in forming its cellular coat, which is termed by some *tunica vaginalis communis testis*, by others, *fascia propria*. Terms are matters of minor importance; the truth to be taught is, that the testicle, cord, and abdomen are invested by the same fascia, having different names and different thicknesses in different parts.

The next layer of the abdominal wall with which the testicle comes in contact is the *transversalis muscle*. At the lower part of the abdomen, the internal oblique is so much blended with the transversalis, that the two may be considered as having the same relation to the testicle in its descent, and also to hernia. At the internal abdominal ring, the testicle, already covered by the peritoneum and fascia transversalis, comes in contact with these muscles; it does not perforate them, but pushes their conjoined lower edge before it, obtains for itself and cord a muscular covering, which is the *cremaster* muscle; and this accounts for that looped appearance which the fibres of this muscle have upon the testicle; also, for the muscle being thicker upon the anterior part of the cord. These muscular fibres are very pale, and very scattered upon the lower part of the testicle, and form an imperfect covering for the testicle. When the cremaster is cut away from the transversalis and internal oblique, their inferior edge presents an arched appearance.

The tendon of the external oblique is the next structure opposing its descent, and since this is very tough, it is not pushed before the

Fig. 60.



testicle; but the testicle passes obliquely downwards and inwards for an inch and a half, until it gets opposite the external abdominal ring, which is a hole, and at which, it emerges between its columns or pillars. The fact, that in health these two rings are not opposite, contributes much to the strength of the arrangement, and preventing the more frequent occurrence of hernia, which is much favoured by a deficiency in the fibrous character of the tendon of the external oblique.

The space between these two rings, is called the *inguinal, abdominal, or spermatic canal*. It is bounded anteriorly by the inferior edge of the internal oblique and transversalis muscles, the tendon of the external oblique, the superficial fascia, and skin; posteriorly by the transversalis fascia, and the conjoined tendon of the transversalis and internal oblique muscles; inferiorly, by Poupart's ligament.

When the hernia does not emerge from this canal, it is called a *concealed* inguinal hernia.

At the external abdominal ring, the testicle, with its covering, comes in contact with the superficial fascia, which has already been described as consisting of numerous laminæ, one of which can readily be shown to extend between the columns of the ring, and hence it is called the intercolumnar fascia by some, by others, the external spermatic, &c. This fascia, pushed before the testicle, assists in forming that covering already alluded to, the fascia propria, or *tunica vaginalis communis*. That portion of the fascia transversalis engaged in forming this cellular coat of the testicle, is actually blended with the superficial fascia of the testicle, on account of the intervening muscular structure, that of the cremaster being deficient in some parts, and very spare in others. Hence a confusion in authors and terms, some attributing this covering of the testicle to the transversalis fascia, and some to the superficial fascia, whereas in fact it is formed partly by both.

The skin is, of course, readily traced from the abdomen to the scrotum, although in the scrotum it is modified by the dartos, which, according to some, is an expansion of the gubernaculum testis.

We have seen the changes which take place in the descent of the testicle, and are now prepared to consider the escape of the intestine.

The convolution or knuckle of intestine first presses against the peritoneum, and being contained within the cavity, can only push before it a single lamina. This portion of the peritoneum always forms the *hernial sac*, which gradually increases in size and thickness. In this variety of hernia, (oblique inguinal), the protrusion takes place at the internal ring; the sac must then necessarily be covered by the transversalis fascia and cremaster muscle, and after passing down the inguinal canal, emerges at the external abdominal ring, where it receives an additional investment of superficial fascia and skin.

Hence, in the operation for hernia, the following layers are cut through :—

*Skin, superficial fascia, cremaster muscle, transversalis fascia, and the hernial sac.*

In the dissection of a hernial sac, we will find alterations in thickness and colour, the consideration of which properly belongs to the surgical part of this work.

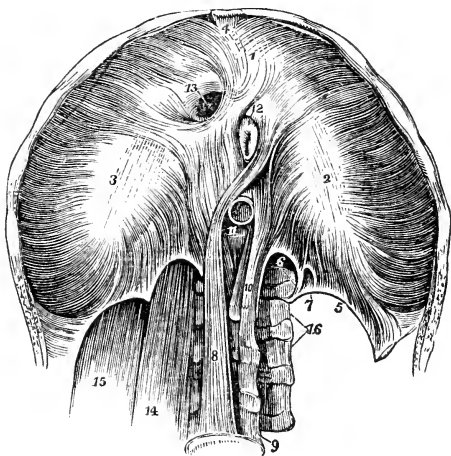
*Direct or ventro-inguinal hernia* consists of a protrusion directly at the external abdominal ring, and of course does not pass through the canal. The coverings are the *skin, superficial fascia*, the common *tendon* of the *internal oblique* and *transversalis* muscles, *transversalis fascia*, and *hernial sac*.

This variety is not of so frequent occurrence, on account of the insertion of the tendon of the internal oblique and transversalis into the pubes immediately behind the external abdominal ring, which protects this opening, and therefore it must be ruptured or expanded when a protrusion takes place at this ring; when it is ruptured, of course this covering of the sac does not exist.

*Diaphragm.*—This muscle forms the septum between the thorax and abdomen; it consists of two parts, a greater and lesser muscle. The *greater*<sup>1 2 3</sup> muscle arises from the ensiform cartilage, and from six inferior ribs; the fibres converge to the cordiform tendon, which is in the centre. The *lesser*<sup>8 10</sup> muscle consists of two bellies, which are called *crura*, the right of which is the larger. *Origin*, from the second, third, and fourth lumbar vertebræ. *Insertion*, into the cordiform tendon.

There are three openings in the diaphragm; one in the tendinous centre,<sup>13</sup> called *foramen quadratum*, which transmits the ascending *vena cava*; another, an elliptical muscular opening,<sup>12</sup> called *foramen œsophageum*, through which passes the œsophagus and the par vagum nerves; and the third, the *hiatus aorticus*,<sup>11</sup> which is between the crura, and in front of the vertebra; through it passes the aorta, the

Fig. 61.



thoracic duct, the azygous vein, and the great splanchnic nerve. *Use*; widens the thoracic, and diminishes the abdominal cavity.

*Quadratus lumborum*.—*Origin*,<sup>15</sup> from the crest of the ilium. *Insertion*, into the transverse processes of the last dorsal and all the lumbar vertebræ, and also into the last rib beneath the ligamentum arcuatum. *Use*; bends the loins to one side.

*Psoas parvus*.—Not always present. *Origin*, from the last dorsal and first lumbar vertebræ. *Insertion*, by a long tendon, into the crest of the pubes and fascia iliaca.

*Psoas magnus*.<sup>14</sup>—*Origin*, from the transverse processes of all the lumbar vertebræ, and from the bodies of the four upper lumbar and last dorsal vertebræ. *Insertion*, into the lesser trochanter of the femur, and into one inch below it.

*Iliacus internus*.—*Origin*, from the transverse process of the last lumbar vertebra, from the costa and crest of the ilium, and from the capsule of the hip joint. *Insertion*, into the tendon of the psoas magnus. *Use*; the action of the last two muscles is the same, to bend the body forwards and draw the thigh upwards.

### MUSCLES OF THE BACK.

*Trapezius*.<sup>1</sup>—*Origin*, from the superior semicircular ridge of the occiput, from all the spinous processes of the neck, by means of the ligamentum nuchæ, and from all those of the back. *Insertion*, into the external third of the clavicle, into the acromion process, and spine of the scapula. *Use*; draws the scapula towards the spine.

*Latissimus dorsi*.<sup>4</sup>—*Origin*, from the seven inferior spinous processes of the back, and from all those of the loins and sacrum, also from four inferior ribs, which heads interdigitate with those of the external oblique. *Insertion*, by a thick flat tendon, in common with the *teres major*, into the posterior ridge of the bicipital groove. *Use*; draws the humerus downwards and backwards.

*Serratus posticus inferior*.<sup>16</sup>—*Origin*, from the two inferior spinous processes of the back, and the three superior of the loins. *Insertion*, into the last four ribs. *Use*; draws the ribs downwards.

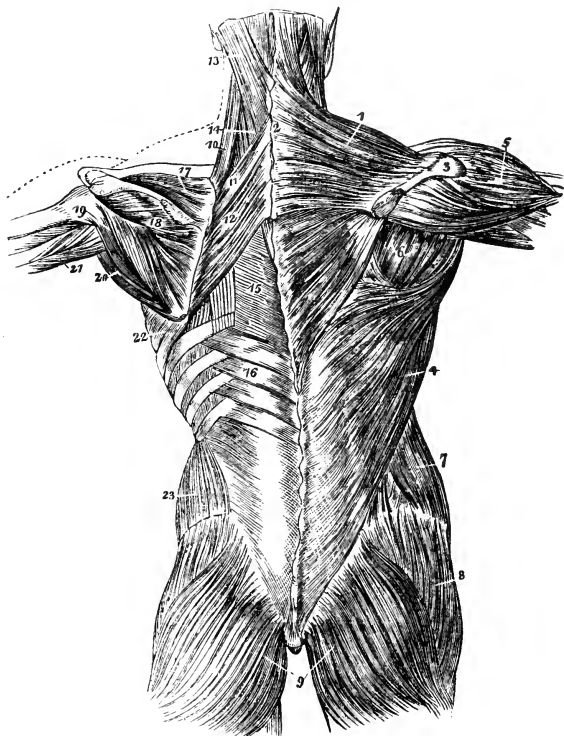
*Rhomboideus minor*.<sup>11</sup>—*Origin*, from the three inferior spinous processes of the neck. *Insertion*, into the base of the scapula opposite the spine.

*Rhomboideus major*.<sup>12</sup>—*Origin*, from the spinous processes of the last cervical, and of the four superior dorsal vertebræ. *Insertion*, into the base of the scapula below the spine. *Use*; the last two draw the scapula upwards and backwards.

*Serratus posticus superior*.—*Origin*, from the three inferior spinous processes of the neck, and the two superior of the back. *Insertion*, into the second, third, and fourth ribs. *Use*; it draws the ribs upwards.

*Levator anguli scapulae*.<sup>10</sup>—*Origin*, from the transverse processes of the three, four, or five superior cervical vertebræ. *Insertion*, into the angle of the scapula, and base above the spine. *Use*; draws the scapula upwards.

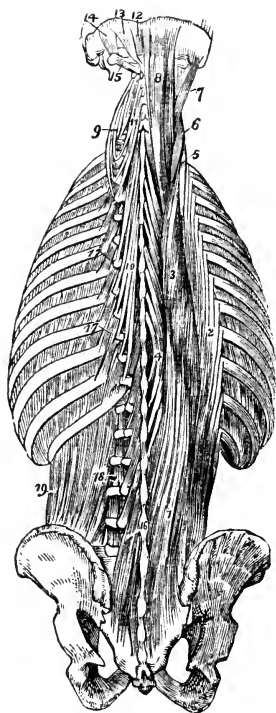
Fig. 62.



*Splenius*.<sup>13 14</sup>—It consists of two parts: splenius capitis and splenius colli. *Origin*, from the spinous processes of the five inferior cervical and the four superior dorsal vertebræ. *Insertion*, into the occipital bone, between the two semicircular ridges, and into the transverse processes of the two superior cervical vertebræ. *Use*; draws the head and neck backwards.

*Sacro-lumbalis* and *longissimus dorsi*.—These two muscles arise in common. *Origin*, from the spinous and transverse processes of the loins and sacrum, and from the crest of the ilium. The first<sup>a</sup> is on the outer side. *Insertion*, into the angles of the rib. The

Fig. 63.



latter<sup>3</sup> is nearest the spine. *Insertion*, into all the transverse processes of the back except the first, and into all the ribs beyond their tubercles, except the two last. *Use*; to keep the spine erect, and draw down the ribs.

*Spinalis dorsi*.<sup>4</sup>—*Origin*, from the three inferior spinous processes of the back, and two superior of the loins. *Insertion*, into the nine superior spinous processes of the back, except the first. *Use*; to keep the spine erect.

*Cervicalis descendens*.<sup>5</sup>—*Origin*, from the four superior ribs. *Insertion*, into the fourth, fifth, and sixth transverse processes of the neck.

*Transversalis cervicis*.<sup>6</sup> <sup>9</sup>—*Origin*, from the five superior transverse processes of the back. *Insertion*, into the five middle transverse processes of the neck. *Use*; the two last draw the neck backward.

*Trachelo-mastoid*.<sup>7</sup>—*Origin*, from the three superior transverse processes of the back. *Insertion*, into the mastoid process.

*Complexus*.<sup>8</sup>—*Origin*, from the transverse processes of the four inferior cervical, and from the spinous process of the first dorsal vertebræ. *Insertion*,

into the occiput between its semicircular ridges. *Use*; the two last draw the head backward.

*Semi-spinalis cervicis*.<sup>11</sup>—*Origin*, from the six superior transverse processes of the back. *Insertion*, into the spinous process of the five middle cervical vertebræ.

*Semi-spinalis dorsi*.<sup>10</sup>—*Origin*, from the transverse processes of the seventh, eighth, ninth, and tenth dorsal vertebræ. *Insertion*, into the spinous processes of the two lower cervical, and five upper dorsal vertebræ.

*Multifidus spinæ*.<sup>16</sup>—*Origin*, from the oblique and transverse processes of all the vertebræ of the sacrum, loins and back, and of the four inferior of the neck. *Insertion*, into the spinous processes of all the vertebræ of the loins and back, and of the five inferior of the neck. *Use*; the three last twist the spine.

*Rectus capitis posterior major*.—*Origin*, from the spinous process of the dentata. *Insertion*, into the occiput at its superior semicircular ridge, and below it. *Use*; it turns the head.



*Rectus capitis posticus minor.*—*Origin*, from the tubercle of the atlas. *Insertion*, into the occiput, at the inferior semicircular ridge, and below it.

*Obliquus superior.*—*Origin*, from the transverse process of the atlas. *Insertion*, into the outer end of the inferior semicircular ridge of the occiput.

*Obliquus inferior.*—*Origin*, from the spinous process of the dentata. *Insertion*, into the transverse of the atlas.

*Interspinales.*—Between the spinous processes of all the vertebræ. In the neck they are double: in the back, tendinous; in the loins single and well-marked.

*Inter-transversarii.*<sup>18</sup>—Between all the transverse processes. In the neck, double; in the back, tendinous; in the loins fleshy and single. *Use*; to approximate these processes.

*Levatores costarum.*<sup>17</sup>—*Origin*, from the transverse processes of the last cervical and eleven upper dorsal vertebræ. *Insertion*, into the upper edge of the two ribs below. *Use*; to elevate the ribs.

## MUSCLES OF THE SHOULDER AND ARM.

### FASCIA.

The brachial fascia covers the muscles of the upper extremity, commencing at the spine of the scapula and clavicle. Upon the deltoid it is thin. At the elbow it sends several processes to the bone, which serve for the origin of muscles, and in front it receives a portion of tendon from the biceps muscle, which renders it tense.

At the wrist it forms the anterior and posterior annular ligaments, which bind down the tendons of the hand, and in the hand it forms the palmar aponeurosis.

*Deltoid.*<sup>5</sup>—*Origin*, from the spine of the scapula, the acromion process, and the external third of the clavicle. *Insertion*, into a triangular roughness near the middle of the humerus. *Use*; it raises the humerus. (Fig. 62.)

*Supra-spinatus.*<sup>17</sup>—*Origin*, from the whole of the fossa supra-spinata. *Insertion*, into the inner facet of the greater tuberosity of the humerus. *Use*; it raises the arm and turns it outwards.

*Infra-spinatus.*<sup>18</sup>—*Origin*, from the whole of the fossa infra-spinata. *Insertion*, into the middle facet of the greater tuberosity of the humerus. *Use*; it rotates the humerus outwards and backwards.

*Teres minor.*<sup>19</sup>—*Origin*, from the lesser costa of the scapula. *Insertion*, into the outer facet of the greater tuberosity of the humerus. *Use*; it rotates the humerus outwards, and draws it downwards and backwards.

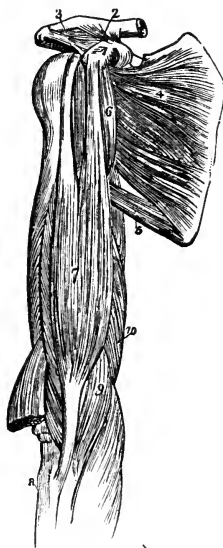
*Teres major.*<sup>20</sup>—*Origin*, from the posterior surface of the angle of the scapula, and a part of its lesser costa. *Insertion*, into the posterior edge of the bicipital groove of the humerus in common

with the tendon of the latissimus dorsi. *Use*; it rotates the humerus inwards and draws it downwards and backwards.

*Subscapularis*.<sup>4</sup> (Fig. 64.) *Origin*, from the whole of the costa of the scapula. *Insertion*, into the lower tuberosity of the humerus. *Use*; it rotates the humerus inwards, and draws it downwards.

*Biceps flexor cubiti*.<sup>7</sup>—*Origin*, by a long tendon from the superior extremity of the glenoid cavity, which passes through the joint and bicipital groove, and by a short head from the coracoid process of the scapula. *Insertion*, into the posterior and inferior parts of the tubercle of the radius, and into the brachial fascia. *Use*; it flexes the fore-arm.

Fig. 64.



*Coraco-brachialis*.<sup>6</sup>—*Origin*, from the middle facet of the coracoid process of the scapula, in common with the short head of the biceps. *Insertion*, into the middle of the os humeri by a rough ridge on its internal side. *Use*; it draws the arm upwards and forwards.

*Brachialis Internus*.<sup>9</sup>—*Origin*, from the anterior and lower half of the os humeri. *Insertion*, in front of the root of the coracoid process of the ulna. *Use*; it flexes the fore-arm.

*Triceps extensor cubiti*.<sup>10</sup>—*Origin*, by three heads; the first or longus, is from the inferior part of the glenoid cavity. The second or brevis, is from a ridge from the back part of the os humeri, just below its head; and the third, or brachialis externus, is from the inner side of the os humeri, near the bicipital groove. *Insertion*, into the olecranon process of the ulna. *Use*; it extends the fore-arm.

*Anconeus*.<sup>11</sup> (Fig. 67.)—*Origin*, from the external condyle of the humerus. *Insertion*, into the ulna below the olecranon. *Use*; it extends the fore-arm.

## MUSCLES OF THE FORE-ARM.

These are eighteen in number, eight of which are on the front of the arm, and are flexors, and for the most part arise from the internal condyle. The remaining ten are extensors, and arise for the most part from the external condyle.

*Pronator radii teres*. (Fig. 65.)—*Origin*, from the internal condyle of the humerus, and the coronoid process of the ulna. *Insertion*, into the middle and back portion of the radius. *Use*; it rotates the hand inwards.

*Flexor carpi radialis.*—*Origin*, from the internal condyle of the humerus, the brachial fascia, and the upper part of the ulna. *Insertion*, into the base of the metacarpal bone of the index finger. *Use*; it flexes the hand at the wrist. (Fig. 65.)

*Palmaris longus.*<sup>6</sup>—Is sometimes deficient. *Origin*, from the internal condyle. *Insertion*, into the annular ligament and palmar aponeurosis. *Use*; it bends the hand.

Fig. 65.

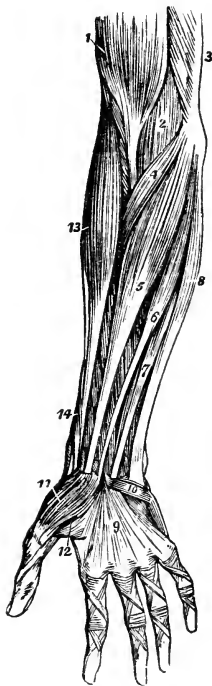
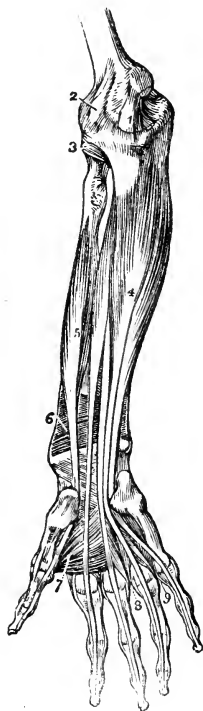


Fig. 66.



*Flexor carpi ulnaris.*<sup>8</sup>—*Origin*, from the internal condyle, and from the ridge at the inner side of the ulna. *Insertion*, into the pisiform bone and sometimes into the base of the metacarpal bone of the little finger. *Use*; it flexes the hand.

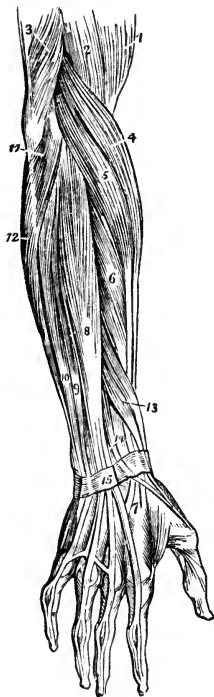
*Flexor sublimus digitorum perforatus.*<sup>7</sup>—*Origin*, from the internal condyle of the humerus, the coronoid process of the ulna, and the tubercle of the radius. *Insertion*, by four split tendons into the second phalanges of the fingers. *Use*; it bends the hand and fingers.

*Flexor profundus digitorum perforans.*<sup>4</sup> (Fig. 66.)—*Origin*, from the ulna by its anterior flat surface, from its coronoid process,

and from the interosseous ligament. *Insertion*, the tendons are four in number, which, passing through the perforations in the tendons of the flexor sublimus, are inserted into the third phalanges of the fingers.

*Flexor longus pollicis*.<sup>5</sup>—*Origin*, from the internal condyle of the humerus, and the middle two-thirds of the radius, and a part of the interosseous ligament. *Insertion*, into the base of the second phalanx of the thumb. (Fig. 66.)

Fig. 67.



*Pronator quadratus*.<sup>6</sup>—*Origin*, from the inner surface of the ulna, near its lower extremity. *Insertion*, into the corresponding surface of the radius. *Use*; it rotates the radius inwards.

*Supinator radii longus*.<sup>13</sup> (Fig. 67.)—*Origin*, from the ridge leading to the external condyle of the humerus. *Insertion* into a ridge of the radius just above its styloid process. *Use*; it rotates the radius outwards.

*Extensor carpi radialis longus*.<sup>5</sup>—(Fig. 66.) *Origin*, From the ridge of the external condyle of the humerus. *Insertion*, into the posterior part of the base of the metacarpal bone of the forefinger. *Use*; it extends the hand.

*Extensor carpi radialis brevis*.<sup>8</sup>—*Origin*, from the external condyle of the humerus, and from the external lateral ligament. *Insertion*, into the posterior part of the base of the metacarpal bone of the middle finger. *Use*; as the last.

*Extensor carpi ulnaris*.<sup>10</sup>—*Origin*, from the external condyle and the brachial fascia. *Insertion*, into the base of the metacarpal bone of the little finger. *Use*; as the last.

*Extensor digitorum communis*.<sup>8</sup>—*Origin*, from the external condyle. *Insertion*, by four tendons which are connected by slips previous to their being spread out, into a membranous insertion, into all the phalanges

of the fingers. *Use*; it extends the joints of the fingers.

*Supinator radii brevis*.—*Origin*, from the external condyle, and from a ridge of the ulna on its posterior surface. *Insertion*, into the radius between its tubercle and the insertion of the pronator. *Use*; it rotates the radius outwards.

*Extensor ossis metacarpi pollicis manus*.—*Origin*, from the posterior surface of the ulna, from the interosseous ligament, and a part of the radius. *Insertion*, into the base of the metacarpal bone of the thumb, and into the trapezium.

*Extensor minor pollicis manus*.<sup>13</sup>—*Origin*, from the back of the

ulna below its middle, and from the interosseous ligament. *Insertion*, into the first phalanx of the thumb.

*Extensor major pollicis manus*.<sup>14</sup>—*Origin*, from the back of the ulna above its middle, from the interosseous ligament, and from the back of the radius. *Insertion*, into the base of the second phalanx of the thumb. *Use*; these last three extend the thumb.

*Indicator*.—*Origin*, from the back of the ulna, and interosseous ligament. *Insertion*, into the base of the first phalanx of the index finger. *Use*; it extends the fore-finger.

## MUSCLES OF THE HAND.

*Palmaris brevis*.—*Origin*, from the anterior ligament of the wrist, and palmar aponeurosis. *Insertion*, into the skin at the inner edge of the hand. *Use*; it contracts the skin.

*Lumbricales*.<sup>7</sup>—These are four in number, and resemble earth-worms. *Origin*, from the tendons of the flexor profundus. *Insertion*, into the radial side of the base of the first phalanx of each finger. *Use*; they assist in bending the fingers. (Fig. 68.)

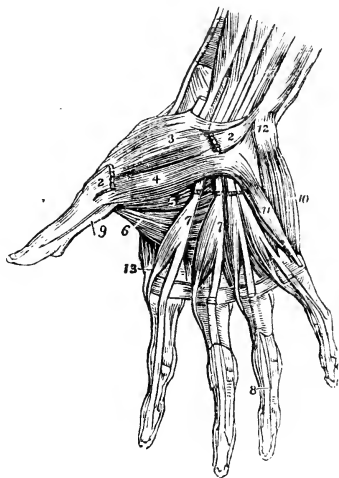
*Abductor pollicis manus*.<sup>2</sup>—*Origin*, from the annular ligament, trapezium, and scaphoid bones. *Insertion*, into the base of the first phalanx of the thumb. *Use*; draws the thumb from the fingers.

*Opponens pollicis*.<sup>3</sup>—*Origin*, from the trapezium and annular ligament. *Insertion*, into the radial edge of the metacarpal bone, from its base to its head. *Use*; it draws the metacarpal bone inwards.

*Flexor brevis pollicis manus*.<sup>4 5</sup>—It consists of two bellies. The external *arises* from the trapezium and trapezoides, and the annular ligament, and is inserted into the outer side of the first phalanx of the thumb. The internal head *arises* from the magnum and unci-form, and the metacarpal bone of the little finger, and is inserted into the inner side of the base of the first phalanx of the thumb. The sesamoid bones are included in these tendons.

*Adductor pollicis manus*.<sup>6</sup>—*Origin*, from the metacarpal bone of the middle finger between its base and its head. *Insertion*, into the base of the first phalanx of the thumb. *Use*; it draws the thumb towards the fingers.

Fig. 68.



*Abductor minimi digiti manus.*<sup>10</sup>—*Origin*, from the pisiform bone, and annular ligament. *Insertion*, into the ulnar side of the base of the first phalanx of the little finger. *Use*; it draws the little finger from the rest.

*Flexor parvus minimi digiti.*<sup>11</sup>—*Origin*, from the unciform process of the unciform bone, and annular ligament. *Insertion*, into the ulnar side of the base of the first phalanx of the little finger. *Use*; it bends the little finger.

*Adductor metacarpi minimi digiti.*—*Origin*, from the unciform process and annular ligament. *Insertion*, into the metacarpal bone of the little finger, from its base to its head. *Use*; it brings the metacarpal bone towards the wrist.

*Interosseous muscles.*—These are seven in number; three of which are on the *palmar* side, and four on the *dorsal* side. The palmar interossei are *adductors*, the dorsal are *abductors*.

Fig. 69.

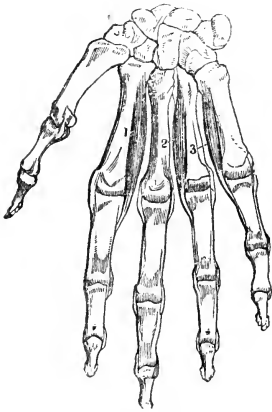
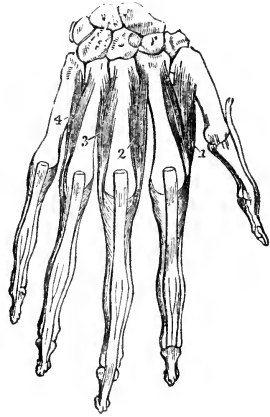


Fig. 70.



The *palmar interosseous muscles*. (Fig. 69.)—These arise from the base of the metacarpal bone of one finger, and are inserted into the base of the first phalanx of the same finger. The first belongs to the index finger,<sup>1</sup> the second to the ring finger,<sup>2</sup> and the third to the little finger.<sup>3</sup>

The *dorsal interosseous* are penniform, arising by two heads from adjoining sides of the metacarpal bones. (Fig. 70.) They are inserted into the bases of the first phalanges; the first into the index finger,<sup>1</sup> the second and third into the middle finger,<sup>2,3</sup> compensating its exclusion from the palmar group; the fourth into the ring finger.<sup>4</sup>

The diversified and confused description of these muscles by different authors, is owing to the use of terms that are not significant, a want of proper classification, and the dividing of one muscle in two; thus, some enumerate four *palmar* and three *dorsal* interossei,

together with the muscle called *abductor indicis*; others, again, enumerate four palmar and four dorsal. The principle of classification should be with regard to their *action*. Whether they are abductors or adductors, with reference to an axis passing through the middle finger. If you split the first dorsal interosseous into two muscles, and call that portion arising from the metacarpal bone of the thumb, the *abductor indicis*; and enumerate the remaining portion among the palmar interossei, you can reconcile the various modes of counting these muscles.

### MUSCLES OF THE LOWER EXTREMITY.

The lower extremity is covered by a dense fascia called *fascia lata*, which commences at the crest of the ilium, and extending over the glutei muscles, reaches the foot. In the front of the thigh it is termed *iliac* and *pubic*, with reference to its proximity to these bones. At the knee, it forms a general covering, called the *involutrum*; in the leg it is termed the *crural fascia*; in front of the ankle it constitutes the *annular ligament*, which binds down the extensor tendons; under the sinuosity of the os calcis, it binds down the flexor tendon in the form of the *ligamentum laciniatum*, or plaited ligament; finally, it terminates in the *plantar fascia*, that firm aponeurosis upon the sole of the foot. From it are formed numerous sheaths for muscles.

### ANATOMY OF FEMORAL HERNIA.

This variety of hernia is a protrusion of intestine at an opening near the passage of the large vessels to and from the thigh. We shall at first describe the parts as they occur upon dissection, and then the descent of the gut.

Upon the removal of the skin from the upper portion of the thigh the *superficial fascia* is brought into view. This fascia is a continuation of the superficial fascia of the abdomen, and like it is capable of being dissected in laminae. In the groin it contains numerous lymphatic glands. It is traversed by the *saphena vein*, which enters the femoral vein, through the *saphenous opening* about an inch below Poupart's ligament.

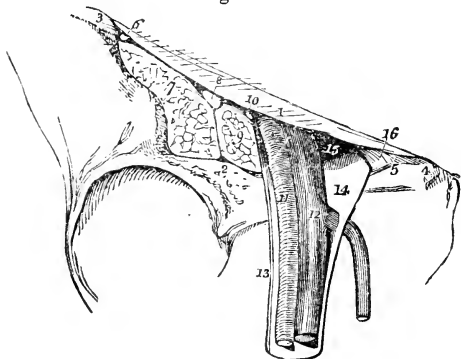
Having removed this fascia we bring into view the *fascia lata* of the thigh. This fascia is of a pearly white colour and very dense structure. It consists of two portions, the sartorial and pectineal. The *sartorial* portion<sup>1</sup> is upon the iliac side, and is connected at its upper part with Poupart's ligament. It passes in front of the sheath of the vessels and has a crescentic edge on its inner side, called the *falciform process*. This process limits the saphenous opening on its outer side; and in order that this edge should be distinctly seen, a layer of superficial fascia with which it is continuous must be carefully removed; this portion of superficial fascia which fills up the saphenous opening is often called *cribriform fascia*. (See Fig. 60.)

The superior horn of this crescentic process is twisted and inserted in the crest of the pubes external to, but continuous with, Gimbernat's ligament, and is called *Hey's* ligament.

The *pectineal* portion of the fascia lata is upon the pubic side ; it is thinner than the sartorial and passes behind the sheath of the vessels.

The sheath of the vessels is formed of condensed cellular tissue, and may be considered a prolongation of the fascia transversalis and fascia iliaca. It is usually compared to the tubular portion of a funnel ; the abdominal portions of these fasciæ constituting the larger part of the funnel. Numerous perforations exist in the sheath of the vessels for the passage of veins and absorbents, which renders it cribriform. One of these perforations can be seen where the sheath is laid open, and also the saphena vein entering the femoral vein.<sup>13</sup> Since the artery and vein are cylinders, it must be evident that there must be some structure filling up the intervening spaces, and also the space<sup>15</sup> between the vein and Gimbernat's ligament,<sup>16</sup> or else there would be a

Fig. 71.



deficiency of structure. Now this space is the *crural ring*<sup>15</sup> and is filled up with loose cellular tissue and a lymphatic gland. This cellular tissue is called by some the *crural septum*, by others *fascia propria*. A weakness of this septum between the cavity and tube of the funnel predisposes to hernia. The crural or femoral ring is *bounded* in front by Poupart's ligament ;

behind, by the bone ; on the inside, by Hey's and Gimbernat's ligament ; on the outside by the vein. The femoral vessels,<sup>11 12</sup> with their sheath, together with the iliacus internus<sup>7</sup> and psoas magnus<sup>9</sup> muscles, pass out under Poupart's ligament, and thus fill the crural arch.

The intestine in femoral hernia pursues the following course. The peritoneum, as in all other instances, is at first distended and forms the hernial sac ; this distension takes place at the crural ring, this being the only spot where it can occur under the crural arch ; the *crural septum* or fascia propria is now stretched and thickened ; gradually yielding, it forms the next covering of the gut. With these it descends the sheath of the vessels, and when it gets below the falciform process, emerges at one of the foramina for veins or absorbents ; then it comes in contact with the cribriform and superficial fascia, which in fact are the same structure ; these form another covering, and the skin forms the last.



In reaching the intestine by an operation for hernia, the order of coverings would be the *skin*, *superficial fascia*, *fascia propria*, and *hernial sac*. Much alteration of structure would of course exist by the parts becoming thicker and more laminated. In some instances the foramen of the sheath is not sufficiently large, and then the sheath is distended and consolidated with the other coverings. Many restrict the term *fascia propria* to this consolidated covering.

A femoral hernia may be concealed either above or below the saphenous opening; then of course the fascia lata will also form one of its coverings.

### MUSCLES OF THE HIP AND THIGH.

*Gluteus maximus*.<sup>9</sup> (Fig. 62.)—*Origin*. From the crest of the ilium, from a portion of the dorsum of the ilium, from the sides of the sacrum and coccyx, and from the greater sacro-sciatic ligament. *Insertion*. Into the upper third of the linea aspera, and into the fascia femoris. *Use*. It draws the thigh backwards and keeps the trunk erect.

*Gluteus medius*.<sup>8</sup> (Fig. 62.)—*Origin*. From the dorsum of the ilium between the crest and semicircular ridge, from between the anterior spinous processes, and from the fascia femoris. *Insertion*. Into the upper surface of the trochanter major, and into that portion of the shaft just in front of it. *Use*. It draws the thigh backwards and outwards.

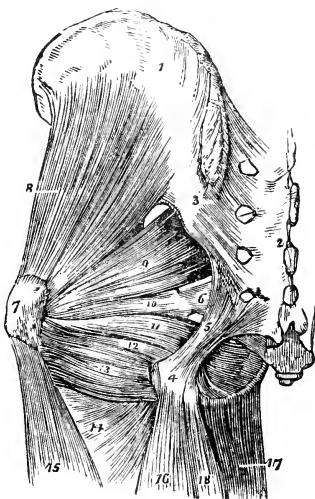
*Gluteus minimus*.<sup>8</sup> (Fig. 72.)—*Origin*. From the dorsum of the ilium, between the semicircular ridge and the capsular ligament. *Insertion*. Into the trochanter major, within that of the last. *Use*. It abducts and rotates the thigh inwards.

*Pyriformis*.<sup>9</sup>—*Origin*. From the second, third and fourth bones of the sacrum. *Insertion*. Into top of the trochanter major. *Use*. It rotates the limb outwards,

*Gemini*.<sup>10 12</sup>—These are two in number; the superior arises from the spinous process of the *ischium*, and the inferior from the tuberosity of the ischium; both are inserted in common with the tendon of the obturator internus.

*Obturator internus*.<sup>11</sup>—*Origin*. From the margin of the thyroid foramen and the thyroid ligament, and fascia iliaca. *Insertion*. Into the digital fossa of the femur.

Fig. 72.



*Quadratus femoris.*<sup>13</sup>—*Origin.* From the tuberosity of the ischium. *Insertion.* Into the femur between the two trochanters.

*Obturator externus.*—*Origin.* From the anterior margin of the thyroid foramen, and ligament. *Insertion.* Into the digital fossa at the root of the trochanter major. *Use.* The last four rotate the thigh outwards.

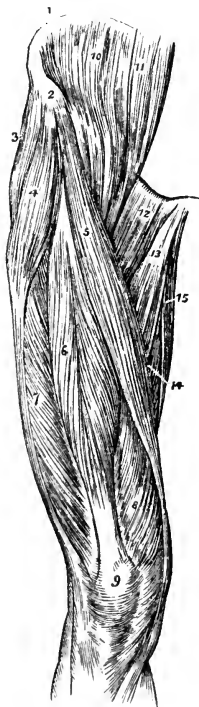
*Biceps flexor cruris.*<sup>16</sup>—*Origin.* By a long head in common with the semi-tendinosus from the tuberosity of the ischium, and by a short fleshy one from the lower part of the linea aspera. *Insertion.* Into the head of the tibia.

*Semi-tendinosus.*<sup>18</sup>—*Origin.* From the tuberosity of the ischium. *Insertion.* Into the side of the tibia just below its tubercle.

*Semi-membranosus.*—*Origin.* From the external part of the tuberosity of the ischium. *Insertion.* Into the inner side of the head of the tibia and into the external condyle of the femur.

*Tensor vaginæ femoris.*<sup>4</sup>—(Fig. 73.) *Origin.* From the anterior superior spinous process of the ilium. *Insertion.* Into the fascia or sheath of the thigh.

Fig. 73.



*Sartorius.*<sup>5</sup>—*Origin.* From the anterior superior spinous process of the ilium. *Insertion.* Into the inner side of the head of the tibia. *Use.* It bends the leg and draws it inwards. It is the longest muscle of the body.

*Rectus femoris.*<sup>6</sup>—*Origin.* From the anterior inferior spinous process of the ilium. *Insertion.* Into the upper surface of the patella.

*Vastus externus.*<sup>7</sup>—*Origin.* From the linea aspera, and trochanter major. *Insertion.* Into the upper and external part of the patella.

*Vastus internus.*<sup>8</sup>—*Origin.* From the linea aspera in its whole length, covering the inside of the thigh. *Insertion.* Into the common tendon of the patella.

*Cruræus.*—*Origin.* From the anterior part of the femur as well as from the linea aspera. *Insertion.* Into the patella.

These four last muscles form a common tendon in which is placed the patella, before it is inserted into the tubercle of the tibia. They are often called the *quadriceps femoris*, and extend the leg.

*Gracilis.*<sup>15</sup>—*Origin.* From the body and ramus of the pubes. *Insertion.* Into the inside of the head of the tibia.

*Pectineus.*<sup>12</sup>—*Origin.* From the crest of the pubis, and the triangular face in front of it.

*Insertion.* Into the linea aspera below the trochanter minor.

*Adductor longus*.<sup>13</sup>—*Origin*. From the body of the pubes. *Insertion*. Into the middle third of the linea aspera.

*Adductor brevis*.—*Origin*. From the body and ramus of the pubes. *Insertion*. Into the upper third of the linea aspera.

*Adductor magnus*.<sup>14</sup>—*Origin*. From the body and ramus of the pubis, and from the ramus of the ischium. *Insertion*. Into the whole length of the linea aspera. It is *perforated* by the femoral artery, at its insertion near its middle third. *Use*. These four last draw the thigh forwards and inwards.

### MUSCLES OF THE LEG.

*Tibialis anticus*<sup>3</sup> (Fig. 74).—*Origin*, from the outer side and head of the tibia and from the interosseous ligament. *Insertion*, into the base of the internal cuneiform bone, and base of the metatarsal bone of the big toe.

Fig. 74.

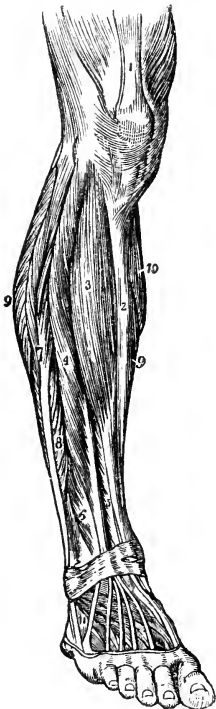
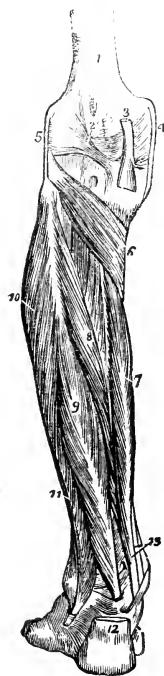


Fig. 75.



*Extensor Longus Digitorum Pedis*.<sup>4</sup>—*Origin*, from the head of the fibula, from the head of the tibia, and from a portion of the interosseous ligament, and edge of the fibula. *Insertion*, by four tendons into the phalanges of the toes.

*Peroneus Tertius*.<sup>6</sup>—*Origin*, from the anterior angle of the fibula, below its middle. *Insertion*, into the upper surface of the base of the metatarsal bone of the little toe. It looks like a portion of the last-named muscle.

*Extensor Proprius Pollicis Pedis*.<sup>5</sup>—*Origin*, from the lower two-thirds of the fibula and interosseous ligament. *Insertion*, into the bases of the first and second phalanges of the great toe. *Use*; it extends the great toe.

*Peroneus Longus*.<sup>7</sup>—*Origin*, from the head and upper third of the outer side of the fibula. *Insertion*, into the base of the metatarsal bone of the great toe. *Use*; it extends the foot and inclines the sole outwards.

*Peroneus Brevis*.<sup>8</sup>—*Origin*, from the lower two-thirds of the outer surface of the fibula. *Insertion*, into the base of the metatarsal bone of the little toe. *Use*; it extends the foot.

*Gastrocnemius*.—*Origin*, by two heads from the condyles of the femur. *Insertion*, by the *tendo Achillis* into the tuberosity of the os calcis.

*Soleus*.—*Origin*, from two-thirds of the posterior part of the fibula, and the middle third of the tibia. *Insertion*, into the *tendo Achillis*.

*Plantaris*.—This muscle has the longest tendon in the body. *Origin*, just above the external condyle of the femur. *Insertion*, into the os calcis before the *tendo Achillis*. These last three muscles form the calf of the leg, and are called the triceps sura.

*Popliteus*<sup>6</sup> (Fig. 75).—*Origin*, from behind the external condyle of the femur. *Insertion*, into an oblique ridge of the tibia, below its head. *Use*; it bends the leg and rolls it inwards.

*Flexor Longus Digitorum Pedis Perforans*.<sup>7</sup>—*Origin*, from the back of the tibia below its oblique ridge. *Insertion*, by four tendons, which perforate the split tendons of the flexor brevis, into the bases of the third phalanges of the four lesser toes. *Use*; it flexes the toes.

*Flexor Longus Pollicis Pedis*.<sup>9</sup>—*Origin*, from the lower two-thirds of the posterior face of the fibula. *Insertion*, into the second phalanx of the great toe. *Use*; it flexes the great toe.

*Tibialis Posticus*.<sup>8</sup>—*Origin*, by two heads from the tibia and fibula, and from the interosseous ligament. *Insertion*, into the tuberosity of the scaphoid bone. *Use*; it extends the foot.

## MUSCLES OF THE FOOT.

*Extensor Brevis Digitorum Pedis*<sup>11</sup> (Fig. 74).—*Origin*, from the greater apophysis of the os calcis. *Insertion*, by four tendons into the backs of the four greater toes. *Use*; it extends the toes.

*Flexor Brevis Digitorum Pedis*<sup>5</sup> (Fig. 76).—*Origin*, from the tuberosity of the os calcis and plantar fascia. *Insertion*, by four small tendons, which are perforated by those of the flexor longus, into the second phalanges of the four smaller toes.

*Flexor Accessorius*.—*Origin*, from the inside of the sinuosity of the os calcis in front of its tuberosities. *Insertion*, into the outside of the tendon of the flexor longus, at its division. *Use*; assists in flexion.

*Lumbricales Pedis*.<sup>7</sup>—*Origin*, from the tendon of the flexor longus. *Insertion*, into the inside of the first phalanx of each toe. *Use*; assist in flexion.

*Abductor Pollicis Pedis*.<sup>3</sup>—*Origin*, from the internal tuberosity of the os calcis, the plantar fascia, and internal cuneiform bone. *Insertion*, into the inner side of the base of the first phalanx of the great toe, including the internal sesamoid bone. *Use*; it draws this toe from the others.

*Flexor Brevis Pollicis Pedis*.—It consists of two bellies, which arise from the calcaneo-cuboid ligament and external cuneiform bone.

*Insertion*, by two tendons into the base of the first phalanx of the great toe, including the sesamoid bones. *Use*; it flexes this toe.

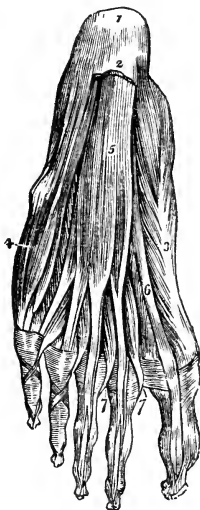
*Abductor Pollicis Pedis*.—*Origin*, from the calcaneo-cuboid ligament, from the bases of the second, third, and fourth metatarsal bones of the lesser toes. *Insertion*, into the tendon of the flexor brevis and external sesamoid bone. *Use*; to draw this toe towards the rest.

*Abductor Minimi Digiti Pedis*.<sup>1</sup>—*Origin*, from the outer tuberosity of the os calcis and the metatarsal bone of the little toe. *Insertion*, into the base of the first phalanx of the little toe. *Use*; it draws this toe from the others.

*Flexor Brevis Minimi Digiti Pedis*.—*Origin*, from the calcaneo-cuboid ligament, and from the fifth metatarsal bone. *Insertion*, into the base of the first phalanx of the little toe, and into the head of its metatarsal bone. *Use*; it bends the little toe.

*Transversalis Pedis*.—*Origin*, from the capsular ligaments of the

Fig. 76.



first joint of the fourth and fifth toes. *Insertion*, into the external sesamoid bone. *Use*; it approximates the heads of the metatarsal bones.

*Interosseous Muscles*.—These are seven in number, four of which are upon the dorsal, and three upon the plantar surface of the foot. The *dorsal interossei* arise by double heads, and are inserted into the base of the first phalanx. The *plantar interossei* arise from the bases of the three outer metatarsal bones, and are inserted into the inner side of the base of the first phalanx of the same toes.

Fig. 77.

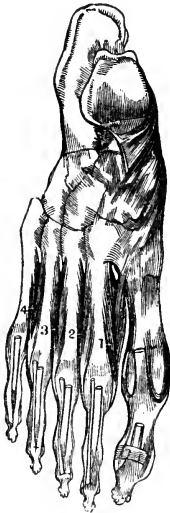


Fig. 78.



## SECTION IV.

## VISCERA.

## ORGANS OF DIGESTION.

## MOUTH.

The *Mouth* is separated from the nose by the hard and soft palate, communicating behind with the fauces; it is bounded in front by the lips, while its floor is formed by the mylo-hyoid muscles; and its sides by the cheeks; the space between the lips and the teeth is called the *vestibule*; it is lined by a mucous membrane, which has a variable degree of thickness. This membrane is thrown into folds, which are called *frena*; there is one beneath the tongue, one beneath the epiglottis cartilage at the root of the tongue, and one

at the inner surface of each of the lips. This membrane is covered with numerous glands, some of which are mucous and some salivary.

The *upper lip* is longer and thicker than the lower, and has a vertical depression on the middle of its front surface called *philtrum*, internally the lips are composed of muscular fibres and fat, externally of skin.

The *Gums* are formed of the lining membrane of the mouth, much thickened; they have great hardness and vascularity, but little sensibility. They include the neck of the tooth, and adhere firmly to the periosteum.

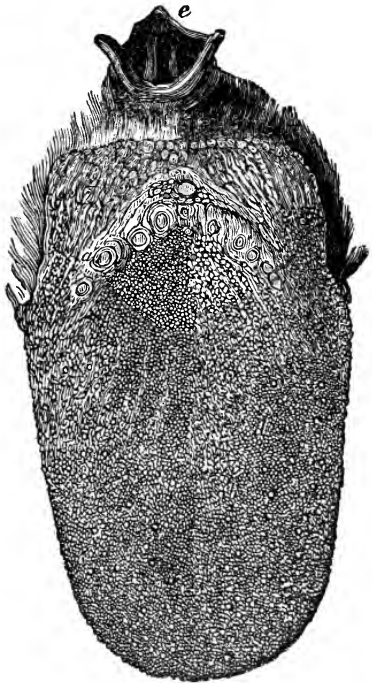
#### TONGUE.

The *Tongue* is an oblong, flattened, muscular body, which varies in size and shape; it is the organ of taste, and also of importance in speech and mastication. Its posterior extremity or root arises from the hyoid bone, to which it is attached by yellow fibrous tissue. Its anterior extremity is called its point or *tip*; its intervening portion its *body*.

The *mucous covering* of the tongue is very thick upon its upper surface, and very thin upon its under surface. Upon its upper surface are a number of projections or *papillæ* of various sizes and shapes; the largest are eight or nine in number, called *papillæ maximæ*, and are situated at the posterior portion of the tongue, in two convergent lines; they are surrounded by *fossæ*, the largest of which is in the middle, and called the *foramen cæcum*. The smallest papillæ are fine and pointed, and are found near the middle of the tongue, and are termed *filiform*. The intermediate papillæ are most abundant, some of them are *conical*, others *fungiform*. Different functions are attributed by some to these different papillæ.

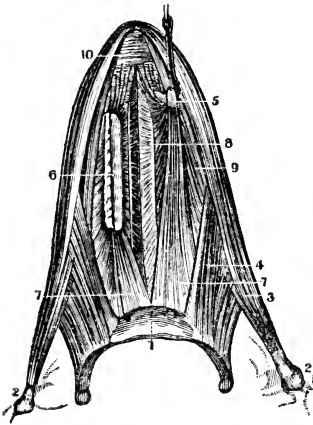
*Muscles of the Tongue.*—*Hyo-glossus*.<sup>4</sup>—*Origin*, from the base

Fig. 79.



and corner of the hyoid bone. *Insertion*, into the side of the tongue, some of the fibres reaching its tip.

Fig. 80.



*Genio-hyo-glossus*.<sup>5</sup> — *Origin*, by a tubercle behind the symphysis of the lower jaw. *Insertion*, into the hyoid bone, and into the whole length of the tongue.

*Lingualis*.<sup>9</sup> — *Origin*, from the yellow tissue at the root of the tongue. *Insertion*, into the tip, between the two last mentioned muscles.

*Superficialis linguae*. — An indistinct layer of muscular fibres on the dorsum of the tongue under the mucous membrane. It seems to curl the tip upwards.

*Transversales linguae*.<sup>10</sup> — Are scattered fibres which pass from the middle line to the edge of the

tongue; they extend from the tip to the root, and their contractions lengthen the tongue.

*Verticales linguae*. — These are fibres which extend from the upper to the lower surface of the tongue.

#### THE PALATE.

The palate separates the back portion of the nose from the mouth, and is divided into two parts: the *hard palate* consists of the palate processes of the superior maxillary and palate bones, covered by mucous membrane, which is continuous with that of the mouth, but is not so vascular or sensitive as that of other parts. It very frequently presents transverse ridges, as well as a ridge in the median line. The *soft palate* is the membranous separation between the back portion of the mouth and nose, and consists of a fold of mucous membrane stretched transversely. From its middle there projects the *uvula*, about three quarters of an inch in length; from each side of the uvula there are two divergent crescentic folds of mucous membrane, which are called *lateral half-arches*; the space between which constitutes the *fauces*.

Between the anterior and posterior arches of each side is the *tonsil gland*. The *tonsil* is about the size of an almond, and consists of a collection of large mucous follicles.

*Muscles of the palate*. — *Constrictor isthmi faucium*. — A small muscle placed in each anterior half-arch, arising from the middle of the soft palate, and inserted into the side of the root of the tongue. It diminishes the opening into the pharynx.



*Palato-pharyngeus*.—Another small muscle, included in the posterior half-arch, *arising* from the soft palate, and *inserted* into the side of the pharynx. It draws the palate down and the pharynx up.

*Circumflexus* or *Tensor palati*.—*Origin*, from the spinous process of the sphenoid bone, and the contiguous portion of the Eustachian tube. *Insertion*, by a tendon, which winds around the hamulus or hook of the internal pterygoid process, into the posterior and crescentic edge of the palate bone. *Use*; to extend the soft palate transversely.

*Levator palati*.—*Origin*, from the petrous portion of the temporal bone and Eustachian tube. *Insertion*, into the soft palate. *Use*; it draws the palate upwards.

*Azygos uvulae*.—Is in the middle of the uvula and soft palate. Its contractions shorten the uvula.

### SALIVARY GLANDS OF THE MOUTH.

The salivary glands are of a light pink colour, and their secretion is of great service in mastication and digestion. They are three in number—the parotid, submaxillary, and sublingual.

Fig. 81.



The *parotid* is the largest of the three, its shape is irregular; it has no capsule, and is merely covered by the superficial fascia of the neck. The position it occupies<sup>t</sup> is in the space behind the ramus of the lower jaw and the mastoid process. It extends in front, so as to cover a portion of the masseter muscle; in depth it reaches towards the styloid process, and superficially it is covered by the skin; its structure is lobulated, and its duct, called the *duct of*

*Steno*,<sup>3</sup> traverses the outer face of the masseter muscle in a line drawn from the lobe of the ear to the end of the nose. It is white and hard, about the size of a crow-quill, and perforates the cheek through a pad of fat by a very small orifice opposite the second molar tooth of the upper jaw. The external carotid artery passes through the deeper portion of the gland, and it is also traversed by the portio dura nerve. There is sometimes found in front of the gland an accessory portion called *socius* or *accessorius parotidis*, whose duct empties into that of Steno.

The *submaxillary gland*<sup>3</sup> is much smaller than the parotid, is irregularly oblong in figure and lobulated in structure. It is situated in a depression on the internal face of the inferior maxillary bone, being covered externally by the skin, superficial fascia, and platysma muscle. Its duct<sup>4</sup> is called the *duct of Wharton*, which empties at the side of the frænum under the tongue by a very small orifice on the summit of a papilla; the coats of this duct are very thin, the gland is traversed by the facial artery as it mounts the lower jaw. Sometimes there is an additional gland and duct, called after Bartolin.

The *sublingual gland*<sup>5</sup> is the smallest of the three; its shape is also oblong, and its structure lobulated; it is situated under the tongue, between the mucous membrane of the mouth and the mylohyoid muscle. Its duct or ducts (for they are frequently numerous) are called after *Rivinus*, and empty into or near the duct of Wharton.

#### THE PHARYNX AND ŒSOPHAGUS.

The *pharynx* is a muscular and membranous sac, communicating with the mouth, nose, œsophagus, larynx, and Eustachian tube. It is situated in front of the vertebral column, and extends from the basilar process of the occiput to the fourth or fifth cervical vertebra. It is funnel-shaped, being larger above than it is below. Its length is about five inches, although this varies by contraction and distension; it is never collapsed, but its walls are always kept distended by its muscular origins. It consists of three coats, *muscular*, *cellular*, and *mucous*.

The *inferior constrictor muscle*<sup>9</sup> arises from the cricoid and thyroid muscles. The fibres terminate in those of its fellow, along the posterior median line; those of the upper part are oblique, those of the lower horizontal.

The *middle constrictor muscle*<sup>10</sup> arises from the cornu of the os hyoides, and the lateral thyreo-hyoid ligament, and is inserted into its fellow in the posterior median line. Its upper fibres ascend obliquely to the basilar process of the occiput, and overlap the superior constrictor, while its lower fibres are horizontal or descending, and are overlapped by the inferior constrictor.

The *superior constrictor muscle* <sup>1</sup> is quadrilateral, and arising from the pterygoid process of the sphenoid bone, from the upper and lower jaw, the buccinator muscles, and the root of the tongue; is inserted into its fellow behind, and also into the basilar process of the occiput.

The *stylo-pharyngeus muscle* <sup>12</sup> has been described before.

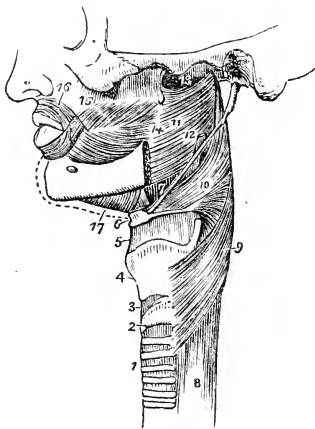
The *cellular coat* is thin, and merely serves for a transmission of vessels and nerves, and the connexion of the external and internal coats.

The *internal or mucous coat* is a continuation of that of the mouth, nose, and Eustachian tube, and it is covered by a thin epithelium, and studded with mucous follicles and glands. It is supplied by the pharyngeal and palatine arteries, and by the sympathetic, and eighth pair of nerves. Its uses are for deglutition, respiration, and modulation of the voice.

The *œsophagus* is a canal which conveys the food from the pharynx to the stomach. It is situated in the median line, in front of the vertebral column, and passing through the posterior mediastinum, and inclined somewhat to the left side in its lower part, where it passes through the diaphragm. Its length is about nine or ten inches, and its diameter is not uniform, gradually increasing as it descends. Its upper portion is the narrowest part of the alimentary canal, and hence foreign bodies which are too large to pass through the alimentary canal, are generally arrested in the neck; its shape is cylindrical, although its walls when at rest, are in contact, never containing air. It consists of three coats, the external of which is muscular, and thicker than any other portion of the canal; it consists of two layers, the *external* consists of longitudinal fibres, and the *internal* of circular fibres. The *cellular coat* attaches the muscular and mucous, and serves for the passage of vessels and nerves. The *internal or mucous coat* is continuous with that of the pharynx, and has a number of longitudinal folds when in a state of quiet. It has a thick epithelium, and numerous mucous glands and follicles. It is supplied by the œsophageal arteries, proceeding from the inferior thyroid, aorta, coronary, and phrenic arteries; its nerves are derived from the eighth pair, and from the sympathetic.

Deglutition is performed by the contraction of its longitudinal

Fig. 82.

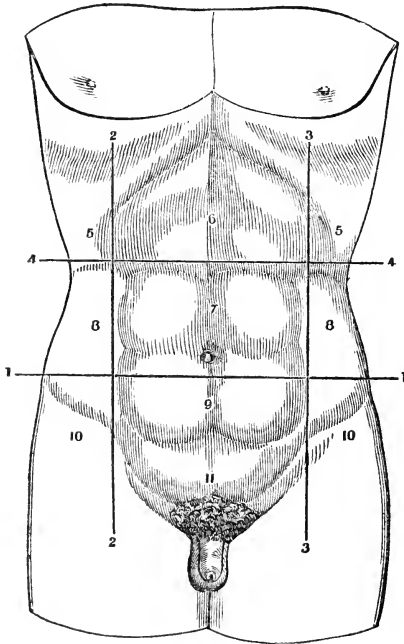


fibres which shorten the passage, and by the contraction of its circular fibres successively from above downwards; vomiting is produced by the contraction taking place from below upwards.

### VISCERA OF THE ABDOMEN.

The cavity of the abdomen is divided into nine different regions, by the

Fig. 83.



drawing of parallel lines vertically,<sup>2 3</sup> through the anterior inferior spinous processes, and intersecting them with two other parallel lines drawn transversely<sup>1 4</sup> over the crests of the ilia, and over the most prominent part of the costal cartilages. We thus have three regions arranged above, three in the middle, and three below.

Those of the *upper row* are termed the *epigastric*,<sup>6</sup> in which are the left lobe of the liver, and a portion of the stomach; the *right hypochondriac*<sup>5</sup> contains within it the right lobe of the liver, while the *left* contains the spleen, a portion of the stomach, and the liver. The *middle row* contains the *umbilical*,<sup>7</sup> in which are the small

intestines, and on either side the lumbar regions;<sup>8</sup> the *right lumbar* region contains the right kidney, and ascending colon; while the *left* contains the left kidney and descending colon.

The lower row contains the *hypogastric* region,<sup>9 11</sup> in which is a portion of the small intestines and bladder, and on either side the *iliac fossæ*,<sup>10</sup> the right of which contains the *cæcum* or *caput coli*, and the left contains the *sigmoid flexure*.

### PERITONEUM.

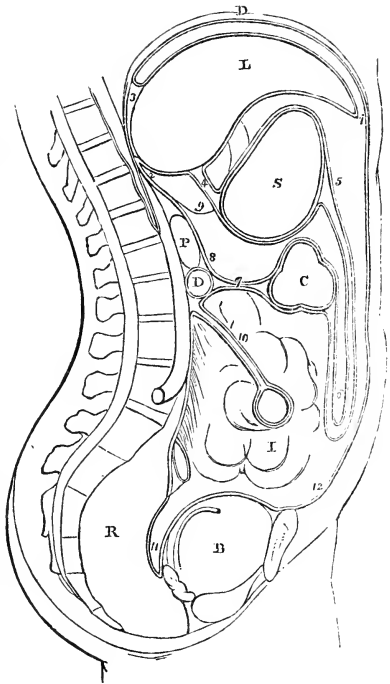
The peritoneum is a thin, transparent membrane, lining the cavity

of the abdomen, and covering most of the viscera that are contained therein; it is a serous membrane, and therefore a shut sac, following the general rule of lining the cavity, and covering the organs contained within. It secretes a small quantity of fluid in health, which lubricates the surfaces of the viscera, so that they readily move upon each other and the walls of the cavity. It also forms ligaments and connexions whereby the viscera are held in their places. That portion of the peritoneum, which passes between one viscus and another, or a viscus and the wall of the cavity, usually consists of two laminæ, and is called an *omentum*. There are four principal omenta, viz. the *gastro-hepatic*, or *lesser omentum*, which reaches from the lesser curvature of the stomach to the liver; the *gastro-splenic*, reaching from the left extremity of the stomach to the spleen; the *colic-omentum* or *mesocolon*, which holds the large intestine to the posterior wall of the abdomen; and lastly, the *gastro-colic* or *great omentum* or *caul* which passes between the stomach and colon; the last is the largest, and covers the intestines like an apron; it appears to consist of four layers, whereas, like the rest, it consists but of two. Owing to its great size and the proximity of the colon to the stomach, it must necessarily be folded or doubled, and thus presents a quadruple appearance.

Since the peritoneum is a continuous membrane, its whole surface can be traced in a male subject with the point of a finger, otherwise it would not be a single sac. In the female there is a deficiency at the extremity of the Fallopian tube.

Commencing at the umbilicus to trace the peritoneum, it will be found to line the anterior wall of the abdomen and under surface of the diaphragm, thence to cover the upper and a part of the lower

Fig. 84.



surface of the liver,<sup>L</sup> thence to pass to the stomach,<sup>S</sup> forming thus<sup>4</sup> the upper lamina of the gastro-hepatic or lesser omentum; having covered the anterior face of the stomach<sup>S</sup> it passes down to form one of the lamina of the apparently quadruple omentum—the gastro-colic; ascending again it forms another lamina, and surrounding the inferior semi-circumference of the colon,<sup>C</sup> it passes to the vertebral column, forming at<sup>7</sup> the inferior lamina of the colic omentum; then we find it including the small intestine forming at<sup>10</sup> the mesentery; from the vertebral column it can be traced over the upper and anterior part of the rectum,<sup>R</sup> and over the posterior and superior portion of the bladder,<sup>B</sup> forming at the vesico-rectal pouch, and again<sup>12</sup> we traced it to the umbilicus, the point whence we started. But in thus tracing it will be found, by the diagram, that we have not traced the peritoneum covering some portions of the viscera and abdomen. In the dead subject it is very easy to introduce the finger through a narrow passage which is called the *foramen of Winslow*, although there is no hole or tearing of the peritoneum. By looking for the posterior end of the gall-bladder and passing the finger under the vessels of the liver it will be easy to touch the peritoneum covering the posterior surface of the stomach. This cannot be demonstrated very clearly from a drawing alone, which represents merely a longitudinal section of the abdominal cavity; and without explanation it gives the false idea of there being two sacs instead of one. In the subject, however, by placing the finger upon the under surface of the liver, we trace the peritoneum in the foramen of Winslow; there it forms the inferior lamina of the lesser omentum,<sup>4</sup> thence it covers the inferior surface of the stomach; descending it forms the third and ascending at<sup>6</sup> it forms the fourth lamina of the great omentum; then it covers the superior convexity of the colon, and forming the superior lamina of the colic omentum at<sup>7</sup> it ascends in front of the duodenum and pancreas,<sup>P</sup> and passing out at the foramen of Winslow we can trace upon the posterior and inferior portion of the liver, the point of starting.

The *mesentery* is formed of two laminæ of peritoneum, and serves to connect the small intestine to the parietes of the abdomen. Its root is about six inches wide, and its inferior edge equals in breadth the whole length of the small intestine. Between these two laminæ of peritoneum are the superior mesenteric artery and vein, lymphatic glands and vessels, and branches of the sympathetic nerve, together with a portion of fat and cellular tissue.

The *meso-colon* is also formed of two laminæ of peritoneum, and holds the large intestine in its place. The transverse portion is long and loose, but on each side in the iliac regions it is short, and binds the intestine down very tightly; it also contains between its laminæ vessels and nerves, together with some fat and cellular tissue; that portion which is attached to the rectum is called the *meso-rectum*.

## THE STOMACH.

The stomach is a conoidal sac, somewhat bent or curved, and is situated in the left hypochondriac and epigastric regions. It is somewhat flattened anteriorly and posteriorly, and thus presents an anterior and posterior face; its direction is oblique from above downwards, and from left to right. The left<sup>3</sup> extremity is much the larger, and terminates in a rounded cul-de-sac; at the superior portion of this extremity is the *Cardiac* orifice, where the œsophagus is continued into the stomach immediately below the diaphragm. The right extremity gradually diminishes in size, and its orifice is called *Pyloric*<sup>9</sup>, which is continuous with the small intestine. The structure of the pylorus is much thicker than that of any other portion.

The upper and lower curvature of the stomach are called the greater and lesser curvatures<sup>5 6</sup>, near the pyloric extremity of the stomach, is a slight dilatation<sup>7</sup> called *antrum pylori*. The dimensions of the stomach are variable, depending upon the mode of life. It consists of four coats; peritoneal, muscular, cellular, and mucous.

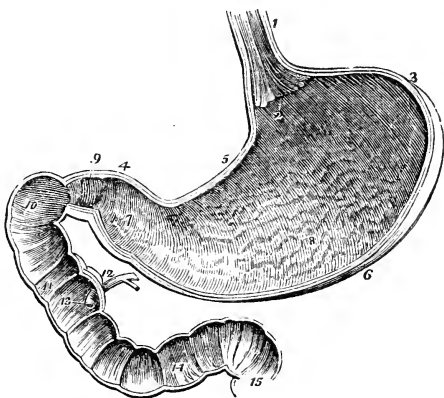
The *Peritoneal coat* completely covers the stomach, except at the

curvatures, where are attached the omentum; the looseness of which adhesion at these points admits of the distension of these remaining coats.

The *Muscular coat* is not so thick as that of the œsophagus, and its fibres pass both in a circular<sup>7</sup> and longitudinal<sup>8</sup> direction, (see Fig. 86.) Some of the muscular fibres which pass obliquely round the left extremity, constitutes the muscle of Gavard. The circular fibres are most numerous near the pyloric orifice, and the longitudinal fibres are most distinct upon the lesser curvature.

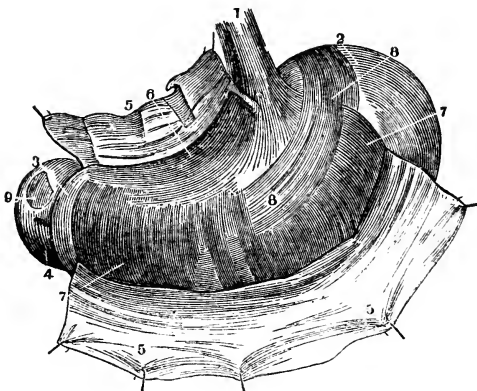
The *Cellular coat* connects the muscular and mucous; it serves for the transmission of vessels and nerves, and can readily be inflated; when dried, it resembles cotton.

Fig. 85.



The *Mucous or Villous coat*, is a continuation of the œsophagus ; it is soft and thick, of a light pink colour, and is thrown into a num-

Fig. 86.



ber of longitudinal *rugæ* or folds, which are particularly numerous at the greater curvature, and nearer the pyloric orifice.<sup>8</sup> (See Fig. 86.)

The *epithelium* of the mucous membrane of the stomach is thinner than that of the œsophagus.

The surface of the stomach is covered by numerous pits or *cells*, into which enter several small tubes, which are supposed to secrete the gastric juice, and hence called *gastric glands*.

At the pyloric orifice, the mucous membrane is thrown into a circular or semi-circular fold, which is called the *pyloric valve*.

The lesser curvature is supplied by the gastric artery, the greater by the right and left gastro-epiploics, and the greater extremity by the *vasa brevia*. The nerves are derived from the *par vagum* and sympathetic.

## INTESTINES.

The intestinal canal is from thirty to thirty-five feet in length, and is divided into large and small intestine.

### SMALL INTESTINE.

The small intestine is four-fifths of the length of the whole canal, reaching from the pylorus to the large intestine ; it is cylindrical, and about one inch in diameter, although there is a gradual diminution in diameter as it descends. It consists of four coats.



The *Peritoneal coat* is the external, being included in the lower edge of the mesentery.

The *Muscular coat* is thin, and consists of pale fibres; the superficial and longitudinal<sup>2</sup> are not distinct; the remainder are circular<sup>3 4</sup>.

The *Cellular coat* connects the muscular and mucous, and contains the vessels and nerves; when inflated with air and dried, it appears like cotton, as is the case in the stomach.

The *Mucous coat* is longer than any other, and hence must be thrown into numerous folds, which are called *valvule conniventes*; these are circular and overlapping, and more numerous<sup>2</sup> and larger<sup>1</sup> in the upper portion of the intestine, than in the lower. The surface of the mucous membrane is covered with a number of papillary projections called *villi*, many of which are conical in shape. Each villus consists of an artery, vein, and lacteal. This lacteal does not open directly upon the surface of the mucous membrane, but the chyle is conveyed into the intestine by the intervention of cells.

Fig. 87.

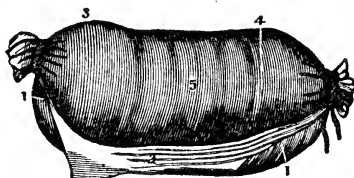


Fig. 88.

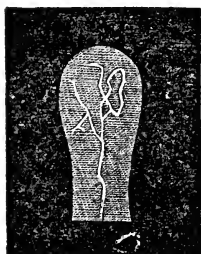
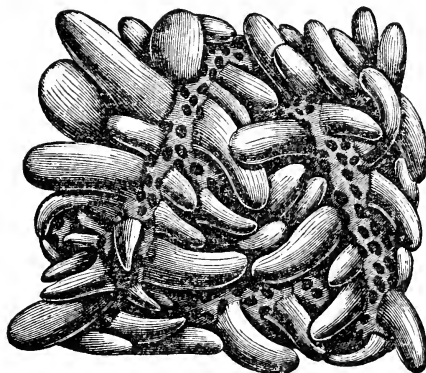


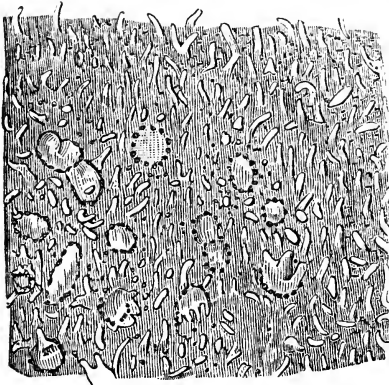
Fig. 89.



*Brunner's Glands* are a number of small *solitary* glands, which are with difficulty perceived by the naked eye. They are most abundant near the *duodenum*, but exist in a scattered manner throughout the intestine.

*Peyer's Glands* are larger, and exist principally in the lower part of the small intestine. They are flat and elliptical, and vary in size,

Fig. 90.



from a few lines to a few inches. They consist of a cluster of smaller glands, and hence are often called *aggregate*. These are ulcerated in typhoid fever.

Besides the villi and glands, the small intestine is found to present throughout its whole surface a great number of *follicles* called after Lieberkühn, that are in fact nothing more than interstices between the meshes of veins, which for the most part constitute the internal surface of the mucous layer. They are seen

in the interstices of the villi. (Fig. 91.)

The arteries are derived from the superior mesenteric, and the nerves from the solar plexus.

The small intestine is divided into Duodenum, Jejunum, and Ilium.

The *Duodenum* is about twelve inches in length, curved in its direction, and partially deficient in its peritoneal coat, on account of its being received between the two laminae of the colic omentum. Its mucous coat is characterized by its colour, being tinged with bile, and by the great abundance of valvulae conniventes and glands of Brunner. The *ductus communis choledochus* opens into the duodenum four or five inches from the pylorus, through a small elevation or tubercle.

The *Jejunum* (from *jejunus, empty*), constitutes two-fifths of the small intestine, and the *ilium* the remaining three-fifths. Although there is no anatomical reason for this division, it being impossible, from its appearance, to say where the jejunum terminates, or the ilium begins, yet if a portion of the upper extremity of the jejunum be compared with a portion of the lower extremity of the ilium, it could be recognised by its diameter, abundance of valvulae conniventes, and the presence of Brunner's rather than *Peyer's Glands*. There are frequently *blind pouches*, varying in size from one to two inches along the course of this small intestine.

#### LARGE INTESTINE.

The large intestine is one-fifth in length of the whole intestinal

canal; it differs much from the small intestine in its diameter, and has a sacculated appearance. Like the small intestine, it consists of four coats.

The *peritoneal coat* is continuous with the meso-colon, and has numerous folds filled with fat, which are called *appendices epiploicae*.

The *muscular coat* consists of two sets of fibres; the longitudinal fibres are collected into three bands, each about a half an inch in breadth, which extend to the rectum; the circular fibres are also thicker than those of the small intestine.

The *cellular coat* connects the mucous and muscular, and contains the blood-vessels and nerves.

The *mucous coat* has no *valvulae conniventes* nor *villi*; it is whiter, thicker, and coarser, than that of the small intestine. Its *follicles*

Fig. 91.

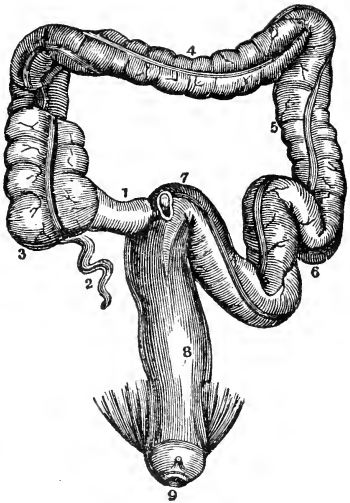


Fig. 92.

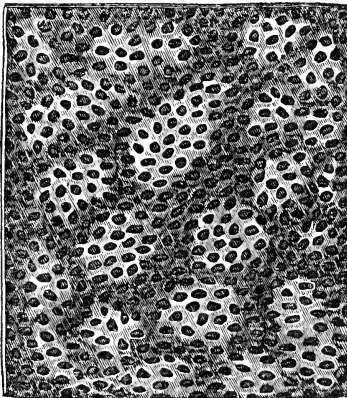
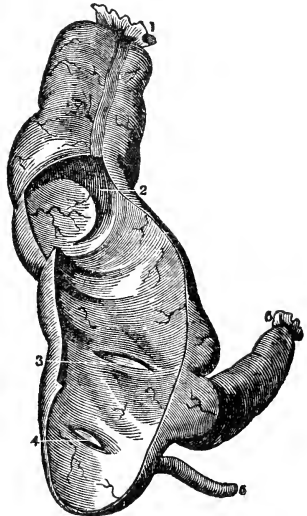


Fig. 93.



of Lieberkühn are extremely numerous, and more readily discerned than in the small intestine. There are also some solitary glands in the mucous coat of the large intestine, which readily ulcerate.

This coat of the large intestine is composed of vessels, principally veins.

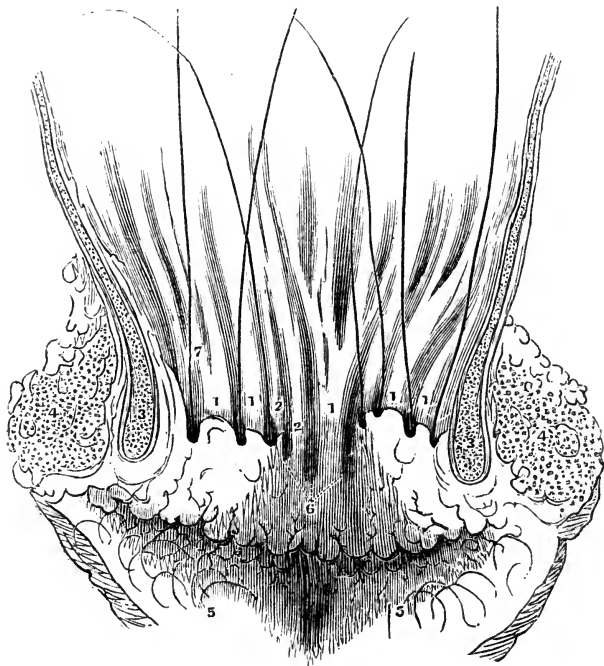
The large intestine is divided into the cæcum, colon, and rectum.

The *cæcum* is a cul-de-sac,<sup>3</sup> (Fig. 91), and the commencement of the large intestine, and hence is often called *caput coli*. It is bound down into the right iliac fossa, by the meso-colon; its length varies from one and a half to three inches, and its diameter is greater than that of any other portion of the alimentary canal, except the stomach.

The *appendix vermiformis*, is a worm-like process, varying in length from three to six inches, attached to the inferior portion of the cæcum.<sup>5</sup> Its coats are the same as those of the intestine, and it usually contains flatus.

The *ileo-colic valve*<sup>3</sup> is an elliptical opening on the side of the cæcum, between its circular fibres, whereby the small intestine empties into

Fig. 94.



the large. Its action is such that the distention of the cæcum will prevent the passage of air or fluids backwards into the small intestine. (Fig. 93.) It is also called the *valve of Bauhin* of *Morgagni*.

The *colon* is the longest portion of the large intestine; it gradually diminishes in diameter until it terminates in the sigmoid flexure on the left side.<sup>6</sup> (Fig. 92.) It ascends upon the right side, and, forming an arch transversely, descends upon the left.

The *rectum* is the terminating portion of the large intestine, and reaches from the sigmoid flexure to the *anus*, occupying a position in front of the sacrum. It is somewhat barrel-shaped, that is, is larger in the middle than at either end. The *peritoneal* covering is deficient below and behind. The *muscular* coat has a very great thickness and redness. The external fibres are *longitudinal*, and the internal are *circular*. The fibres of the external muscular coat wind around the inferior edge of the circular coat, and terminate in the mucous coat, which, in some measure, accounts for hæmorrhoids and prolapsus ani. The mucous coat is thicker and redder than in the upper part of the intestine, and at the lower extremity, just above the anus, is thrown into a *number of pouches* between the longitudinal muscular fibres. (Fig. 94.) About five or six inches above the anus, is a *semicircular fold* of the mucous membrane on each side of the rectum; these two are about half an inch distant from each other: they resemble the *valvulæ conniventes*, and in some measure prevent the involuntary discharge of fæces.

#### THE LIVER.

The *liver* is the largest glandular organ in the body, and secretes bile. It is oblong and oval in its shape, and occupies the right hypochondriac, a portion of the epigastric and left hypochondriac regions. It *weighs* from four to five pounds; *measures* from ten to twelve inches transversely, and from six to seven antero-posteriorly; its greatest thickness is from four to five inches. It is convex upon its upper surface, and concave upon its lower. Its *colour* is of a reddish brown, with occasional spots of black. It is covered almost entirely by peritoneum, which upon its upper surface, forms a broad *suspensory ligament*,<sup>5</sup> whereby it is held in contact with the diaphragm. In the anterior edge of this ligament, is another of a cord-like character called *ligamentum teres*,<sup>6</sup> which was originally the umbilical vein. It passes through the anterior notch of the liver and umbilical fissure. Posteriorly, the two laminæ of the suspensory ligament diverge, forming the *coronary ligament*, under which the liver is destitute of peritoneum. The *lateral ligaments*<sup>7 8</sup> are also peritoneal, being, in fact, a continuation of the coronary; they are horizontal and attach the right and left sides of the liver to the posterior walls of the abdomen. There is a deep depression upon

Fig. 95.

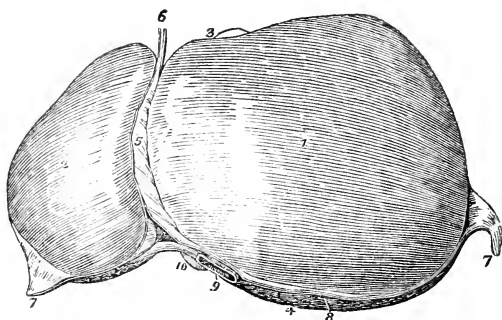
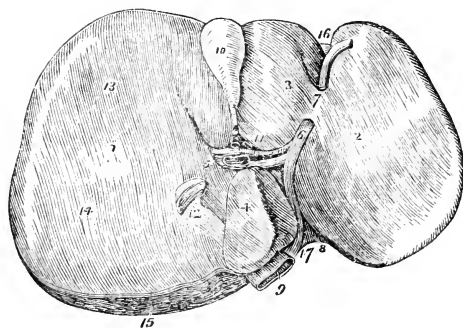


Fig. 96.



the posterior edge of the liver, called the *posterior notch*, whereby the liver is adjusted to the vertebral column. The anterior and posterior notch divide the liver into *two lobes*, the right of which is much the larger and thicker, and the left terminates in a thin cutting edge.

The under surface of the liver presents

a deep *fissure* called *umbilical* or longitudinal, which reaches from the anterior<sup>16</sup> to the posterior<sup>17</sup> notch, and contains the remains of the umbilical vein, now the *ligamentum teres*, and the remains of the *ductus venosus*. Sometimes this fissure is converted into a *foramen*,<sup>7</sup> the right and left lobes being connected. At right angles to this fissure, is another called the *transverse fissure*,<sup>11</sup> which contains the portal vein, hepatic artery, and hepatic duct, bound together by cellular tissue, which is called the *capsule of Glisson*. A deep depression upon the under surface of the right lobe of the liver, parallel with the longitudinal fissure, contains the gall-bladder;<sup>10</sup> that portion of the liver included between this depression and the longitudinal and transverse fissures is called the *lobulus quadratus*,<sup>3</sup> or *quartus*, from its shape. The *lobulus spigelii*<sup>4</sup> is a small triangular lobe at the posterior and inferior portion of the liver, and with the

lobulus quadratus, constitutes the *porta* or gateway of the liver. An elongated ridge, running from the lobulus spigelii outwardly,<sup>5</sup> is called the *lobulus caudatus*; in the angle between the lobulus spigelii and the right lobe of the liver, is a *deep fissure* for the passage of the ascending vena cava.<sup>2</sup>

There are *four sets of vessels* for the liver.

The *hepatic artery* is a branch of the cœliac, approaches the liver at the transverse fissure, and divides into two or three large branches previous to entering it.

The *portal vein* collects the blood from all the chylopoietic viscera, and upon reaching the transverse fissure, divides into two large branches, called the *right and left sinuses*.

The *hepatic duct*, commencing by fine branches in the interior of the liver, is about the size of a small quill, and is also included with the two last vessels by the capsule of Glisson in the transverse fissure.

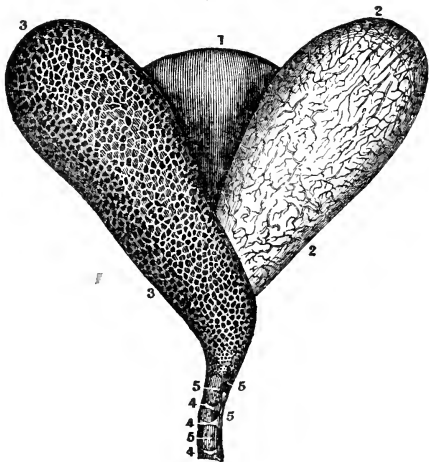
The *hepatic veins* commence also by capillaries in the liver. The branches collect and form three large trunks, whose course is backwards towards the posterior notch of the liver. These trunks appear more like channels lined by a thin venous coat, than the ordinary veins. They empty into the ascending vena cava as it is passing through the fissure formed between the lobulus spigelii and the right lobe.

The *structure* is best exhibited by tearing the liver; this shows a granulated arrangement, and each of these granules is usually called a *lobule*. Each consists of a terminal branch of the portal vein, hepatic artery, hepatic duct, and hepatic vein, and in it the bile is primitively secreted (see Physiology). The aggregation of these acini, is by means of cellular tissue, called the *parenchyma*, which may be considered as a continuation of Glisson's capsule.

#### GALL-BLADDER.

It is placed on the under surface of the right lobe of the liver, and inclines somewhat to the right

Fig. 97.

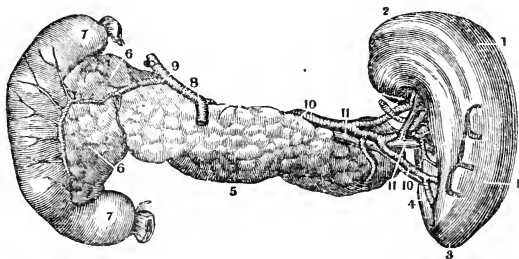


side. It is a pyriform sac of about three inches in length; its anterior extremity is globular, and called the *fundus*; its posterior end or *neck*, is narrow, and twisted like a screw. It consists of *three coats*. The external is formed of the peritoneum,<sup>1</sup> and is only a partial covering for its inferior surface; the middle<sup>2</sup> consists of a strong layer of fibrous and cellular tissue; and the internal is mucous,<sup>3</sup> with short, irregular folds, giving it a fine net-like appearance; its colour is usually that of the bile; in the *neck* it is spirally twisted, and thus acts as a valve. Its duct, called the *cystic duct*, is shorter and thinner than the hepatic duct, which it joins at a very acute angle; this junction forms the *ductus communis choledochus*, which is about the size of a goose-quill, and often three inches in length. It passes through the right extremity of the pancreas at its posterior portion, and perforates the duodenum obliquely and with a very small orifice, through an elevated tubercle. Its artery, called *cystic*, is a branch of the hepatic.

#### PANCREAS.

This is the largest *salivary gland* of the body; it is long and flat in *shape*, and of a light pink *colour*. It is *placed* transversely behind the stomach, and in front of the last dorsal and first lumbar vertebræ. It has no peritoneal covering, but is included between

Fig. 98.



the two laminæ of the meso-colon, and extends from the curvature of the duodenum<sup>7</sup> across to the spleen.<sup>1</sup> It is about seven inches long. Its right extremity<sup>6</sup> or *head*, is much the thickest part, is traversed by the ductus choledochus, and often called the *lesser pancreas*. Its left extremity gradually diminishes in breadth until it touches the spleen.

The superior edge of the pancreas has a *groove* for the passage of the splenic artery.<sup>8 9 10</sup> Its *structure*<sup>1</sup> like that of other salivary glands, is conglomerate. Its excretory *duct*, called after *Wirsungius*, is formed by a collection of small branches, which come from the lobules of the gland. Its walls are thin, white, and



smooth, gradually increasing in size; it *opens* into the duodenum near the orifice of the ductus choledochus, and sometimes into it. Its arteries are branches of the splenic.

## S P L E E N .

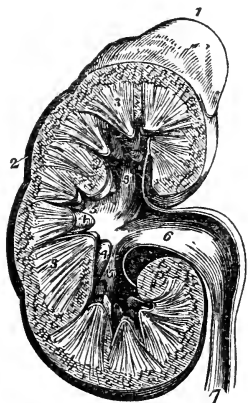
The spleen is *placed* in the left hypochondriac region. Its figure is semi-oval; its *colour* brown or purple; its *length* four or five inches, and its breadth two or three. Its *external surface* is convex and smooth, and comes in contact with the diaphragm. Its *internal surface* is slightly concave, and presents a depression or hilum, where the splenic artery and vein are attached. The edges of the spleen are frequently indented, and there are frequently attached small additional spleens. The *structure* presents a spongy, grumous mass, which upon washing leaves a fine gray tissue. It is covered with a thin elastic coat, and also by the peritoneum; this last often has a *wrinkled* appearance.

The *splenic artery*, is the largest branch of the cœliac, and divides into four or five branches before it enters the spleen: it has no *secretion*, and its *use* is uncertain.

## K I D N E Y S .

The kidneys are two hard glands for the secretion of urine, placed in each lumbar region, and reaching from the first to the third lumbar vertebræ; they are outside of the peritoneal cavity and surrounded with an abundance of fat and loose cellular tissue. The *right kidney* is rather lower than the left, on account of superposition of the liver. The *length* is four inches, and the breadth two inches. The *shape* is oval, resembling a bean; the position is upright, and the *fissure* or *hilum* is directed inwards towards the vertebral column. The upper end of the kidney is rather larger than the lower. It is covered by a strong *fibrous capsule*. The *colour* is of a reddish brown. Upon making a longitudinal section of the kidney, *two different structures* are presented. The *internal* is of the darker colour, and consists of about fifteen cones of Malpighi, which are arranged in three rows, their apices converging towards the hilum. These constitute the *medullary* portion. The *external* structure is of a lighter colour usually, is extremely vas-

Fig. 99.



cular, and of a granulated arrangement; it constitutes the *cortical* portion.

The *cortical* substance<sup>2</sup> consists of a number of *tortuous tubes of Ferrein*, in which the urine is first formed, and between whose walls are a number of small bodies called the *corpuscles of Malpighi*; these are composed principally of vessels.

The *medullary* cone of Malpighi,<sup>3</sup> is capable of subdivision into small *pyramids of Ferrein*, and each pyramid of Ferrein will be found to consist of a number of straight *tubes of Bellini*, into which the tortuous tubes of Ferrein empty.

The apex of each cone is called *papilla renalis*, and in the centre of each papilla is a slight depression called *foveola*.

Each papilla is surrounded by a small membranous cup called *infundibulum*,<sup>4</sup> into which the urine is first received as it oozes from the orifices of the papillæ. Four or five of these infundibula join to form a common trunk called *calyx*,<sup>5</sup> and the junction of about three calyces form a common cavity called the *pelvis*,<sup>6</sup> which is of a conoidal shape, and from which proceeds the *ureter*,<sup>7</sup> the excretory tube of the kidney which conveys the urine to the bladder.

The *ureter*<sup>3</sup> is a cylindrical tube of the size of a quill, with thin, white, extensible walls. Crossing in its descent the iliac artery, it enters the inferior fundus of the bladder very obliquely, and opens by a very small orifice. It consists of two coats; the external of which is fibrous, and the internal is mucous. The structure of the calyces and infundibula is the same.

#### SUPRA-RENAL CAPSULES.

The *capsulæ renales*<sup>1</sup> (fig, 99), are two small borders, varying much in size, placed one on each side just above the kidney, and reposing on its upper extremity. They are of a light brown colour, and surrounded by condensed cellular tissue. In foetal and youthful life they are much larger than in adult life, and hence it is supposed that the use is confined to that period of life, as in the case of the thymus gland. They are of a triangular or semicircular shape, the base being excavated where it is adjusted to the kidney. Having no secretion they of course have no duct.

They are supplied by the *capsular* artery, a branch of the renal or aorta.

#### WOOLFIAN BODIES.

These structures exist only until the sixth month of foetal life. Before this period they conceal the kidney and renal capsule. They consist of tubes which empty into the sinus uro-genitalis, a duct peculiar to foetal life.

## BLADDER.

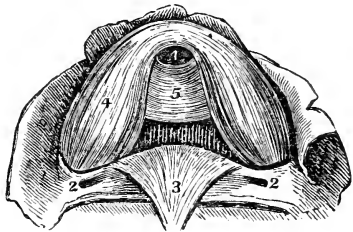
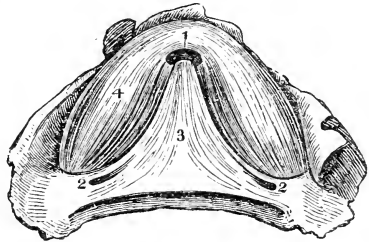
The bladder is a musculo-membranous sac for the reception of urine. It is situated in the anterior and middle portion of the cavity of the pelvis, and connected with the umbilicus by means of a kind of ligament called the *urachus*.<sup>1</sup> (Fig. 101.)

Its *shape* is oval, the larger end being downwards; in women and children it is more spheroidal. It is divided into a superior and inferior *fundus*, a *body*, and *neck*.

Its *dimensions* vary with health and disease. An ordinary healthy bladder will hold nearly a pint. The *round ligaments* of the bladder were formerly the umbilical arteries, and are contained in a fold of peritoneum on each side of the superior fundus.

The bladder has four coats: viz., the *peritoneal*, which only covers the posterior part of the body and superior fundus. The *muscular* coat is thicker than that of the intestine; the fibres are pale, and pass in various directions. The *cellular* coat is thick and dense, very distensible and impervious to water. It connects the muscular and mucous coats and transmits the vessels and nerves. The *mucous* coat is of a light pink colour, and has an epithelium. It has numerous follicles, which are exceedingly small. The *vesical triangle* is a space within the cavity of the bladder, and included between the two orifices of the ureters<sup>2</sup> and the orifice of the urethra. In the anterior angle there projects in the bladder the *uvula vesicæ*, a prominence of the third lobe of the prostate, covered by the mucous membrane. Under the mucous membrane of the vesical triangle is a plane of fibres,<sup>3</sup> connected with the orifice of the ureters,<sup>2</sup> and ductus ejaculatorius. Surrounding the neck of the bladder is the *sphincter vesicæ*, which consists of a semicircular<sup>4</sup> and a transverse<sup>5</sup> set of fibres.<sup>1</sup> The latter are composed of yellow fibres. (Fig. 100.)

Fig. 100.

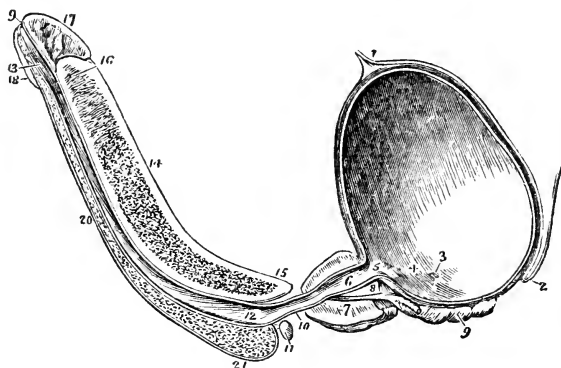


## PENIS.

The penis conveys the urine from the bladder, and the semen

into the female. The anterior extremity or head is the *glans*,<sup>17</sup> the posterior extremity is the *root*, and the intervening part is the *body*, which consists of two structures, the *corpus cavernosum* and *corpus spongiosum*.

Fig. 101.



The skin of the penis is thin and delicate, and has numerous hairs and sebaceous follicles. Surrounding the glans is a loose doubling called the *prepuce*, which is connected to the orifice of the urethra by a vertical process called the *frænum*.

The base of the glans has a thick rim or edge around its base, the *corona glandis*, behind which the penis is narrow, and this portion is known as the *neck* or *collum*. The *glands of Tyson* are the sebaceous follicles, numerous about the *neck* and *crown*, and whose secretion is called *smegma*.

Beneath the skin is the *fascia* of the penis, which is formed of condensed cellular tissue, and is in fact a continuation and modification of the superficial fascia of the abdomen. That portion which passes from the pubis to the penis is the *ligamentum suspensorium*, which is triangular in shape and vertical in position, and antero-posterior in direction. The fascia of the penis may be said to be formed, by the penis being included between two laminæ of this ligament.

The *corpus cavernosum* forms the largest part of the penis, and is in shape a double cylinder. At the root these cylinders are separate and pointed, and called the *crura*<sup>15</sup> of the penis—each crus is firmly attached to the ramus of the pubes and ischium, constituting the origin of the penis. *Externally* the corpus cavernosum is covered by a dense, thick, fibrous, and elastic coat. *Internally* it consists of a spongy structure made up of cells, which readily communicate with the arteries and veins. There are some arteries

which do not terminate, however, in these cells, but in blind tufts, called *helicine arteries*. The two cylinders are partially separated from each other by the *septum pectiniforme*, a partition which is more complete behind than before, and whose fibres being vertical, somewhat resemble the teeth of a comb, whence the name.

The *corpus spongiosum*<sup>20</sup> occupies the same position with relation to the corpus cavernosum, as a ramrod does to a double-barrelled gun; being a longitudinal groove on its inferior surface, the nutritious vessels occupying a corresponding position above. It is covered by a dense fibrous covering also, but it is thinner than that of the corpus spongiosum. *Internally* it is composed of cells, which are larger than those of the corpus cavernosum.

Posteriorly it touches the triangular ligament; this extremity is enlarged into what is called the *bulb*,<sup>21</sup> which lies between the divergent crura of the penis; anteriorly it forms the glans penis.<sup>17</sup>

The *urethra* is the urinary canal or tube from the bladder, and perforates the corpus spongiosum. It consists of two coats; the external is formed of yellow elastic tissue, and often called muscular; the internal is mucous, and continuous with that of the bladder. Its course is curved and its diameter varies. The first part perforates the middle of the prostate gland, and is termed the *prostatic portion*;<sup>6</sup> this is an inch in length, and in it we find the *uvula vesicae* behind and looking into the bladder; and a triangular elevation of mucous membrane in front, called the *caput gallinaginis* or *verumontanum*, at the base of which are the orifices or orifice of the ejaculatory duct. The next portion is the *membranous*;<sup>10</sup> this is eight or ten lines in length, and is very narrow; it is surrounded by loose tissue, and a few muscular fibres called the muscle of Guthrie and Wilson. It perforates the triangular ligament. The urethra now perforates the corpus spongiosum, not directly at its pendulous tip, but through its superior convexity just in advance of this extremity—there the urethra is of course called *bulbous*;<sup>12</sup> this portion is the longest, and commences with an enlargement; gradually it diminishes in diameter until it reaches the glans, in which it again enlarges and constitutes the *fossa navicularis*.<sup>13</sup> When the urethra is relaxed, longitudinal folds exist in this portion. Numerous mucous follicles are also readily seen, of which the largest is in the *fossa*. The orifices of Cowper's glands open obliquely upon the mucous membrane also, about an inch in front of the glands.

The penis is supplied by the internal pudic arteries and pudendal nerves.

#### VESICULÆ SEMINALES.

The seminal vesicles consist of two convoluted tubes placed at the posterior and inferior portion of the bladder. They are oblong in shape, and converge downwards and forwards. Each appears to be about two inches in length, but when cleanly dissected and

unravelled, it is a tube five inches in length, with numerous pouches or cæca.

The duct of the vesicle is joined by the vas deferens on either side in the prostate gland; the junction forms the *ductus ejaculatorius*, which, passing through the prostate, opens into the urethra in front of the *caput gallinaginis*. They contain a mixture of mucus and semen.

#### PROSTATE GLAND.

This is a dense hard structure, about the size of a horse-chestnut, which surrounds the neck of the bladder and the commencement of the urethra. It is of a light colour, and somewhat triangular in shape, the point being in front. It is placed between the rectum which is behind, and the triangular ligament in front.

It is enveloped in a fascia; and may be divided into two lateral and a middle lobe. The urethra perforates the middle lobe,<sup>8</sup> and the projection of the *uvula vesicæ* and *verumontanum* are partially formed by it.

Its structure is composed of tubes united by condensed and hard cellular tissue. The secretion is thick and white, and is discharged by orifices into the urethra on each side of the *verumontanum*.

*Cowper's glands*.<sup>11</sup>—These are two in number; placed in front of the prostate, and included between the two laminæ of the triangular ligament. They are about the size of a pea, and of a yellow colour; secreting a mucous fluid which is discharged into the urethra about an inch in front of the gland.

#### SCROTUM AND TESTICLES.

The scrotum is a bag-like covering for the testicles formed externally of skin, which is of a dark colour, and thickly covered by hairs and studded with sebaceous follicles. The skin is loose and thin; on its middle is a ridge still darker in colour, which reaches from the anus to the prepuce, called the *raphe*. The transverse wrinkles of the scrotum which cold produces, are due to a structure immediately beneath and intimately connected with the skin, called the *dartos*.

The *dartos* is a dense, reddish, contractile covering, divided by a partition into two bags. It was once considered muscular, and the remains of the *gubernaculum testis*; it is partly composed of the yellow fibrous elastic tissue. Its contractions are involuntary.

The position of the testicle in *fœtal* life, and its descent, have been noticed under the head of inguinal hernia. Beneath the *dartos* is a covering of fascia, which may be called the *tunica vaginalis communis testis*, partly formed by the superficial and transversalis fasciæ.

The *cremaster* muscle sends a few fibres and loops upon the anterior and upper part of the testicle.

The *tunica vaginalis testis* or *peritestis*, is the next covering. A serous membrane lining the cavity and reflected over the testicle within; it was originally peritoneum, and is the seat of hydrocele.

The *testicles* are the glands for the secretion of semen. They are two in number, oval in shape, and flattened laterally. They hang obliquely by the spermatic cord, being attached above the middle of the posterior edge; the right being higher than the left.

The *tunica albuginea*,<sup>2</sup> is the dense, white, thick, fibrous coat of the testicle, which gives it shape. In structure it resembles the dura mater or sclerotica; externally it is covered by a portion of the peritestis, which is transparent and very closely adherent; from its internal face are given off numerous partitions called *septulæ testes*, and which uniting at the posterior edge of the testicle, form that prismatic ridge termed *corpus Highmorianum*.<sup>3</sup>

The testicle is formed by *lobules*, each placed within the spaces between the septulæ. Each lobule<sup>3</sup> consists of a *tubulus seminiferus*, very finely convoluted. This tube becoming straight forms the *vas rectum*;<sup>4</sup> the union of which makes the *rete testis*,<sup>5</sup> which is in the corpus Highmorianum; from the upper part of this rete proceed 15 or 20 tubes through the tunica albuginea; they are called *vasa efferentia*;<sup>6</sup> each vas efferens is convoluted in a conical form, and termed *conus vasculosus*; the union of the coni vasculosi forms the commencement of the epididymis.

The *epididymis*<sup>8</sup> is that vermiform appendage encircling the posterior edge, as a crest upon a helmet. It is soft and formed of a single convoluted tube, originating by the junction of the bases of the coni vasculosi. The upper extremity is the larger, and called *globus major*,<sup>7</sup> and the lower is *globus minor*.<sup>9</sup> From the globus minor this tube ascends in a less convoluted form, under the name of the *vas deferens*,<sup>10</sup> which forms one of the constituents of the cord. Connected with the epididymis is the *vasculum aberrans*,<sup>11</sup> a small, blind, convoluted duct.

Fig. 102.

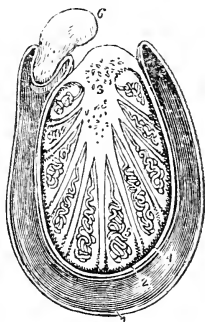
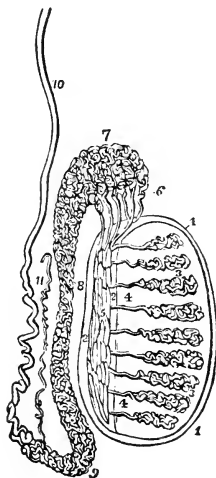


Fig. 103.



## SPERMATIC CORD.

Each spermatic cord consists of an artery and vein, and nerves, together with the duct, vas deferens. These constituents are united by cellular tissue, which may be the remains of that canal of peritoneum peculiar to fœtal life.

It is covered by the fascia transversalis prolonged from the abdomen, and also the cremaster muscle, which has been previously described.

The *spermatic artery* comes from the aorta, and sometimes from the renal. It is tortuous, and after passing through the rings divides into two or three branches; the termination of the artery is larger than its origin.

The *spermatic veins* are very tortuous and numerous, and on account of their vine-like appearance are termed *vasa pampiniformia*. The seat of circocele.

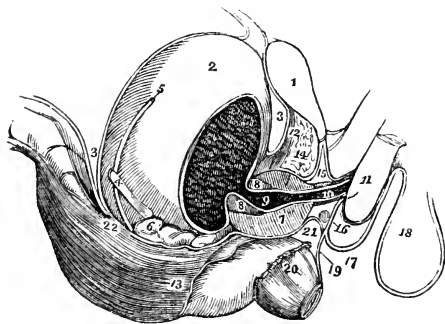
The *external spermatic nerves*, and also branches of the abdomino-crural, supply the muscular structure; filaments of the sympathetic run also to the testicle.

The *vas deferens* is a continuation of the epididymis. Passing through the cord and rings, it descends behind the bladder and joins the duct of the vesiculæ seminales. It is very hard, and readily recognised by touch; its walls are extremely thick, and its bore almost capillary. It is nearly white, and thicker than a knitting needle.

## THE PERINEUM.

The perineum is that space included between the anus, arch of the pubis, and the tuberosities of the ischia, and a correct knowledge of it is of great importance to a surgeon.

Fig. 104.



In a proper dissection the removal of the skin reveals the *superficial fascia*, which is continuous with the superficial fascia of other parts of the body. When this is removed, the *perineal fascia* is exhibited, which is a

dense, thin, and tough fascia,<sup>17</sup> adhering to the rami of the pubes and ischium on each side; in front it is continuous with the dartos<sup>18</sup>



of the scrotum ; behind it is continuous with the base of the triangular ligament by its anterior lamina,<sup>16</sup> and also with the *anal fascia*,<sup>19</sup> a portion of the pelvic fascia. It is this connexion which prevents the urine infiltrating the fascia lining the cavity of the pelvis, which would be most disastrous, and which also renders fluctuation indistinct in abscess of the perineum. If this be turned up, the muscles of the perineum will be exposed.

The *triangular ligament*<sup>15</sup> fills up the arch of the pubis, and is shaped as its name implies. It is a fibrous membrane, separating the pelvis from the perineum ; the base is not so dense and fibrous as its apex, and joins the perineal and anal fascia.<sup>21</sup> It is perforated by the membranous portion of the urethra, about one inch below the symphysis.

It consists of two laminae,<sup>16 21</sup> between which are situated Cowper's and the prostate gland ;<sup>7</sup> thus the fascia of the prostate, as it is usually called, is merely the posterior lamina of the triangular ligament.

#### PELVIC FASCIA.

This fascia is continuous with the transversalis and iliac fascia, surrounding that portion of the peritoneum which lines the pelvis. Like all fasciæ it is easily divided into laminae ; different portions receiving different names.

It may be said to commence at the brim of the pelvis, and by its intervention the different viscera are united with each, and held in their proper positions. Thus, two processes of it on the sides of the bladder form the *anterior ligaments of the bladder*. A layer covering the obturator muscle is called the *obturator fascia*. The levator ani is included between two layers of this fascia ; that portion between the rectum and bladder is called the *recto-vesical fascia* ; and that which covers the lower part of the rectum is the *anal fascia*.

#### MUSCLES OF THE PERINEUM AND ANUS.

*Erector penis*.<sup>3</sup>—*Origin*, from the tuberosity of the ischium. *Insertion*, by a broad flat tendon into corpus cavernosum.

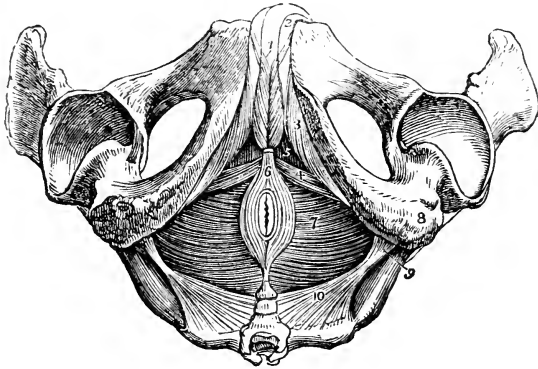
*Accelerator urinæ*,<sup>1</sup> or *ejaculator seminis*.—It lies on the bulb of the corpus spongiosum. *Origin*, from the crus of the penis, and the ramus of the pubes ; and also by a tendinous membrane which is between the corpus spongiosum and corpus cavernosum, and continuous with the fascia of the penis. The fibres are semi-pennate, and with those of its fellow surround the bulb. *Insertion*, by a white tendinous line into its fellow, and into the *perineal centre*, which is formed by the junction of several muscles.

*Transversus perinei*.<sup>4</sup>—*Arises* from the tuberosity of the ischium,

and is *inserted* into the perineal centre. Sometimes there is an additional portion in front, called *transversus perinei alter*.

*Sphincter ani*.<sup>6</sup>—A thick muscular ring surrounding the anus. Its superficial fibres are elliptical. It is connected with the coccyx and perineal centre.

Fig. 105.



*Coccygeus*.<sup>10</sup>—*Origin*, from the spine of the ischium. *Insertion*, into the side of the coccyx and last bone of the sacrum.

*Sacro-coccygeus*.—A few fibres passing from the sacrum to the coccyx in front.

*Levator ani*.<sup>7</sup>—Is a plane of muscular fibres. *Origin*, from the interior of the body of the pubes, the superior edge of the thyroid foramen, and the spine of the ischium. *Insertion*, by converging and descending fibres into the lateral semi-circumference of the rectum; also into the coccyx and perineal centre.

## ORGANS OF RESPIRATION AND CIRCULATION.

### LARYNX.

The *larynx* is a canal formed of cartilages which move in such a manner as to regulate the voice.

It is situated in the upper and anterior part of the neck, in the median line, below the hyoid bone.

It forms the commencement of the windpipe; is cylindrical below, but prismatic above; it is larger in males than in females.

The cartilages of the larynx are five in number; thyroid, cricoid, two arytenoid, and epiglottis.

The *thyroid* is the largest; it occupies the upper and anterior

portion of the larynx. It consists of two quadrilateral plates, which are united in an acute angle in the median line in front; this angle is usually called the *pomum Adami*,<sup>5</sup> which is much larger in men; it has a deep notch at its upper part.<sup>4</sup> The upper edge<sup>3</sup> is curved, and has the middle thyreo-hyoid ligament attached to it; the lower edge<sup>6</sup> is also curved, and to it is attached the middle crico-thyroid ligament. The posterior edge<sup>7</sup> terminates in two processes called cornua, of which the *superior*<sup>8</sup> is the longer, and is attached to the lateral thyreo-hyoid ligament.

The *inferior cornu*<sup>9</sup> is short and curved, and receives the lateral crico-thyroid ligament. Upon the external surface<sup>1</sup> is an oblique ridge, passing between two tubercles, from which arise the thyreo-hyoid and inferior constrictor muscles.

The *cricoid cartilage* is next in size, and situated at the base of the larynx; its form is that of a thick ring compressed laterally; its lower edge<sup>3</sup> is circular, and attached to the trachea; its upper edge is oval and oblique, on account of the cartilage being three times as thick behind as it is in front; the posterior portion of the superior edge has two heads<sup>4</sup> of a peculiar convexity, for articulating with the arytenoid cartilages; the external surface posteriorly is flattened, giving origin to the posterior crico-arytenoid muscle. (Fig. 107.)

Fig. 107.

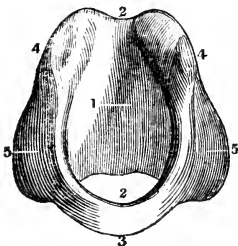


Fig. 108.

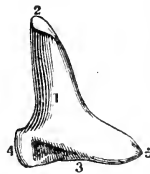


Fig. 109.



The *arytenoid cartilages* are two in number, situated at the upper and back portion of the larynx, and are of a pyramidal shape.

The base<sup>3</sup> is concave, and articulates with the heads of the cricoid ; the apices<sup>2</sup> have attached to them a small cartilage called *corniculum laryngis*, or *tubercles of Santorini*. The posterior surface<sup>1</sup> is triangular and concave, for the insertion of the posterior crico-arytenoid muscle ; the internal surface is flat, and can be adjusted to its fellow ; the anterior surface is uneven, to which are attached the superior and inferior thyreo-arytenoid ligaments. (Fig. 108.)

The *epiglottis cartilage* is a thin, oval, cartilaginous plate, behind the root of the tongue, and attached to the angle of the larynx ; it resembles a leaf in shape ; its direction is vertical ; its inferior extremity<sup>4</sup> is thin and pointed ; its superior edge is thin, its anterior surface<sup>1</sup> is slightly convex, and its posterior<sup>2</sup> concave. It is perforated by numerous foramina. (Fig. 109.)

These cartilages are held together by numerous ligaments, of which the principal are, the *middle thyreo-hyoid* ; a thin membranous expansion between the inferior circumference of the hyoid bone and the superior edge of the thyroid cartilage : the *lateral thyreo-hyoid* ; which is funicular, extending from the great cornu of the thyroid cartilage to the tubercle of the cornu of the hyoid bone ; in it is found a small oval cartilage or bone, called *cartilago triticea* ; the *middle crico-thyroid*, a thick membrane filling up the space between the superior edge of the cricoid and inferior edge of the thyroid cartilages ; this is usually divided in the operation of laryngotomy ; the *lateral crico-thyroid*, reaching from the inferior cornu of the thyroid to the side of the cricoid ; a *capsular ligament* surrounds the joint between the arytenoid and cricoid.

Within the larynx are two *thyreo-arytenoid ligaments* on either side. The *inferior* ligaments extend from the angle of the thyroid to the base of the arytenoid, and are usually called the vocal cords ; the space between them is the *rima glottidis*. The *superior* ligaments extend from the angle of the thyroid to the middle of the arytenoid cartilages. These ligaments are not cords as they appear, but merely edges of a membrane lining the larynx, and composed of yellow elastic fibrous tissue.

The mucous membrane lining the larynx is continuous with that of the mouth, and forms numerous folds between the cartilages, of which the most remarkable is a pouch between the superior and inferior thyreo-arytenoid ligaments, which has been called the *ventricle* of the *larynx*. To the ventricle of either side is attached an additional pouch, which is called the *sinus of Morgagni*. In the fold between the arytenoid and epiglottis cartilages is a small gland called the arytenoid, which is of the shape of the letter L.

*The muscles of the larynx* move the various cartilages and modulate the voice.

*Thyreo-hyoid*.—This was described with the muscles of the neck.  
*Crico-thyroid*, arises from the anterior and lateral surfaces of the

cricoid, and passes backwards to be inserted into the inferior cornu of the thyroid; it draws these two cartilages together obliquely.

*Posterior crico-arytenoid*,<sup>5</sup> arises from the flat surface on the back of the cricoid, and is inserted into the posterior part of the base of the arytenoid; it draws the arytenoid backwards, and thus tightens the vocal ligaments. (Fig. 110.)

*Lateral crico-arytenoid*.<sup>6</sup>—Arises from the side of the cricoid, and is inserted into the side of the base of the arytenoid; it separates the arytenoid, and widens the glottis.

*Thyreo-arytenoid*.<sup>7</sup>—Arises from the posterior face, and near the angle of the thyroid, and is inserted into the anterior surface of the arytenoid, which it draws forwards, and thus relaxes the vocal ligaments.

*Oblique arytenoid*.<sup>5</sup>—It consists of oblique fibres arising from the tip of one cartilage, and inserted into the top of another. (Fig. 111.)

*Transverse arytenoid*.<sup>6</sup>—Arises from the side of one cartilage, and is inserted into the side of the other. These last two muscles are often considered as one, and by them the glottis is narrowed.

*Thyreo-epiglottideus*.—Consists of a few fibres passing between these two cartilages.

*Aryteno-epiglottideus*, are also a few indistinct fibres passing between the cartilages from which it derives its name. These last two draw the epiglottis downwards.

Fig. 110.

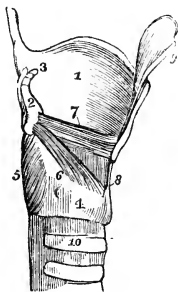
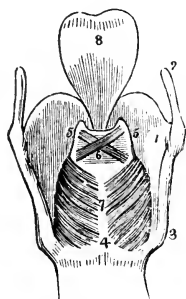


Fig. 111.



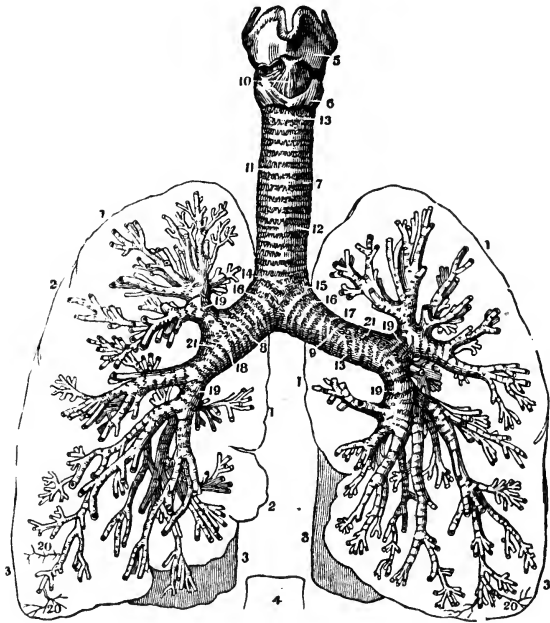
#### TRACHEA.

The trachea is a cylindrical tube, four or five inches in length, reaching from the larynx as low as the third dorsal vertebra, where it divides into the *bronchi*. It is formed of from *sixteen to twenty cartilages*, united by *ligamentous* tissue, which is of an elastic character. Each ring is about two lines broad and constitutes two-thirds of a circle; the first ring is the largest, and the last ring is of such a shape as to be adapted to the first rings of the bronchi.

The posterior third of the trachea is completed by a *muscular* structure, whose fibres are transverse, and the contraction of which diminishes its diameter, by which expectoration is facilitated; it is lined by a *mucous* membrane continuous with that of the larynx, which is extremely vascular, and covered with numerous follicles.

At the bifurcation of the trachea into the bronchi, there are a number of hard, *black* glands, which are lymphatic in their character, and called bronchial from their position. The *bronchi* are essentially of the same structure and arrangement as the trachea; the right bronchus is shorter and of a larger diameter than the left; they soon

Fig. 112.



ramify into numerous subdivisions, which finally terminate in the lobules of the lungs. In the smaller ramifications of the bronchi there is some modification of structure; the tube is no longer flattened behind, because the cartilages form complete circles; each cartilaginous ring is not composed of a single piece, but of several segments of a circle; there is also a semilunar cartilage at each of the lesser bifurcations.

#### THYROID GLAND.

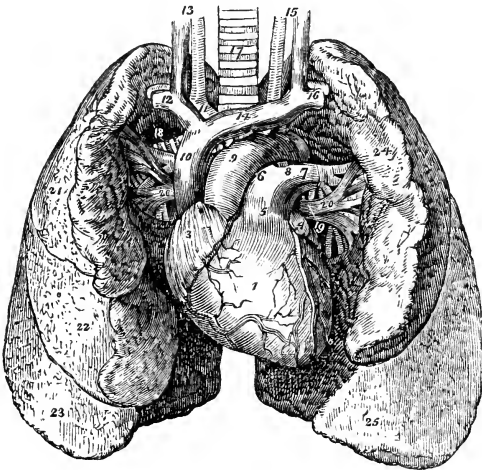
It is situated in front of the first rings of the trachea, and upon the sides of the larynx; it consists of two lateral lobes, placed on either side, united by a narrow isthmus in front; it is extremely vascular, of a brownish colour, and of tolerably firm consistence. It is gra-

nular in its structure, has no excretory tube, but very large lymphatic vessels. It is supplied by the superior and inferior thyroid arteries. It is sometimes much enlarged, constituting bronchocele or goître.

## THE LUNGS.

The lungs are the organs of respiration properly; they are two in number, and situated in the thorax, placed side by side, being separated from the abdomen by the diaphragm. The size varies with the capacity and condition of the thorax, age, inspiration, ex-

Fig. 113.



piration, and disease. They are conical in shape, are longer posteriorly than anteriorly, and have concave bases. The colour of the lungs is of a pinkish-gray, mottled with black; these black spots are more numerous in adult life than in infancy.

The *right* lung is shorter but larger than the left, whose transverse diameter is somewhat diminished by the position of the heart. It has three lobes, the left having but two.

The *structure* of the lungs is spongy, and its compression between the fingers produces a crackling called *crepitation*. It consists of a number of air-vesicles held together by cellular tissue, called *parenchyma*; through which blood-vessels and air-vessels are ramified. A certain number of air-cells communicate with each other, and with a single branch of the bronchial tube; these are separated

from neighbouring cells by partitions of parenchyma, and thus are formed *lobules*. These subdivisions are evident upon the external surface of the lung. The air-vesicles are formed of ligamentous tissue lined by a mucous membrane.

The *root* of the lung, consists of the bronchus, pulmonary artery, two pulmonary veins, bronchial artery and vein, nerves, and lymphatics. These enter upon its internal surface, and in some degree retain the lung in its proper position. The branches of the pulmonary artery terminate in capillaries, upon the walls of the air vessels, from which arise the branches of the pulmonary veins.

The bronchial artery is the nutritious artery of the lung. Its nerves are derived from the sympathetic and eighth pair.

#### PLEURÆ.

The pleura is a serous membrane investing each lung, and then reflected upon the parietes of the chest. That portion in contact with the chest is called *pleura costalis*; that covering the lung, *pleura pulmonalis*. It also covers the diaphragm and the root of the lung, between which there exists a fold called *ligamentum pulmonis*.

#### MEDIASTINUM.

The space between the two pleuræ of the lungs is called the mediastinum, and it is divided, by the position of the heart, into the anterior, posterior, and superior mediastinum.

The *anterior mediastinum* is that space between the sternum and the heart; it contains some loose cellular tissue, and a portion of the remains of the thymus gland.

The *posterior mediastinum* is that portion between the vertebral column and the heart, and through it passes the œsophagus, par vagum nerve, aorta, vena azygos, and the thoracic duct.

The *superior mediastinum* is above the heart, and surrounded by the first ribs and sternum; it contains the roots of the large vessels, and the remains of the thymus gland.

#### THYMUS GLAND.

This is a triangular body of a pinkish hue, occupying a portion of the superior and anterior mediastina. It grows until the end of the second year, after which it diminishes, and almost entirely disappears. It has a large lymphatic vessel, which has been supposed to be an excretory duct. Its structure is lobulated, and surrounded by loose cellular tissue.

#### THE HEART.

The heart is a hollow muscular organ, situated between the two



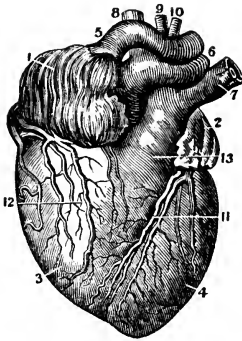
pleuræ, and resting upon the cordiform tendon of the diaphragm, in the cavity of the thorax; it is surrounded by a membrane called the pericardium. Its *shape* is conoidal, its apex inclines to the left side, touching the walls of the thorax, between the fifth and sixth ribs. It is somewhat flattened upon that side which rests upon the tendon of the diaphragm. It *measures* five inches and a half from its apex to its base, three inches and a half in the diameter of its base, and *weighs* about six or eight ounces. It contains *four cavities*, and performs two functions, that of receiving the blood and throwing it into the lungs, and that of receiving it again after it has been oxygenated, and distributing it throughout the body. The *auricles* are receptacles, and the *ventricles propel* the blood to the lungs and through the system.

The auricle and ventricle of the *right side* receive and propel the venous blood into the lungs. The auricle and ventricle of the *left side* receive and propel the arterial blood.

The *circulation* of the blood is as follows: the ascending and descending vena cava empty the venous blood into the right auricle; from here it passes to the right ventricle, through an opening protected by a valve opening downwards; from the right ventricle it is propelled through the pulmonary artery, which divides into two branches, to the lungs; after it has been subjected to the influence of the respiratory process, it is brought from the lungs, by four pulmonary veins into the left auricle. The left auricle has an opening into the left ventricle, protected by a valve opening downwards, and from the left ventricle it passes into the aorta, thence to be distributed throughout the body.

The *right auricle*<sup>4</sup> is an irregularly-shaped cavity, somewhat oblong and cuboidal; anteriorly it has a convexity which is called its *sinus*, superiorly there is an elongated process resembling the ear of an animal, whence the term auricle. Its walls are thin, and composed of muscular fibres, which from their parallel arrangement resemble the teeth of a comb, and hence are called *musculi pectinati*. The superior<sup>5</sup> and inferior vena cavæ enter the auricle from behind, and between their orifices there is an elevation called *tuberculum Loweri*. On the septum or partition between this and the left auricle, is a depression called *fossa ovalis*, where formerly existed the foramen ovale of foetal life; the ring or edge surrounding it, is called the *annulus ovalis*, from which there extends downwards to the inferior semi-circumference of the ascending cava, a crescentic doubling of the lining membrane, which is the remains of the *Eustachian valve*. The *coronary veins* open into this cavity, and their orifice is protected by the *valve of Thebesius*. The opening to the ventricle, called the *ostium venosum*, is circular and surrounded by a dense white line.

Fig. 114.



The *right ventricle*<sup>3</sup> is a triangular cavity, with thick walls, and containing more than any other cavity of the heart. Its muscular structure is in the form of large fleshy fibres, called *columnæ carneæ*, from which proceed thin, white cords, called *chordæ tendineæ*, which are attached to the edge of the *tricuspid valve*. The tricuspid valve is circular, and attached to the tendinous line of the ostium venosum; its lower edge has three spear-pointed or leaf-like processes, whence its name; since it opens downwards, the contraction closes the ostium venosum, and prevents the blood from returning into the auricle, and therefore it passes out by the *pulmonary artery*. The orifice of the *pulmonary artery* is protected by three valves opening outwards, which are called semilunar valves, formed by three crescentic folds of the lining membrane; in their loose edges is a small tubercle, called *corpus arantii*: the use of these valves is to prevent the blood returning from the artery to the ventricle, when it dilates. Behind each valve is a pouch or dilatation, called the *sinus of Valsalva*, into which the blood flows by its reflux tendency, upon the dilatation of the ventricle, and thus these valves are closed. The *pulmonary artery* is of the same diameter as the aorta, but its walls are thinner; after its origin it curves upwards and backwards, and divides into two branches, the right of which is both longer and larger than the left,<sup>7</sup> and passes under the arch of the aorta.

The *left auricle*<sup>2</sup> is more concealed in its natural position than the right. Into it enter four pulmonary veins, which give it a quadrangular shape. Its walls are muscular, and somewhat thicker than those of the right auricle. In its ear-like appendage the muscular fibres are arranged as *musculi pectinati*; the opening, by means of which it communicates with the right ventricle, is called *ostium venosum*, and surrounded by a white tendinous ring. The septum between the auricles is not always perfect in adult life.

The *left ventricle*.<sup>4</sup>—This cavity forms the apex of the heart; it is conoidal in its shape. Its walls are thick, and its *columnæ carneæ* numerous, strong, and projecting; the *chordæ tendineæ* are well developed, and attached to the *bicuspid* or *mitral valve*. This valve consists of but two leaflets, one of which is much larger than the other; its base is attached to the ring surrounding the ostium venosum, and its edge opens downwards into the left ventricle, hence the contraction of the ventricle closes this opening, and the blood passes out by the *aorta*,<sup>6</sup> at whose orifice there are three *semilunar* or *sigmoid* valves, each having a corpuscle of Arantius in its edge, and

*sinuses* of Valsalva or Morgagni behind them. The vessels supplying the heart with blood are the right and left coronary arteries;<sup>11 12</sup> the veins which accompany them empty by a common trunk into the right auricle. The nerves are derived from the cardiac plexuses of the sympathetic.

#### PERICARDIUM.

The pericardium is a membranous sac, in which the heart is contained. It consists of two layers, the external of which is fibrous, dense and white, and the internal is serous. The serous lamina lines the fibrous layer, and then is reflected over the heart and the roots of its vessels.

### SECTION V. VESSELS.

#### STRUCTURE OF ARTERIES.

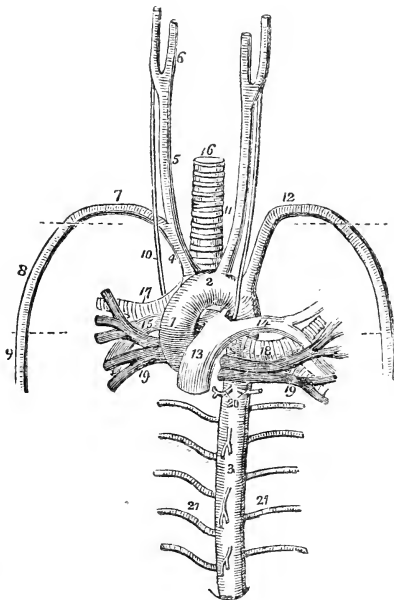
*Arteries* are composed of three coats, external, middle and internal. *The external* is firm and strong, formed of condensed cellular tissue; it does not yield upon the application of a ligature.

*The middle* is formed of elastic, fibrous tissue, and was formerly called the muscular coat. It is thick, and its fibres are arranged circularly; in which direction they readily yield to a ligature.

*The internal* is a thin, serous covering, which diminishes the friction of the passage of the blood. It is smooth and transparent, and readily torn.

*Arteries* convey blood from the heart, and *veins* carry blood to the heart; thus, the pulmonary artery contains blue or what is usually called venous blood, and the pulmonary veins contain red or what is termed arterial blood. The nutri-

Fig. 115.



tious vessels of the arteries are called *vasa vasorum*, and their nerves are derived from the sympathetic.

### A O R T A .

The aorta arises from the left ventricle, and *arches* backwards and towards the left side. This *arch*<sup>1 2</sup> frequently has an enlargement, which is called its *sinus*; under it passes the right branch of the pulmonary artery.—The descending aorta<sup>3</sup> while passing through the thorax is termed *thoracic*, and while passing through the abdomen, *abdominal*.

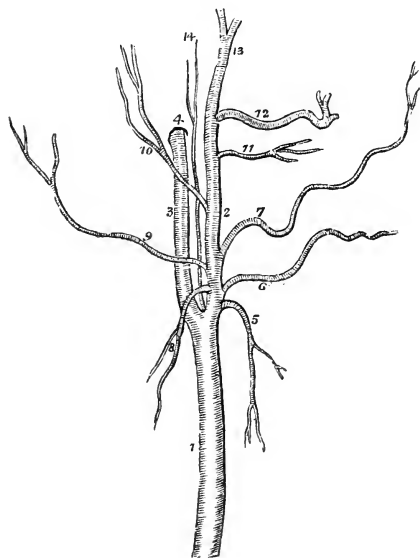
The *coronary* arteries are the first branches of the aorta, and are distributed to the heart, through the grooves between the auricles and ventricles. They arise just beyond the semilunar valves.

The *Innominate*.<sup>4</sup> This artery arises from the arch of the aorta, is an inch and a half in length, ascends obliquely towards the right side in front of the trachea, and behind the sterno-clavicular articulation, divides into the right carotid and right subclavian. (Fig. 115.)

The *right carotid*<sup>5</sup> ascends the neck as far nearly as the hyoid bone, where it divides into the external and internal carotids.

The *left carotid*<sup>11</sup> arises from the arch of the aorta, ascends the neck and divides as the right. Each primitive carotid is on the inner side of the internal jugular vein, with which and the par vagum nerve it is included in a sheath. (Fig. 115.)

Fig. 116.



### EXTERNAL CAROTID.

It ascends perpendicularly from the bifurcation, and passing through the deep portion of the parotid gland it divides into the *internal maxillary*<sup>12</sup> and *temporal*.<sup>13</sup>

*Superior thyroid*,<sup>5</sup> arises near the root of the external carotid and is its first branch; it pursues a curved course and is distributed to the thyroid gland, after giving off a *laryngeal branch*. (Fig. 116.)

*Lingual*<sup>6</sup> ascends obliquely from its origin, which is just above the superior thyroid. It courses between the muscles of the tongue, giving off the dorsalis linguæ, sublingual and ranine branches.

*Facial*.<sup>7</sup>—This arises above the lingual, is tortuous, becomes imbedded in the submaxillary gland, and then passes over the lower jaw, and gives off several branches to the face.

*Sub-mental*, arises from the last, and supplies the chin.

*Masseteric*, also arises from the facial, and is distributed to the masseter muscle.

*Inferior labial*, is spent upon the integuments and muscles between the chin and the lip.

*Superior and inferior coronary*, surround the lips and mouth. The remainder of the facial artery is distributed by a branch upon the side of the nose and the inner angle of the eye, where it anastomoses with the ophthalmic.

*Inferior pharyngeal*,<sup>14</sup> arises near the bifurcation of the carotid or from the external carotid, and is distributed to the pharynx. It often gives off the *posterior meningeal*, which enters the cranium through the *posterior foramen lacerum*.

*Occipital*,<sup>9</sup> arises from the external carotid a little below the facial, forming a loop with the hypoglossal nerve; is distributed upon the muscles and integuments, anastomosing with the temporal and its fellows.

*Mastoid*.<sup>8</sup>—This branch is irregular and uncertain in its origin, and supplies the muscles and glands of the neck.

*Posterior auricular*,<sup>10</sup> arises from the external carotid, ascends obliquely backwards, beneath the parotid gland, and passing between the external meatus and mastoid process, is distributed upon the integuments. A branch of it, called *stylo-mastoid*, enters the stylo-mastoid foramen.

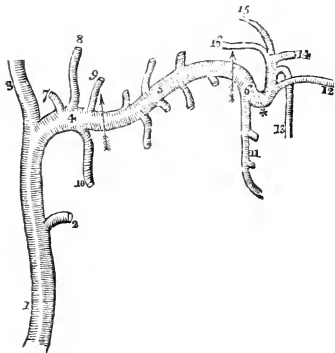
*Transversalis faciei*,<sup>11</sup> arises from the temporal and sometimes from the carotid; and crossing the masseter muscle parallel with the duct of Steno, is distributed upon the face.

*The anterior posterior and middle temporal* are the terminating branches of the temporal artery. The *anterior* is distributed upon the temple and arch of the skull. The *posterior* is distributed upon the integuments on the back of the head. The *middle* perforates the temporal fascia and supplies the temporal muscle.

## INTERNAL MAXILLARY.

This<sup>4</sup> commences at the bifurcation of the external carotid, and pursues a very tortuous course, supplying the back portions of the

Fig. 117.



mouth and palate. At first it is horizontal, then ascending, it terminates in a horizontal course. Its branches are numerous, and as follow: (Fig. 117.)

*Tympanic*,<sup>7</sup> is distributed to the tympanum through the glenoid fissure.

*Meningea magna*,<sup>8</sup> passes through the foramen spinale and becomes the middle artery of the dura mater.

*Meningea parva*,<sup>9</sup> arises from the last or near to it, and is also distributed to the dura mater, having entered the cranium through the foramen ovale.

*Inferior dental*,<sup>10</sup> descends to the posterior mental foramen, and supplies the teeth of the lower jaw, then emerging at the anterior mental foramen, anastomoses with the facial.

*Deep temporal*.—These are two branches distributed to the temporal muscles.

*Pterygoid and Buccal*.—These are muscular branches supplying the muscles and the lining of the cheek.

*Superior dental, or alveolar, or maxillary*,<sup>11</sup> descends, and winding round the tuberosity of the upper jaw, gives off branches to the molar teeth, antrum, and gums.

*Infra-orbital*,<sup>12</sup> enters the orbit of the eye, and passes along the infra-orbital canal; it sends branches to the teeth and integuments.

*Superior palatine*,<sup>13</sup> passes through the posterior palatine foramen, and supplies the mouth and palate.

*Superior pharyngeal*,<sup>15</sup> supply the upper part of the pharynx and the Eustachian tube; from it arises the *vidian*.<sup>16</sup>

*Spheno-palatine*,<sup>14</sup> enters the nose through the spheno-palatine foramen, and is distributed by branches to the mucous membrane of the nose.

#### ARTERIES OF THE BRAIN.

The arteries at the base of the brain are derived from the vertebrals and internal carotids. (Fig. 118.)

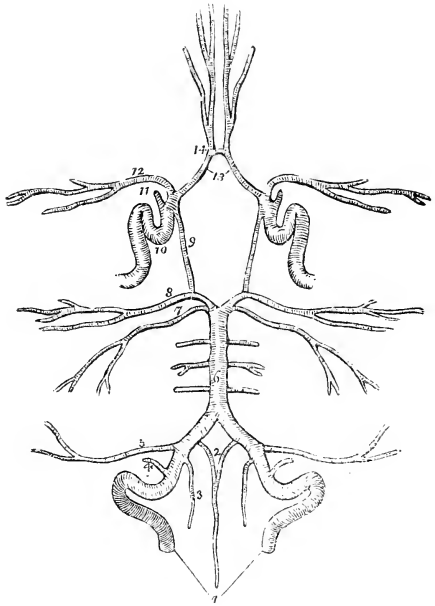
The *vertebral* arteries<sup>1</sup> enter the cavity of the cranium through the foramen magnum occipitis, and coalescing, form a thick trunk called the *basilar*.<sup>6</sup> Previous to their union are given off the *anterior*<sup>2</sup> and *posterior*<sup>3</sup> spinal. Sometimes the *inferior cerebellar* arises from the vertebral also. The basilar pursues its course along the median line of

the pons varolii, giving off several branches in its course. The principal being the *superior cerebellar*<sup>7</sup> and the *posterior cerebral* arteries.<sup>8</sup>

The *posterior communicating*<sup>9</sup> joins the carotid with the posterior cerebral.

From the carotid, which enters through the carotid canal, are given off the *ophthalmic*,<sup>11</sup> *middle cerebral*,<sup>12</sup> and *anterior cerebral* arteries.<sup>13</sup> The two anterior cerebral arteries are connected by a transverse branch<sup>14</sup> called the *anterior communicating* artery, and thus is formed the circle of Willis. These vessels are distributed to the *pia mater*, and the substance of the brain.

Fig. 118.

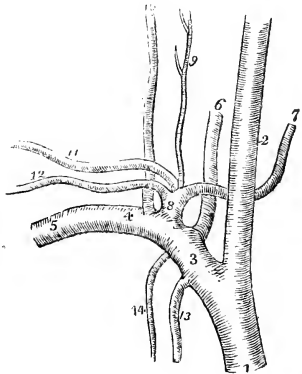


## SUBCLAVIAN.

The *subclavian*<sup>3</sup> of the right side arises from the innominate,<sup>1</sup> and the subclavian of the left side from the arch of the aorta. The right is shorter and more superficial than the left. The subclavian emerges from the thorax by passing over the first rib between the anterior and middle scaleni muscles. Its branches are usually five in number. Some of which arise by a common origin<sup>8</sup> called the *thyroid axis*.

*Vertebral*,<sup>6</sup> is the first and largest branch of the subclavian. It passes through the foramina of the transverse processes of the six superior cervical vertebræ, and enters the cavity of the cranium through the foramen magnum occipitis.

Fig. 119.



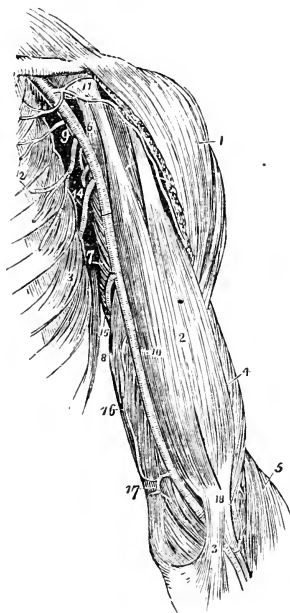
*Inferior thyroid*,<sup>7</sup> ascends obliquely from the subclavian and supplies the thyroid gland, giving off the *ascending* or *superficial cervical*.<sup>9</sup>

*Superior intercostal*,<sup>14</sup> arises from the subclavian, and descending, supplies the two upper intercostal spaces.

*Internal mammary*,<sup>13</sup> is larger than the last, and entering the cavity of the thorax, descends within a few lines of the sternum, giving off branches to the diaphragm, thorax, and abdomen.

*Posterior cervical*,<sup>11</sup> arises from the subclavian in an irregular manner, and winding round the root of the neck, supplies the muscles upon its back. Another large artery is frequently given off from the subclavian called *profunda cervicis*.<sup>10</sup> The subclavian artery, passing under the subclavian muscle, is afterwards called *axillary*.

Fig. 120.



#### AXILLARY.

The branches of this artery may also be considered five in number, although there is great irregularity in their mode of origin.

*Supra-scapular*.—This usually arises from the axillary, but sometimes from the thyroid axis, as is seen in the last figure.<sup>12</sup> It passes over the scapula, and supplies its muscles, sending a branch through the coracoid notch.

*External mammary*.—Usually are four in number, arising singly or together, from the axillary. They are the *acromial thoracic*,<sup>11</sup> distributed upon the shoulder; *superior* and *inferior thoracic*,<sup>12</sup> which are long branches, upon the *pectoralis major* and *serratus magnus* muscles, and the *axillary thoracic*, which is

distributed to the fat and glands of the axilla.

*Scapular*.<sup>14</sup>—This is the largest branch of the axillary; it passes along the lower border of the subscapular muscle, and gives off a large branch called *dorsalis scapulae*, which anastomoses with the super-scapular.

*Anterior and Posterior Circumflex*, arise from the axillary, opposite the neck of the humerus. The anterior is small and supplies



the front of the joint; the posterior large, and passes backwards, supplying the joint and deltoid muscle.

## BRACHIAL.

The *brachial* artery extends from the axillary to the elbow joint, descending upon the inner edge of the biceps flexor muscle, in company with the median nerve. (Fig. 120.)

*Profunda major*,<sup>15</sup> arises from the brachial at its upper part, and passing between two heads of the triceps muscle, with the spiral nerve, supplies the external portion of the arm.

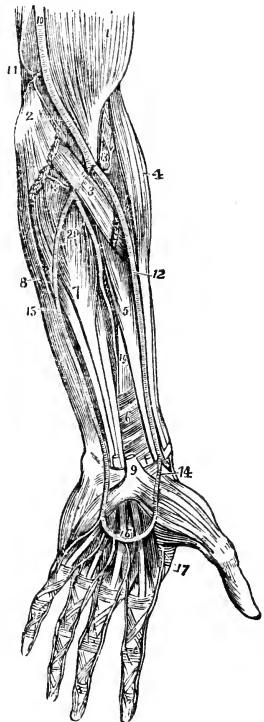
*Profunda minor*,<sup>16</sup> is small, arises below the last, is distributed superficially about the internal condyle, and anastomoses with the radial recurrent.<sup>18</sup>

*Nutritious* artery, arises opposite the nutritious foramen of the humerus, which it enters to supply the bone.

*Anastomotic*,<sup>17</sup> arises from the brachial just above the elbow, and winding round the internal condyle, anastomoses with the ulnar recurrent.

The brachial passing under that portion of the brachial fascia which is connected with the tendon of the biceps, now usually divides into the radial and *ulnar*, although this division may take place at any point between the arm-pit and elbow.

Fig. 121.



## RADIAL.

The *radial*<sup>12</sup> is more superficial than the ulnar. It descends the outer side of the arm,<sup>12</sup> between the tendons of the supinator radii longus and flexor carpii radialis.

*Radial recurrent*,<sup>13</sup> arises from the radial and inosculates with the profunda major. In its descent, the radial gives off numerous muscular branches, until it reaches the wrist, it then passes backwards under the extensor tendons of the thumb.

*Superficialis volæ*, is given off from the radial, and distributed upon the palmar surface of the thumb, joining the superficial arch.

*Dorsalis carpi*, arising from the radial, is distributed upon the back of the wrist beneath the extensor tendons.

*Magna pollicis*, one of the terminating branches of the radial, supplying the thumb.

*Radialis indicis*,<sup>17</sup> arises in connexion with the last, and is distributed upon the radial side of the forefinger.

*Palmaris profunda*, another terminating branch, which passes between the flexor tendons and bones of the metacarpus, to join the cubitalis manus of the ulnar.

#### U L N A R .

It passes<sup>15</sup> under the bellies of several muscles arising from the internal condyle, and descends the inner side of the arm, between the tendons of the flexor carpi ulnaris and flexor sublimis muscles; then passes over the annular ligament of the wrist, to form the superficial arch. (Fig. 121.)

*Ulnar recurrent*,<sup>18</sup> arises from the ulnar near its commencement, and winding under the internal condyle, anastomoses with the anastomotic.

*Interosseous*, arises from the ulnar opposite the tubercle of the radius, and divides into an anterior and posterior branch, the anterior interosseous descending to the wrist in front of the interosseous ligament; the posterior perforating the ligament, is distributed to the extensor muscles of the arm.

*Dorsalis manus*, arises from the ulnar, and is distributed upon the back of the hand.

*Superficial arch*,<sup>16</sup> is a continuation of the radial artery, immediately beneath the palmar fascia.

*Cubitalis manus profunda*, a branch of the ulnar, arising near the superficial arch; it joins the deep arch.

*Digital arteries*.—These are three in number, which divide into the digito-radial and digito-ulnar, for each side of the finger. The ulnar side of the little finger is supplied by a distinct branch from the superficial arch.

#### T H O R A C I C A O R T A .

*Bronchial*,<sup>20</sup> vary in size and origin; sometimes arising by a common trunk; they enter the root of each lung, and supply its parenchymatous structure, glands, &c. (Fig. 115.)

*Æsophageal*,<sup>3</sup> are from four to six in number, arising from the anterior convexity of the aorta, to be distributed to the œsophagus.

*Intercostal*.<sup>21</sup>—These are ten in number on each side, arising from the posterior convexity of the aorta.

They supply the ten inferior intercostal spaces, the right being

somewhat longer than the left. They are received in the intercostal groove upon the under edge of each rib, for two-thirds of its length.

ABDOMINAL AORTA.

*Phrenic.*<sup>1</sup>—These are two in number, one for each side of the diaphragm, to which they are distributed; sometimes they arise by a common trunk and from the cœliac.

*Celiac axis.*<sup>2</sup>—A short, thick trunk about half an inch in length, given off opposite the junction of the last dorsal and first lumbar vertebra; it divides into the gastric, hepatic, and splenic.

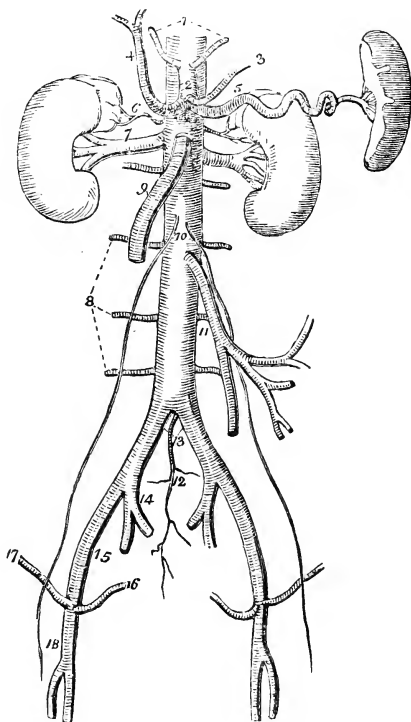
*Gastric,*<sup>3</sup> is the smallest branch of the cœliac, and supplies the lesser curvature of the stomach.

*Hepatic,*<sup>4</sup> enters the transverse fissure of the liver and divides into two or three branches, before entering the substance of the liver. It gives off the *cystic*, which supplies the gall-bladder, and the *right gastro-epiploic*, which supplies the right side of the greater curvature of the stomach.

*Splenic.*—This is the largest branch of the cœliac. It is very tortuous and passes transversely to the spleen over the upper edge of the pancreas; from it are given off the *vasa brevia* and *left gastro-epiploic arteries*, supplying the left extremity and left side of the greater curvature.

*Superior mesenteric,*<sup>9</sup> arises below the cœliac and is nearly as large. It passes beneath the pancreas and over the colon, and is distributed by a number of branches to the small intestine, and by these branches to the right side of the large, viz.: *ileo-colic,*<sup>15</sup> supplying the cæcum and a portion of the ileum; *colica dextra,*<sup>14</sup> supplying

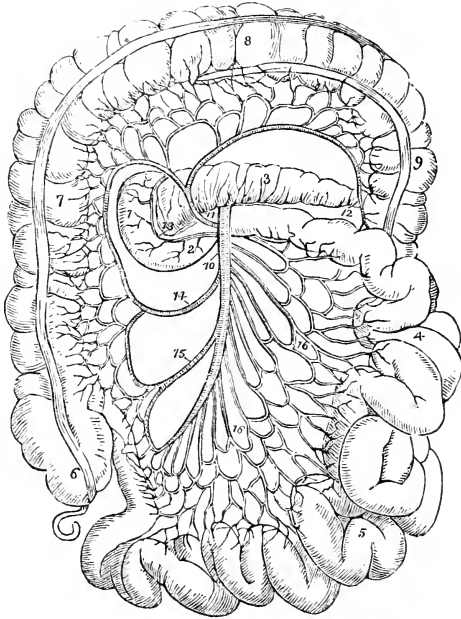
Fig. 122.



the ascending colon, and *colica media*,<sup>11</sup> supplying the arch of the colon. (Fig. 123.)

*Capsular*,<sup>6</sup> arise from the aorta or renal, and supply the suprarenal capsules.

Fig. 123.



*Renal or emulgent*.<sup>17</sup>—These are of large diameter, though not very long. They pass transversely to the kidney, and divide into several branches before entering it. The right is longer and more oblique in its course than the left, and is partly concealed by the ascending vena cava. (Fig. 122.)

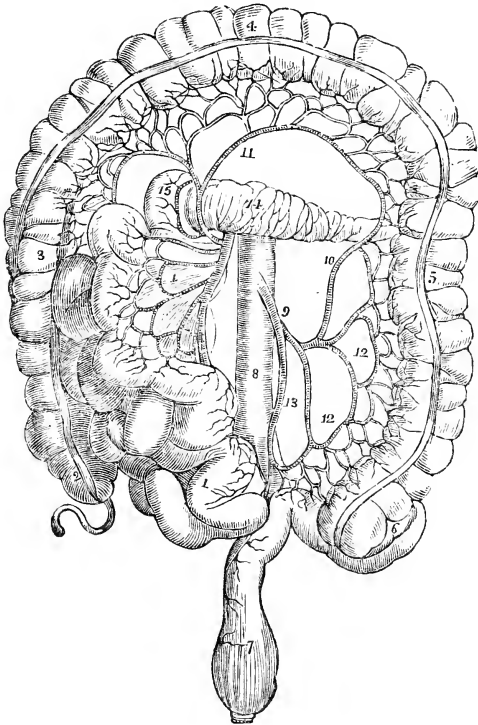
*Spermatic*.<sup>10</sup>—These are about the size of a large knitting-needle, arising from the aorta and sometimes from the renal. They are tortuous in their course and pass through the abdominal rings; after which they divide into several branches before reaching the testicles.

*Inferior mesenteric*,<sup>11</sup> arises from the aorta an inch above its bifurcation. (Fig. 124.) It is about the size of a goose-quill, and gives off the *superior left colic*,<sup>11</sup> *middle left colic*,<sup>12</sup> and *inferior left colic* arteries, which supply the descending colon and also the *superior hæmorrhoidal*,<sup>13</sup> which is distributed to the upper part of the rectum.

*Lumbar.*<sup>8</sup> (Fig. 122.) Arise on each side of the aorta, are four or five in number; they correspond with the intercostals of the chest, and supply the loins, &c.

*Middle sacral.*<sup>12</sup>—Is the termination of the aorta arising at its bifurcation into the iliacs. It descends along the median line of the sacrum.

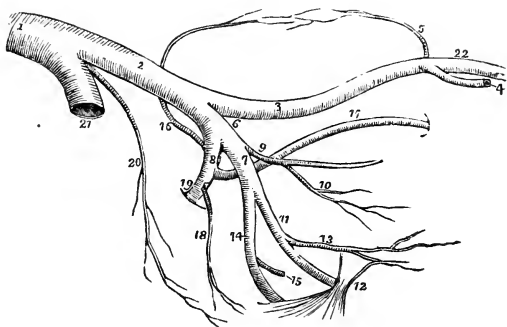
Fig. 124.



## COMMON ILIAC.

The aorta<sup>1</sup> divides into the *iliacs* about the fourth lumbar vertebra. The iliac<sup>2</sup> descends obliquely outwards to the sacro-iliac articulation, being crossed by the ureter, and divides into the *external* and *internal iliac*.

Fig. 125.



## INTERNAL ILIAC.

This is a short trunk,<sup>6</sup> descending from the sacro-iliac junction into the cavity of the pelvis, and giving off numerous branches with great irregularity and variety from its two principal trunks, the *gluteal*<sup>9</sup> and *ischiatic*.<sup>7</sup>

*Ilio-lumbar*.<sup>16</sup>—Arises from the internal iliac or one of its principal trunks, ascends outwardly toward the crest of the ilium, and is spent upon the loins, &c.

*Obturator*.<sup>17</sup>—May arise at various parts of the internal iliac, and passing forwards below the brim of the pelvis, escapes from it at the upper part of the thyroid foramen; it is distributed by two branches upon the obturator and adductor muscles.

*Lateral sacral*.<sup>18</sup>—This artery sends four branches through the anterior sacral foramina, or they may be several distinct arteries with different origins.

*Gluteal*.<sup>19</sup>—Is a continuation of the posterior trunk. It passes out of the pelvis at the upper part of the sacro-sciatic notch above the pyriformis muscle, and is distributed by two or three branches to the glutei muscles.

*Vesical*.<sup>10</sup>—Arises from the remains of the *umbilical*, or from the internal iliac, and is spent upon the bladder. There is sometimes an inferior vesical.<sup>15</sup>

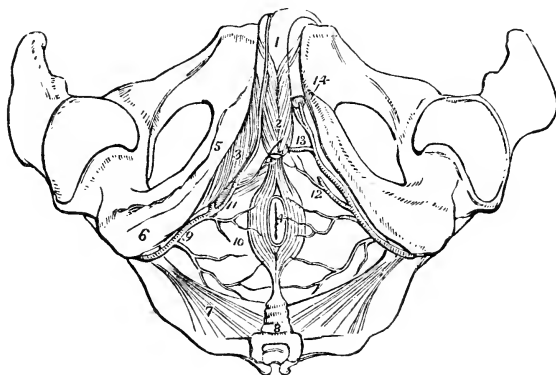
*Middle hæmorrhoidal*.<sup>13</sup>—Is of variable size and origin. It is distributed to the rectum, vesiculæ seminales and prostate gland.

*Ischiatic*.<sup>14</sup>—Is the anterior of the two principal trunks of the internal iliac. It passes out of the pelvis through the sciatic notch, between the pyriformis muscle and great sacro-sciatic ligament. It supplies the muscles on the floor of the pelvis and back of the thigh.

*Internal pudic*.<sup>11</sup>—Arises from the last, previous to its emergence

from the pelvis, from which it escapes and returns between the sciatic ligaments; ascending upon the ramus of the ischium it supplies the penis and perineum.

Fig. 126.



*Lower hæmorrhoidal.*<sup>10</sup>—Arises from the internal pudic, and is distributed upon the anus and rectum. There are sometimes two arteries.

*Transverse perineal.*<sup>11 12</sup>—Arises near the crus of the penis, and runs across the transverse perineal muscles. It is cut in the lateral operation for lithotomy.

*Urethro-vulvar.*<sup>13</sup>—Is given off from the pudic near its perforation of the triangular ligament, and enters the corpus spongiosum.

*Dorsal.*—Ascends until it gets under the arch of the pubis, and then runs along the back of the penis.

*Cavernous.*<sup>14</sup>—Another terminal branch which enters the corpus cavernosum.

## EXTERNAL ILIAC.

This artery extends from the sacro-iliac junction along the inner border of the psoas muscle to the crural arch; when it passes under Poupart's ligament it becomes *femoral*.

*Epigastric.*<sup>4</sup>—Arises from the external iliac just behind Poupart's ligament, and ascends obliquely upwards and inwards, under the transversalis fascia, and between the two abdominal rings, whereby it is endangered in the operation for hernia. A branch of it supplies the cremaster muscle.

*Circumflex ilii* arises from the external iliac, opposite the epigastric, and ascends obliquely until it reaches the crest of the ilium, where it supplies the muscles of the loins and abdomen. The last two arteries anastomose freely with the internal mammary and lumbar arteries.

#### FEMORAL.

This artery commences at Poupart's ligament, being a continuation of the external iliac. It passes down the inner side of the thigh, and perforating the tendon of the adductor magnus muscle, becomes the *popliteal*. Its upper third is superficial, and upon the outer side of the femoral vein. Its lower two-thirds are covered by the sartorius muscle.

*Superficial artery of the abdomen*,<sup>2</sup> arises from the femoral, just below Poupart's ligament, and ascends obliquely upon the integuments on the lower portion of the abdomen. It may be cut in the operation for inguinal hernia.

*External pudics*.<sup>16</sup>—These are several branches, arising from the upper part of the femoral, and distributed to the integuments.

*Profunda*<sup>17</sup> is almost as large as the femoral, from whence it arises at about two inches below Poupart's ligament.

*External circumflex* is a branch of the profunda, and passes outwards to supply the upper part of the muscles of the thigh.

*Internal circumflex*<sup>3</sup> is larger than the external, and supplies the muscles upon the inner side of the thigh, and gives off a *perforating* artery. The *perforating* arteries are branches of the internal circumflex and profunda, which supply the muscles upon the back of the thigh.

*Anastomotic*,<sup>19</sup> <sup>6</sup> arises from the femoral, above its perforation of the adductor tendon, and anastomoses with the articular arteries of the knee.

#### POPLITEAL.

This artery is a continuation of the femoral, and extends from the perforation in the adductor tendon, to its division into the anterior and posterior tibial below the knee. (Fig. 128.)

*Superior articular*.<sup>9</sup>—These are two in number, one internal and one external, given off above the condyles, anastomosing with each other and the anastomotic artery.

*Inferior articular*.—These are also external and internal, and supply the knee-joint below the head of the tibia.

*Middle articular*.—Is small, and perforates the ligament of Winslow, to supply the interior of the joint.

*Gemellar*.—These supply the heads of the gastrocnemius muscle.



POSTERIOR TIBIAL.

This artery<sup>11 12</sup> descends the back of the leg, under the muscles which form its calf, and nearer the tibia than the fibula.

*Peroneal or fibular,*<sup>13 14</sup> arises from the posterior tibial, and divides into several branches, which are distributed upon the muscles arising from the fibula.

ANTERIOR TIBIAL.

This artery perforates the interosseous membrane, at its upper part, and descends in front of it to the ankle. Its upper third is situated between the tibialis anticus and extensor longus digitorum muscles; below, it runs between the tibialis anticus and extensor proprius pollicis. In its course it gives off numerous muscular branches, and when it reaches the ankle becomes more superficial, being covered by the tendons upon the instep.

*Recurrent tibial,*<sup>10</sup> ascends beneath the tibialis anticus, and anastomoses with the arteries of the knee-joint.

*Internal malleolar.*<sup>14</sup>—Arises from the anterior tibial above the ankle joint, and is distributed upon its inner side.

*External malleolar.*<sup>17</sup>—Arises below the last, and is distributed upon the outside of the ankle.

*Tarsal.*<sup>8</sup>—Arises from the anterior tibial, and arches transversely across the tarsus, beneath the extensor brevis digitorum muscle.

*Metatarsal.*<sup>14</sup>—Arches across the bases of the metatarsal bones, and gives off three interosseal branches, which supply the toes.

*Dorsal.*<sup>15</sup>—Is the terminating branch of the anterior tibial, and

Fig. 127.

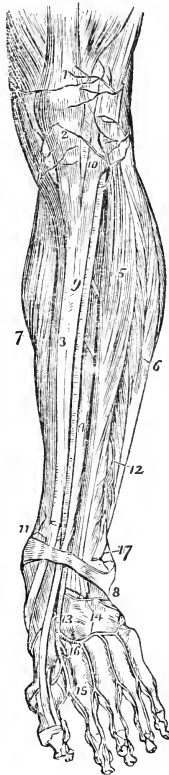


Fig. 128.

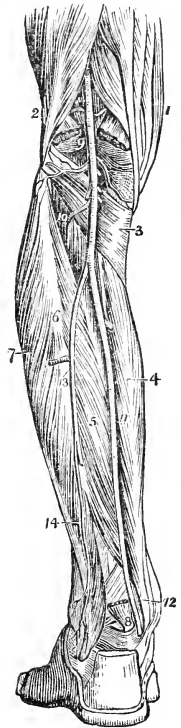
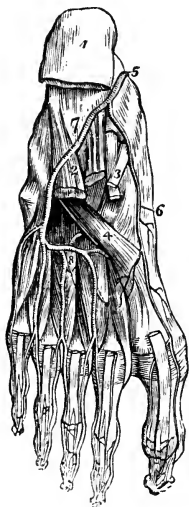


Fig. 129.



supplies the outer side of the great toe and the inside of the second toe.

*Pedal.*<sup>16</sup>—This branch forms the communication between the anterior tibial and external plantar arteries. It descends to the sole of the foot, through the first interosseous muscle.

#### PLANTAR.

These arteries are branches of the posterior tibial,<sup>5</sup> which reach the sole of the foot, through the sinuosity of the os calcis.

*External plantar.*<sup>7</sup>—This is the larger of the two, and passing obliquely outwards upon the sole of the foot, it forms a *deep arch*<sup>8</sup> above the muscles of the foot. From it are given off digital arteries for the supply of the interosseous spaces, and which, bifurcating into the external and internal branches, supply the toes. The external plantar terminates in the pedal artery.

*Internal plantar.*<sup>6</sup>—This is a small artery, which passes along the inner border of the foot, and terminates in the digital artery of the great toe.

#### VEINS.

The veins return the blood to the heart. They are much more numerous than the arteries; the deep arteries having two accompanying veins called *venae comites*. Their walls have the three coats, but they are much thinner than the arteries; this deficiency, particularly in the middle elastic coat, gives them a flaccid appearance when empty, whereby they can be readily distinguished from arteries, which retain their cylindrical character.

They differ from arteries also, in having numerous valves opening towards the heart, which are more numerous in the superficial veins.

These valves are formed of two or three crescentic folds of the lining membrane, and give the veins a knotty appearance when injected.

*Sinuses* are channels conveying venous blood and lined by the internal coat of the veins.

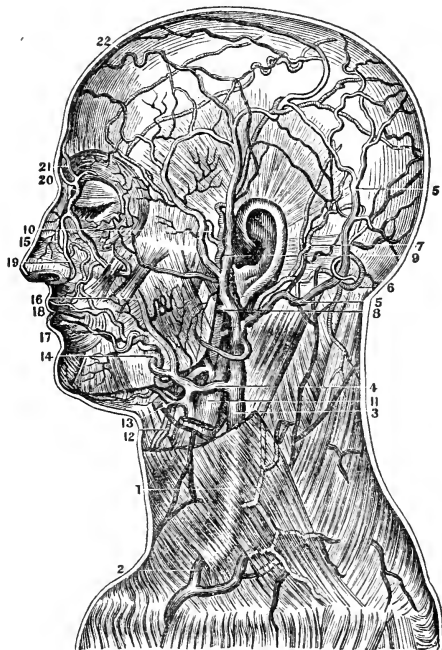
The distribution and anastomoses of the veins are much more irregular than those of the arteries.

#### VEINS OF THE HEAD AND NECK.

The venous blood from the face is for the most part collected by veins accompanying the arteries, and which have the same name.

The principal trunks, viz., the *temporal*, *internal maxillary*, and *occipital*, join to form a superficial vein of the neck, called *external jugular*.

Fig. 130.



*External jugular.*<sup>3</sup>  
—Receives the blood from the temporal,<sup>8</sup> occipital,<sup>5</sup> and internal maxillary. It commences at the lower edge of the parotid gland, and descends the neck superficially, being merely covered by the skin, platysma myoides muscle, and superficial fascia. Its course is towards the middle of the clavicle. It crosses obliquely the sterno-cleido-mastoid muscle, and empties into the subclavian outside of the origin of this muscle. It is frequently selected for bleeding in children.

*Internal jugular.*<sup>11</sup>  
—This vein is the largest of the neck. It receives the blood from the sinuses of the cranium, and also from some superficial veins.

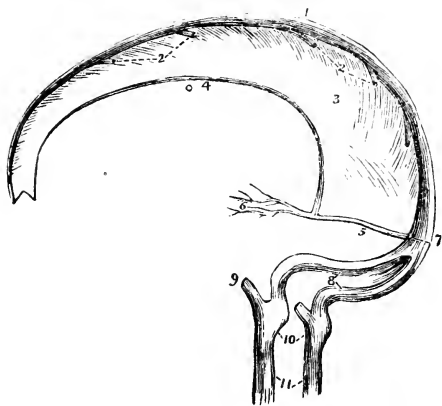
The facial vein<sup>16</sup> empties into the internal jugular, and also forms a communication<sup>4</sup> between it and the external jugular. It descends the neck in a sheath with the carotid artery, being on the outer side. The par vagum nerve is in the same sheath. The vein empties into the subclavian on the inner side of the origin of the sterno-cleido-mastoid muscle. This junction forms the *innominata*.

#### SINUSES OF THE DURA MATER.

These are channels between the laminae of the dura mater, which remove the blood from the brain. (Fig. 131.)

*Superior longitudinal sinus.*<sup>1</sup>—This is a triangular channel, commencing at the foramen cæcum by a small vein from the nose, and gradually increasing in size by the junction of the veins of the pia mater<sup>2</sup> in an oblique manner, forms an arch in the median line of the arch of the cranium, which terminates at the internal occipital

Fig. 131.



cross in an enlargement called *Torcular Herophili*;<sup>7</sup> where it is joined by other sinuses.

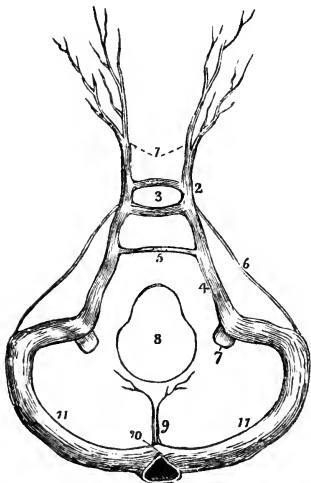
*Inferior longitudinal sinus.*<sup>4</sup>—This is situated in the inferior margin of the falx cerebri; it empties into the straight sinus at the anterior edge of the tentorium.

*Straight, or Fourth sinus.*<sup>5</sup>—It reaches from the junction of the superior longitudinal sinus to the torcular Herophili, in the

median line of the tentorium, where it is joined by the falx cerebri.

*Venæ Galeni.*<sup>6</sup>—These veins are in the velum interpositum; they frequently unite into a trunk called *azygos*, before entering the straight sinus.

Fig. 132.



*Lateral sinuses.*<sup>11</sup>—These commence at the torcular Herophili, are oval-shaped channels, and pursue a curved course over the occipital, parietal, and temporal bones, until they reach the posterior foramen lacerum, where they emerge, and form the commencement of the internal jugular vein. In their course they receive blood from several other sinuses. (Fig. 132.)

*Cavernous sinuses.*<sup>2</sup> are venous cells on either side of the *sella turcica*, containing a spongy structure; into them empty the ophthalmic veins,<sup>1</sup> and through them pass the internal carotid artery and the sixth nerve.

*Circular sinus.*<sup>3</sup>—It surrounds the pituitary gland in the *sella turcica*, and communicates upon each side with the cavernous sinus.

*Superior petrosal sinus.*<sup>6</sup>—This is a small sinus, running along the edge of the petrous portion of the temporal bone, and reaches from the cavernous to the lateral sinus.

*Inferior petrosal sinus.*<sup>4</sup>—Extends from the cavernous sinus on either side, along the inferior margin of the petrous portion of the temporal bone, and opens into the lateral sinus near its exit from the cranium.

*Anterior occipital sinus.*<sup>5</sup>—It passes transversely across the basilar process of the occipital bone, between the two inferior petrosal sinuses.

*Posterior occipital sinus.*<sup>9</sup>—This is in the inferior edge of the falx cerebelli, descending from the torcular Herophili; when it reaches the foramen magnum, it bifurcates and empties into the lateral sinus upon either side. This communication is not represented in the diagram.

The venous blood from the channels in the diploic structure empties into the sinuses at the base of the cranium.

*Emissaries of Santorini*, are small veins passing through minute foramina of the bones of the cranium and forming a communication between the vessels of the scalp and the sinuses of the brain.

#### VEINS OF THE UPPER EXTREMITY.

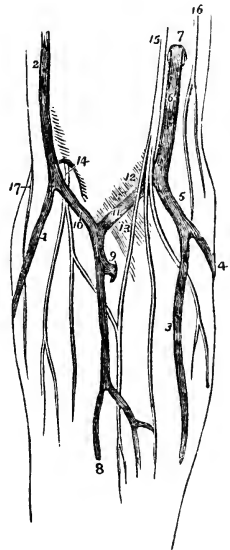
The veins of the upper extremity are *superficial* and *deep*. The *superficial* are readily seen beneath the skin; the deep veins have the usual arrangement of the *venæ comites*. The superficial veins are the following:

*Cephalic.*<sup>2</sup>—This originates upon the thumb by a branch called *cephalica pollicis*, and also upon the back of the hand, and ascending upon the radial side<sup>1</sup> of the fore-arm, is joined at the elbow by the *median cephalic*. It pursues its course along the outer side of the arm, and entering a fissure between the *pectoralis major* and *deltoid* muscle, it enters into the subclavian vein under the clavicle. It sometimes communicates with the external jugular.<sup>2</sup> (Fig. 133.)

*Basilic.*<sup>7</sup> commences with the *vena salvatella* of the little finger, and receiving large branches upon the ulnar side of the fore-arm, it is joined at the elbow by the *median basilic*. It then ascends the arm along the inner edge of the biceps muscle, and about its middle is joined by the *vena comites* to form the *axillary* vein.

*Median.*<sup>8</sup>—This collects the blood from the anterior face of the fore-arm, and near the elbow communicates<sup>9</sup> with the deep veins. It afterwards divides into the *median basilic*<sup>11</sup> and *median cephalic*.<sup>10</sup> The latter is the

Fig. 133.



smaller of the two, and under it pass branches of the external cutaneous nerve.<sup>14</sup> A branch of the internal cutaneous nerve<sup>12 13</sup> passes over the median basilic, and may be cut in bleeding.

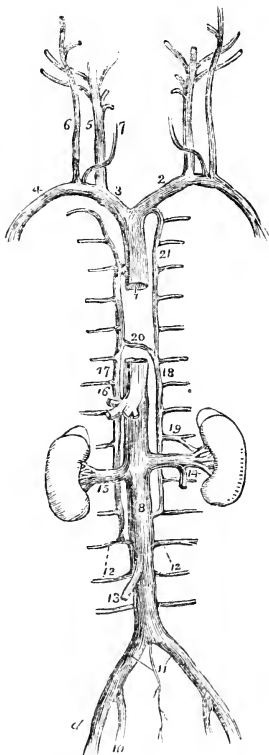
#### SUPERIOR OR DESCENDING VENA CAVA.

The veins which are engaged in forming the descending cava<sup>1</sup> are the right and left vena innominata.

*Right Innominata*,<sup>3</sup> is about an inch and a quarter in length, and is formed by the junction of the internal jugular<sup>5</sup> and subclavian<sup>4</sup> veins. It is situated at the root of the neck, and descends superficially and obliquely in front of the arteria innominata to join its fellow. At this junction it receives the right thoracic duct.

*Left Innominata*,<sup>3</sup>—This is much longer than the right, and is formed in the same manner. It receives at its commencement the left thoracic duct. It passes horizontally across the root of the chest, and is frequently called the *transverse vein*. It joins its fellow to form the *descending cava*.

Fig. 134.



#### INFERIOR OR ASCENDING VENA CAVA.

This is formed by the junction of the iliac veins between the fourth and fifth lumbar vertebræ. It ascends<sup>8</sup> upon the vertebral column to the right of the aorta, and in its course receives the lumbar, right spermatic, renal, and hepatic veins; it then passes through the foramen quadratum of the diaphragm, to enter the right auricle of the heart.

*Spermatic veins*.—These originate in the vasa pampiniformia. The *right*<sup>13</sup> empties into the ascending cava, and the *left*<sup>14</sup> into the left renal.

*Renal or emulgent*.—These are large and return the blood from the kidney to the ascending cava. The *right*<sup>15</sup> is much shorter than the left.

*Hepatic*.<sup>16</sup>—These convey the venous blood from the liver by three large branches, which open at its posterior notch, into the ascending cava.

## VENA AZYGOS.

This vein<sup>17</sup> commences in the lumbar regions, and being joined by the intercostal veins of the right side, winds around the root of the right lung and empties into the descending cava. It also receives the right bronchial and the left superior intercostal veins.

*Vena hemiazygos.*<sup>18</sup>—This is formed by the lower intercostal and superior lumbar veins, and passes in front of the vertebral column to join the vena azygos.

*Left superior intercostal.*<sup>21</sup>—This receives the blood from the sixth superior intercostal and left bronchial veins, and forms a communication between the left subclavian and azygos veins.

The above veins form a communication between the venous blood of the upper and lower extremity, independent of its mingling in the heart. (Fig. 134.)

## PORTAL VEIN.

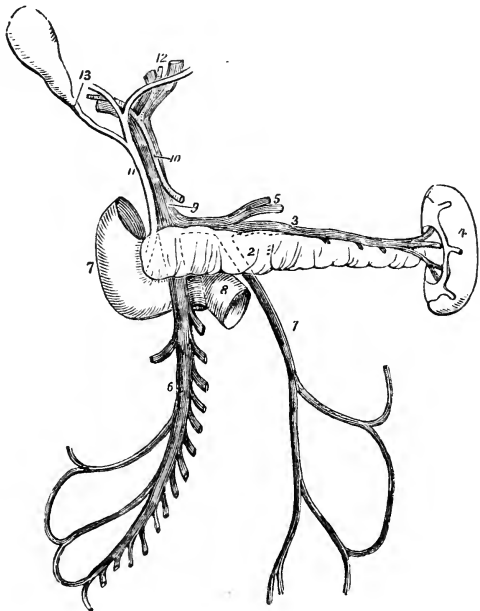
This vein collects the blood from all the chylopoietic viscera,<sup>9</sup> and entering the transverse fissure of the liver, divides into the right and left sinuses. In its course it receives the inferior<sup>1</sup> and superior<sup>6</sup> mesenteric veins, splenic,<sup>3</sup> and gastric;<sup>5</sup> and then is included with the hepatic artery,<sup>10</sup> and the ductus communis choledochus in the capsule of Glisson.

*Vesical plexus.*—This plexus surrounds the neck of the bladder, seminal vesicles, prostate gland, and penis; its blood passes into the internal iliac vein.

*Uterine plexus.*—Surrounds the uterus and vagina and empties as the vesical does.

*Hæmorrhoidal veins.*—Surround the rectum and empty into the inferior mesenteric.

Fig. 135.



## LOWER EXTREMITY.

The superficial veins of the lower extremity are two in number.

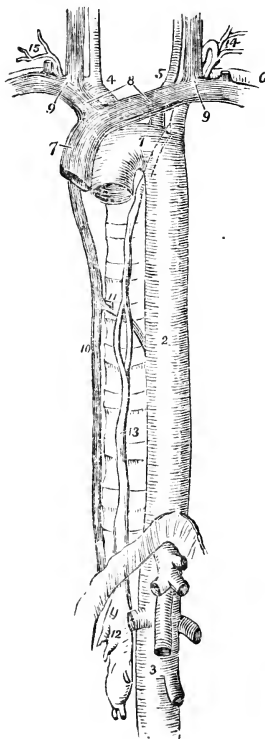
*Internal saphena.*—Commencing upon the inside of the foot and ankle it ascends upon the inside of the leg, and passing over the internal condyle, it traverses the superficial fascia of the thigh and enters the femoral vein at the saphenous opening of the fascia lata.

*External saphena.*—Commencing upon the outer and posterior parts of the foot, it ascends upon the back of the leg and enters the popliteal vein above the knee.

*Popliteal*, is formed by the junction of the deep veins accompanying the anterior and posterior tibial arteries.

*Femoral vein.*—The deep veins of the leg and thigh unite to form the femoral vein, which passes under Poupart's ligament, to become the external iliac vein. It is upon the inside of the femoral artery, and forms the outer boundary of the crural ring.

Fig. 136.



## LYMPHATICS.

Lymphatics are small pellucid vessels found in all portions of the body but the teeth. They are exceedingly numerous, and found most constantly in company with veins.

They enter the lymphatic glands, which are most numerous in the neck, groin, axilla, loins, and mesentery, and then emerge from them.

The lymphatics of the intestine, commence in the villi of the intestine and are often called *lacteals*, and contain the chyle.

They have three coats, like arteries, and present a knotted appearance when distended, owing to the existence of sinuses and valves.

*Left thoracic duct.*<sup>13</sup>—This is the principal lymphatic vessel of the body; it receives the contents of the lymphatics or absorbents of the lower extremity, by an enlargement called *receptaculum chyli*,<sup>13</sup> and entering the thorax through the hiatus aorticus; it traverses the thorax through the posterior mediastinum in front of the vertebral column, and between the vena azygos<sup>10</sup> and aorta.<sup>2</sup>



After reaching the fourth dorsal vertebra it ascends obliquely to the left side, and enters<sup>14</sup> the junction<sup>9</sup> of the left subclavian and the internal jugular veins.

*Right thoracic duct.*<sup>15</sup>—It is a short trunk, formed by the union of the lymphatics of the right side of the head and neck, and right upper extremity. It terminates at the junction of the right subclavian in the right internal jugular vein.

## SECTION VI.

### NERVOUS SYSTEM.

The principal *divisions* of the nervous system are the Brain, Spinal Marrow, and Nerves.

The *tissue* of this system is included in membranes or sheaths, and consists of two differently coloured pulpy materials; one of which is the *white* or *medullary*, and the other the *gray* or *cineritious*.

The *white* or *medullary structure* is *fibrous*; these fibres are looped; in the centre of each is a stripe called the *cylinder axis* of *Purkinje*.

The *gray* is more vascular and is globular in its structure. These globules are kidney-shaped, and contain a vesicular nucleus with a nucleolus. They are soft and of a yellow or brownish colour.

All ganglia and nervous centres consist of a mixture of white fibres and gray globules.

The sheath of the nerves is called the *neurilemma*, and the internal material *neurine*.

An *anastomosis* is the interchange of fasciculi between two trunks; each single fasciculus remaining unaltered by, although in contact with, another.

A *plexus* is a combination of anastomoses into a network.

*Pacinian corpuscles*, are small elliptical bodies, found attached to the ulnar and digital nerves. They are of a dull white colour, or opalescent, and about two-thirds of a line in length.

### MEMBRANES OF THE SPINAL MARROW.

The spinal marrow has three coverings. The *dura mater* is a white fibrous membrane, and is external. It is continuous with that of the brain, and investing the spinal marrow loosely terminates at its inferior extremity in a pointed cul-de-sac. It does not adhere closely to the bony canal, except at the intervertebral foramina, where it affords sheaths for the nerves. Between it and the walls of the bony canal is a quantity of loose cellular tissue infiltrated with fat and serum.

The *arachnoid* is the middle covering. This is a serous membrane, investing the spinal marrow, and lining the inner surface of the *dura mater*, to which it gives a smooth, polished appearance. It is extremely thin and transparent, and destitute of red blood-vessels.

The *pia mater* is the immediate covering. This is a cellular membrane, consisting almost entirely of vessels. It terminates in a round cord-like process, reaching from the end of the spinal marrow to the bottom of the canal, being concealed in the roots of the nerves which constitute the *cauda equina*.

## SPINAL MARROW.

The spinal marrow is the medullary column included in the spinal canal of the vertebræ.

Fig. 137.

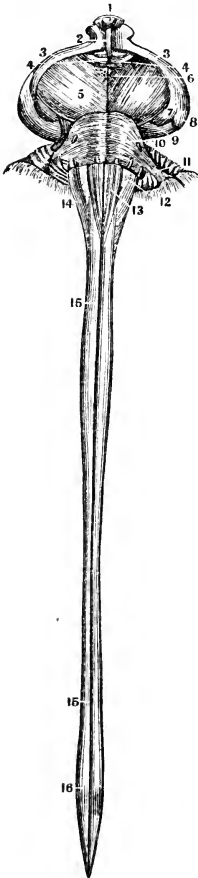


Fig. 138.



It is cylindrical, and reaching from the atlas, terminates in a point at the first or second lumbar vertebra. It is flattened anteriorly and posteriorly, and has an enlargement in the neck and loins. It is divided longitudinally into symmetrical halves, by an anterior and a posterior fissure. The anterior<sup>2</sup> fissure is broad and shallow; the posterior<sup>3</sup> is deep and narrow. Each half is divided unequally by a lateral fissure; the anterior column being the larger.<sup>1</sup>

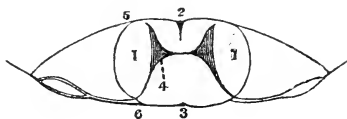
A transverse section of the spinal marrow exhibits the arrangement of its medullary and gray matter. The medullary matter is external, and the gray, in this section, resembles two crescents united by a commissure.

The posterior horns of the crescent extend to the surface in the lateral fissure, in which originates the posterior root of the nerves.

From the sides of the spinal marrow proceed 30 pairs of nerves, each ori-

ginating by two roots; the anterior from the anterior column, and the posterior from the lateral fissure, where they connect with the posterior horns. The posterior is the larger, and upon it is a ganglion, which is in the intervertebral foramen, beyond which the two roots unite. These two roots are separated by the *ligamentum denticulatum*, a process of pia mater, having a serrate appearance, which contains a good deal of yellow fibrous tissue in its structure.

Fig. 139.



## MEMBRANES OF THE BRAIN.

The brain has three membranes, of which the most external is the *dura mater*. It is of the same structure as the dura mater of the spinal cord, composed almost entirely of white fibrous tissue. It consists of two laminæ, which are only separate at the points where the *sinuses* exist.

It adheres firmly to the bones of the cranium, particularly to those at the base of the skull. The internal lamina forms several processes. The *falx cerebri* is a fold of the internal lamina, reaching in the median line from the crista galli to the tentorium, and separating the two hemispheres of the brain. The *tentorium* is another fold, stretched horizontally, and also of a crescentic shape, separating the cerebrum from the cerebellum. The *falx cerebelli* is a smaller fold, reaching from the internal occipital cross to the foramen magnum, and separating the lobes of the cerebellum.

The *arachnoid* is the serous membrane covering the brain, and lining the inner surface of the dura mater. It is thin and transparent.

The *pia mater* is a vascular covering consisting of arteries and veins united by a small quantity of cellular tissue. It passes down in the fissures, between the convolutions, so as to invest them completely. It contains a number of *glands of Pacchioni*, which are usually small and white, but which sometimes are very large, especially in old persons.

## THE BRAIN.

The brain consists of four principal parts: Medulla Oblongata, Pons Varolii, Cerebrum, and Cerebellum.

## MEDULLA OBLONGATA.

This is the upper part of the spinal cord; it is conical in its shape, and extends from the atlas to the pons Varolii. It is divided by the

anterior and posterior fissures into symmetrical halves, and each half consists of three different parts.

*Corpus pyramidale*.—This is a narrow, cylindrical portion, resembling a cord, and situated in front. It communicates freely with its fellow, by a decussation of their fibres, about one inch from the pons.

*Corpus olivare*.—This is an oval, convex mass, behind the corpus pyramidale, from which it is separated by a fissure. It is about half an inch in length. A section of it exhibits an arrangement of cineritious matter called *corpus fimbriatum*.

*Corpus restiforme* is the posterior division of each lateral column, and is separated from the corpus olivare by a groove. Between it and its fellow is a continuation of the posterior fissure called *calamus scriptorius*, across which pass transverse fibres of medullary matter.

#### PONS VAROLII.

This is formed of medullary matter, and is cuboidal in shape. Externally, the fibres are transverse; internally, they are longitudinal, being a continuation of those of the medulla oblongata. It is situated in front of the medulla oblongata, and rests upon the basilar process. From it proceed *four crura*.

#### CEREBRUM.

The cerebrum is an oval mass, weighing from three to four pounds, and divided into two hemispheres by the superior longitudinal fissure. Each hemisphere consists of an anterior, middle, and posterior lobe. The anterior and middle lobes are separated by the fissure of Sylvius. The division between the middle and posterior, is an imaginary line in front of the anterior edge of the cerebellum. The surface presents a number of *gyri*, or convolutions, each separated by deep *sulci*, or fissures. The interior of each hemisphere is medullary, and the surface of each convolution is cineritious for the depth of one to two lines.

*Crura Cerebri*, are two thick, cylindrical white cords, which diverge from the anterior border of the pons, and their fibres terminate in the hemispheres of the brain. In a triangular space between them, is a layer of medullary matter called the *locus perforatus*.

*Eminentie Mammillares*, are two white, globular bodies, about the size of a pea, situated between the crura of the brain, and in front of the locus perforatus.

*Tuber Cinereum*, is a soft, gray mass, in front of the eminentie mammillares, and behind the chiasm of the optic nerves.

*Infundibulum*, is a hollow, conical body, of a reddish colour, with its base upon the *tuber cinereum*, and its apex attached to the *pituitary gland*.

*Pituitary Gland*, is a vascular mass of a light colour, situated in the sella turcica. It consists of two lobes.

*Longitudinal Fissure*, separates the two hemispheres of the cerebrum laterally, and contains the *falx cerebri*.

*Corpus Callosum*, is a white, arched band, seen at the bottom of the longitudinal fissure, forming a commissure between the two hemispheres. It is three inches and a half long, and about an inch broad. Its fibres are for the most part transverse, and consist of medullary matter, with the exception of a few, which pass longitudinally, and are called the *raphé*.

*Septum Lucidum*, is a vertical partition, consisting of two laminæ, and separating the lateral ventricles. Its upper edge is in contact with the *corpus callosum*, and its lower with the *fornix*.

*Fornix*.—It is a triangular, medullary arch, whose base is continuous with the *corpus callosum* posteriorly, and whose apex divides into two crura, which terminate in the *eminentia mammillares*; its under surface is termed *lyra*. Under these crura is the *foramen of Monro*, by which the third and two lateral ventricles communicate.

*Velum Interpositum*, is a triangular reflection of pia mater, immediately under the fornix; its edges contain a plexus of veins called *plexus choroides*.

*Pineal Gland*, is a small, reddish-gray, conical body, situated upon the *tubercula quadrigemina*, and connected by two crura with the optic tubercles.

*Tubercula Quadrigemina* are four prominences situated over the junction of the pons and crura cerebri. Under them is a passage called aqueduct of Sylvius, or *iter e tertio ad ventriculum quartum*.

*Corpus Striatum*, a gray mass of an oblong shape, situated in the lateral ventricle on either side. It is medullary within.

*Thalamus Opticus*, is an oval, convex mass, behind the corpus striatum on each side. It consists of a mixture of medullary and gray matter, and has three prominences called *corpora geniculata*, one on either side, and one in front. It is connected with its fellow by some cineritious substance, called the soft commissure.

*Tenia Striata*, is a thin edge of medullary matter, in the groove between the corpus striatum and thalamus opticus.

*Hippocampus Major*, is a scroll extending into the inferior cornu of the lateral ventricle, the extremity of which resembles a foot, and is called the *pes hippocampi*.

*Corpus Fimbriatum*, or *Tenia Hippocampi*, is a thin edge of medullary matter upon the concave side of the hippocampus major; beneath which is a layer of cineritious matter, having a serrate appearance, and called the *fascia dentata*.

*Hippocampus Minor*, or *Ergot*, resembles a cock's spur; is a conical elevation pointing backwards into the *posterior cornu*.

*Ventricles of the Brain*.—These are five in number. They are called the *right and left lateral*, the *third*, *fourth*, and *fifth ventricles*.

*Lateral Ventricles*, exist in each hemisphere, and contain the *corpus striatum* and *thalamus opticus*. Each communicates with the third and its fellow by the foramen of Monro, being separated partially by the *septum lucidum*; the roof is formed by the corpus callosum. It contains three angular depressions called *cornua*; the anterior contains nothing; the posterior, the hippocampus minor; and the inferior, the hippocampus major.

*The third ventricle* is the space between the *thalami optici*. Its roof is formed by the velum interpositum and fornix, and its floor by the locus perforatus and the tuber cinereum. It is traversed in front by the anterior commissure, a medullary cord extending between the *corpora striata*, and by the posterior commissure, which extends transversely between the *thalami optici*. It communicates with the lateral ventricles by the foramen of Monro, and with the fourth by the aqueduct of Sylvius.

*The fourth ventricle* is situated between the pons Varolii, cerebellum, and medulla oblongata. Its floor is the calamus scriptorius, and its roof is the *valve of the brain*. Laterally, it is limited by the pia mater and the arachnoid. It communicates with the third.

*The fifth ventricle* is situated between the laminae of the septum lucidum. It does not communicate with the other ventricles.

#### CEREBELLUM.

This constitutes about one-sixth of the brain, and is contained between the occiput and tentorium. It is oblong and flattened: its greatest diameter being transverse. It is composed of white and gray substances, the latter of which is external, and apparently arranged in laminae. It is divided by a longitudinal fissure into two lobes; the superior part of which fissure contains a ridge called *vermis superior*, in advance of which is an elevation called *monticulus*. In the inferior part of this fissure is a smaller ridge called the *vermis inferior*.

At the root of the crura cerebelli are two small protuberances; the one below it, in the erect position, is the *lobulus amygdaloides*, and the other the *lobulus nervi pneumogastrici*.

*The valve of the brain* is a thin gray plate, extending from the inferior surface of the cerebellum to the *corpora restiformia*.

*Arbor vitæ*, a section of either lobe of the cerebellum, presents an arborescent arrangement of the medullary matter.

*Corpus dentatum*, is a name applied to a gray mass with serrated edges, in the trunk of this medullary tree.

#### CRANIAL NERVES.

These are nine in number, and are so called from their emerging through the foramina, at the base of the cranium. They are designated by their function, as well as numerically. Their origin is as follows:

1st. *Olfactory*.—Arises by three roots, which coalesce in the fissure of Sylvius.

2d. *Optic*.—Arises from the thalamus opticus and the tubercula quadrigemina.

3d. *Motor Oculi*.—Arises from the crus cerebri.

4th. *Patheticus*.—Arises from the valve of the brain.

5th. *Trifacial*.—Arises from the medulla oblongata, but emerges from the pons Varolii.

6th. *Motor Externus*.—Arises from the corpus pyramidale.

7th. *Facial and Auditory*.—Arises from the corpus restiforme and calamus scriptorius.

8th. *Pneumogastric, glosso-pharyngeal, and spinal accessory*.—Arises by filaments from the fissure between the corpora olivare and restiforme, and from the spinal cord opposite the fourth cervical vertebra.

9th. *Hypoglossal*.—Arises in the fissure between the corpus pyramidale and corpus olivare.

The cranial nerves may be divided into three classes, according to their function, viz. :—*Nerves of special sense*, including the 1st, 2d, and the auditory branch of the 7th. *Nerves of motion*, including the 3d, 4th, 6th, facial branch of the 7th and 9th. *Compound nerves*, comprising the 8th and 5th.

The distribution of the cranial nerves—

1st. *Olfactory*.—Forms a large soft bulb, which rests on the cribriform plate, and sends filaments through its foramina to the Schneiderian membrane.

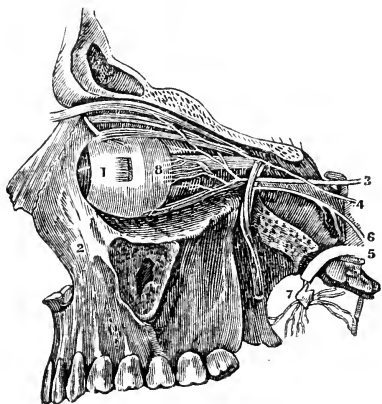
2d. *Optic*.—Forms a chiasm with its fellow, and enters the globe of the eye to join the retina. Is a flattened cord.

3d. *Motor Oculi*.<sup>3</sup>—Passes through the walls of the cavernous sinus to escape at the sphenoidal foramen, and then is distributed upon the muscles of the eyeball, with the exception of the superior oblique and external rectus. It sends a *branch* to join the ophthalmic ganglion, from which proceed the ciliary nerves,<sup>8</sup> which supply the iris.

4th. *Pathetic*.—Passing through the walls of the cavernous sinus, and through the sphenoidal foramen, it is distributed upon the superior oblique muscles of the eyeball. It is the smallest cranial nerve.

6th. *Motor Externus*.—

Fig. 140.

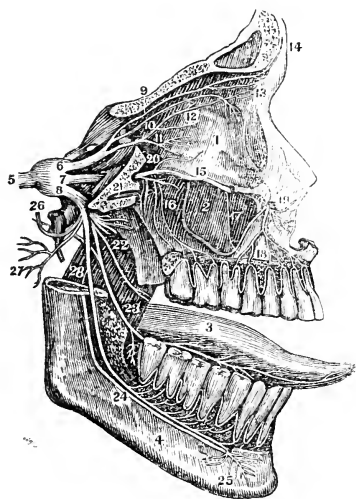


Passing through the cavernous sinus, it escapes from the cranium through the sphenoidal foramen or fissure, and is distributed to the external rectus muscle. Its paralysis will produce an internal squint. A branch enters the carotid canal to join the ganglion of Laumonier.

5th. *Trifacial*.—From the ganglion of *Casser*, which is upon the trunk<sup>5</sup> of this nerve, proceed three branches, the ophthalmic,<sup>6</sup> superior maxillary,<sup>7</sup> and inferior maxillary.<sup>8</sup>

The *ophthalmic*<sup>6</sup> passes out through the sphenoidal foramen, and then divides into three branches, the nasal, frontal, and lachrymal.

Fig. 141.



The *nasal*<sup>11</sup> gives off the *internal nasal*, which enters the anterior ethmoidal foramen, and then goes through the cribriform plate into the nose; and also a branch (*ramus ciliaris*) to the lenticular or ophthalmic ganglion. It is distributed to the muscles, eyelids, and conjunctiva. The *frontal*<sup>9</sup> divides into two branches, and is spent upon the integuments and muscles of the forehead; one branch goes through the supra-orbital foramen. The *lachrymal*<sup>10</sup> branch supplies the lachrymal gland, and the contiguous portions of the orbit.

The *superior maxillary*<sup>7</sup> passes through the foramen rotundum, and then enters the pterygo-maxillary fossa. A large branch called *infra orbital*<sup>15</sup> traverses the

infra-orbital canal, and emerges at the infra-orbital foramen<sup>19</sup> to supply the face; giving off the *dental nerves*<sup>16 17</sup> in its course. The *pterygo-palatine branch*, or branches, join the *ganglion of Meckel*, from which proceed the spheno-palatine branches, which enter the nose through the spheno-palatine foramen; one of these branches is long, and called *naso-palatine*, which joins its fellow at the ganglion of *Cloquet* in the *foramen incisivum*; the posterior palatine descends from the ganglion through the posterior palatine foramen, and is distributed to the palate and fauces; the *vidian*, or *pterygoid*, or *recurrent*,<sup>21</sup> passes backwards from the ganglion through the pterygoid foramen, and divides into two branches called *superficial* and *deep petrous*. The superficial petrous enters the *hiatus Fallopii*, and passing between the smaller bones of the ear, emerges at the Glaserian fissure under the name of *chorda tympani*, which joins the submaxillary ganglion. The deep petrous enters the carotid canal, and joins the ganglion of *Laumonier*, which was formerly considered the origin of the sympathetic nerve.

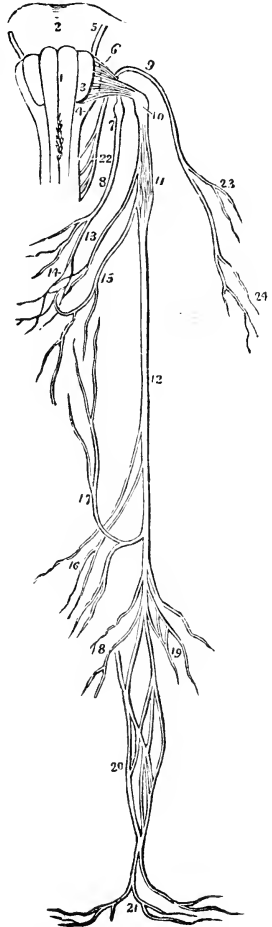


The *inferior maxillary*<sup>8</sup> passes through the foramen ovale, and gives off numerous muscular branches<sup>22</sup> to the masseter, buccal, and pterygoid muscles. The *inferior dental*<sup>2</sup> is a large branch; it enters the posterior mental foramen and supplies the teeth and mylo-hyoid muscle,<sup>23</sup> and part of it emerges upon the skin.<sup>25</sup> It also gives off the *superficial temporal* nerve,<sup>26</sup> and the *auricular* branches, &c. The *lingual*, or *gustatory*,<sup>23</sup> enters the side of the root of the tongue, and is distributed to its papillæ. It sends a branch to the submaxillary ganglion.

7th. *Facial and auditory*. — Both branches enter the internal meatus; the auditory is also called *portio mollis*, and is distributed to the internal ear. The facial is also called *portio dura*, and emerges from the temporal bone through the stylo-mastoid foramen. It penetrates the parotid gland, and is distributed by numerous branches upon the face, which are called *pes anserinus*.

8th. The *glosso-pharyngeal*<sup>6</sup> comes through the *foramen lacerum posterius*, and curves forward to the side of the tongue, and is distributed about its root. It sends branches to the tonsils and pharynx,<sup>13</sup> and also one to the tympanum, called Jacobson's nerve. It has near its root a small ganglion,<sup>7</sup> called *petrosal*, or *Anderschian*. The *pneumo-gastric* having escaped from the cranium by the posterior foramen lacerum, or jugular foramen, presents a ganglionic enlargement<sup>11</sup> called *plexus gangliformis*. A small ganglion<sup>10</sup> is also found upon that portion which passes through the foramen. It then descends within the sheath of the vessels of the neck, lying behind and between the artery and vein, and entering the thorax and abdomen, supplies the lungs and stomach, giving off the following branches: the *superior pharyngeal* assists in forming the pharyngeal plexus,<sup>14</sup> assisted by branches from the glosso-pharyngeal, the superior laryngeal, and sympathetic. This plexus is distributed to the muscles and mucous membrane of the pharynx.

Fig. 142.



The *superior laryngeal*<sup>15</sup> arises from the ganglionic plexus, enters the larynx, and is distributed to its mucous membrane. The *cardiac branches*<sup>16</sup> are two or three in number, and descend to join the cardiac plexus. The *inferior laryngeal*,<sup>17</sup> or *recurrent laryngeal*, curves around the aorta upon the left side, and the subclavian upon the right; ascending between the trachea and œsophagus, it is distributed to the muscles of the larynx, communicating with the superior laryngeal and sympathetic nerve. *Anterior* and *posterior*<sup>18 19</sup> *pulmonary branches* are given off in the thorax to form the pulmonary plexus. The *œsophageal branches*<sup>20</sup> surround the œsophagus, and with it enter the abdomen through the diaphragm, there to be spent upon the stomach and neighbouring viscera, and also communicating with the solar plexus.

*Spinal accessory*.—This branch<sup>9</sup> of the eighth pair escapes also at the jugular foramen, and divides into two branches, one of which gives filaments to the superior pharyngeal nerve; the other, which is the larger, descends obliquely backwards, and piercing the sternomastoid muscle, is distributed to the trapezius, after having communicated with the upper cervical nerves.<sup>23 34</sup>

9th. The *hypoglossal nerve* emerges from the cranium through the anterior condyloid foramen, it then passes between the internal carotid artery and internal jugular vein, and curving around the occipital artery, sends branches to the muscles of the tongue. The *descendens noni* descends as a long, thin filament, in front of the sheath of the vessels, and below the middle of the neck; forming a loop with a branch from the second and third cervical nerves; it communicates with the pneumogastric and sympathetic.

## SPINAL NERVES.

After the union of the anterior or motor root with the posterior or sensitive root in the intervertebral foramen, the spinal nerves divide into two trunks, the *posterior* of which are much the smaller, and supply the muscles of the back; the *anterior* are large, and communicating with the ganglions of the sympathetic nerve, form plexuses which give off the principal nerves to the muscles of the trunk and extremities.

## CERVICAL NERVES.

These are eight in number: the first is called the *sub-occipital*; it passes out of the spinal canal between the occiput and atlas.

*Three superior cervical nerves* anastomose freely and form a *cervical plexus*, which sends numerous branches to the muscles and skin of the neck, forming communications with the ninth and facial nerves. The *phrenic nerve*<sup>6</sup> is formed by filaments of the cervical plexus, and passing over the scalenus anticus muscle, and through

the anterior mediastinum, frequently adhering to the pericardium, it is distributed to the diaphragm by several branches.

The *four inferior cervical* nerves, together with the first dorsal, emerging from the spinal canal between the scalenus anticus and medius muscles, form a large plexus, which is plaited around the subclavian and axillary arteries.

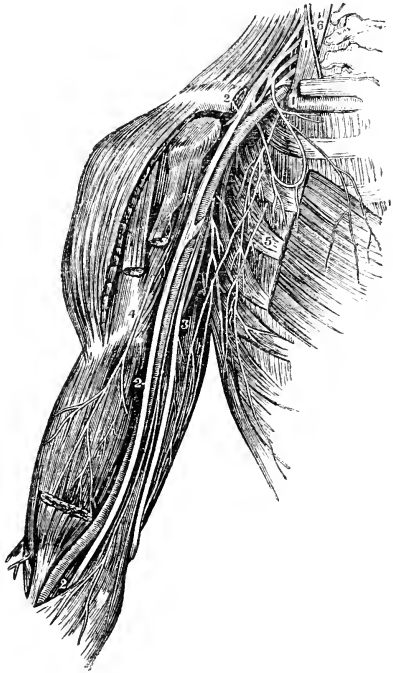
The *brachial plexus* gives off a *scapular* branch, which ascends upon the shoulder and supplies its muscles; passing through the coracoid notch.

The *thoracic branches* are distributed to the muscles covering the parietes of the thorax, with the *sub-scapular* branches, which supply the muscles under the shoulder. The *circumflex* or *axillary* nerve winds round the head of the humerus, in company with the posterior circumflex artery, and is distributed to the deltoid muscle. The *internal cutaneous* is a very small, thin filament, passing down the inside of the arm, and sends branches across the superficial veins of the elbow, then is distributed to the skin, fascia, and fore-arm. The *external* or *musculo-cutaneous*<sup>4</sup> perforates the coraco-brachialis, and is also distributed to the muscles and integuments of the fore-arm.

The *ulnar*,<sup>3</sup> descending the arm, it passes superficially under the internal condyle, and is finally distributed to the little finger, and the ulnar side of the ring finger. The *radial* or *musculo-spiral* winds around the humerus, between the heads of the triceps muscles, which it supplies with branches, and then descends the fore-arm supplying its muscles, a large branch accompanying the radial artery, supplying the wrist and thumb.

The *median*<sup>2</sup> is the largest of these nerves which come from the brachial plexus; it descends the arm in close company with the brachial artery, until it reaches the elbow; it there passes between

Fig. 143.



the two heads of the pronator teres muscle, and descending the forearm, between the flexor sublimis and profundus muscles, it is distributed to the fingers, with the exception of those supplied by the ulnar.

#### DORSAL NERVES.

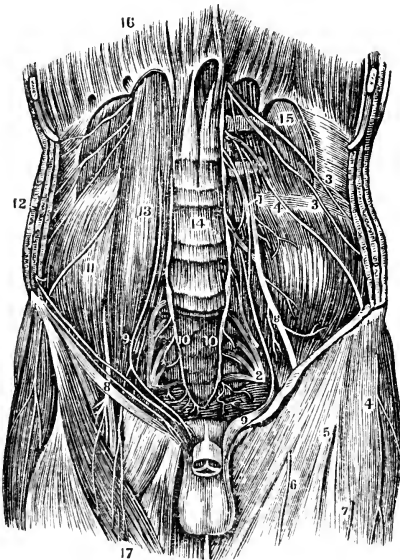
These are twelve in number; the anterior branches are the larger, and received into the intercostal grooves, in which they run, to be distributed to the muscles of the chest.

The *first dorsal nerve* joins the brachial plexus. The *intercosto-humeral nerves*<sup>5</sup> are two in number, and proceed from the second and third dorsal nerves to be distributed upon the skin and fascia of the arm; the larger is sometimes called the nerve of Wrisberg.

#### LUMBAR NERVES.

These are five in number; the anterior branches descending form the *lumbar plexus*, which is situated upon the quadratus lumborum muscle and behind the psoas magnus muscle; from it are given off two or three *abdomino-crural*<sup>3</sup> branches, which supply the muscles

Fig. 144.



of the abdomen, sending a filament to the groin. The *external cutaneous*<sup>4</sup> crosses obliquely the iliacus internus muscle, towards the anterior superior spinous process. It perforates the fascia lata, and is distributed to the integuments of the thigh. The *external spermatic*<sup>9</sup> perforates the psoas muscle, and descending to the groin, supplies the glands and cremaster muscle. The *anterior crural*,<sup>8</sup> the largest branch of the lumbar plexus, passes under Poupart's ligament, and gives off the *anterior, middle, and internal cutaneous* branches,<sup>5,6,7</sup> which are distributed to the integuments; the *long* or *internal saphenous*

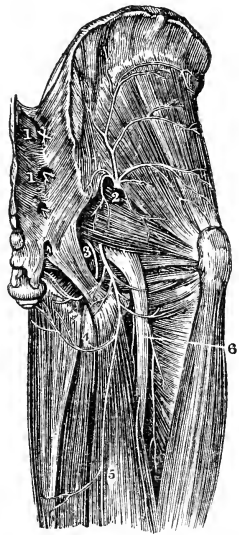
nerve, which accompanies the femoral artery as far as its perforation of the adductor tendon, and then accompanies the saphena vein to the foot. The *obturator* accompanies the obturator artery, and emerges from

the pelvis at the upper portion of the thyroid foramen. It is distributed upon the obturator and adductor muscles.

## SACRAL NERVES.

These are five and sometimes six in number; the anterior trunks, with a portion of the last dorsal, constitute the *sacral plexus*. From it are given off a few small branches and to the viscera and muscles within the pelvis. There also arise from it the *gluteal*,<sup>2</sup> which emerging from the sacro-sciatic notch, divides into two large branches to supply the glutei muscles. The *internal pudic*<sup>3</sup> or *superior long pudendal*, which accompanies the internal pudic artery, and supplies the perineum, and organs of generation; it divides into two branches, the *superior* continuing to the extremity of the penis with the dorsal artery. The *lesser ischiatic*<sup>4</sup> divides into the *inferior long pudendal*, which winds around the tuberosity of the ischium, and is distributed to the integuments of the perineum; and the *posterior cutaneous*,<sup>5</sup> a long filament passing down the back of the thigh and leg, to be spent upon the integuments. The *great sciatic*<sup>6</sup> is the largest nerve in the body; it escapes from the pelvis beneath the pyriformis muscle, and descends the back of the thigh between the flexor muscles; about one-third above the knee it divides into two large branches, called *peroneal* and *popliteal*. The *popliteal* descends through the popliteal space, giving off numerous muscular branches, one of which is the *external saphenous nerve*, which becomes superficial near the ankle, and is joined by the external peroneo-cutaneous nerve; it then passes behind the external malleolus, and supplies the external malleolus and the foot. The *posterior tibial* is a continuation of the popliteal, descending the back of the leg in company with the posterior tibial artery; it is finally distributed upon the sole of the foot by two branches called the *external* and *internal plantar* nerves.

Fig. 145.



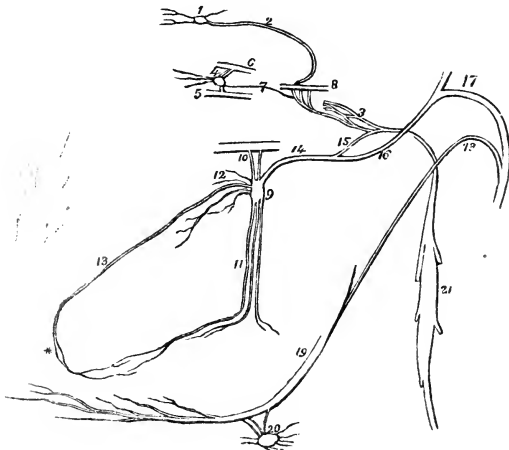
The *peroneal nerve* extends towards the head of the fibula, where it gives off two small cutaneous branches; distributed about the joint, called *internal* and *external peroneo-cutaneous*; the internal joins with the external saphenous, and thus forms the *communicans tibiæ*. The peroneal now divides into the external peroneal and anterior tibial; the *external peroneal* passes down upon the fibular side of the

leg, through the peroneus longus muscle, and becoming superficial in the lower third of the leg, is distributed to the integuments of the foot and ankle. The anterior tibial descends in front of the interosseous ligament, in company with the anterior tibial artery, and is distributed to the muscles upon the foot.

### SYMPATHETIC NERVE.

The sympathetic system consists of two chains of ganglia, united to each other and to the cranial and spinal nerves. Each ganglion may be considered as a distinct nervous centre, and is placed opposite the intervertebral space. The two halves of the sympathetic system are united in the head by the ganglion of Ribes, which may be considered as the origin of the sympathetic nerve. There is also a ganglion in the median line of the coccyx, whereby the two lateral halves of the sympathetic are united. It is distributed in connexion with all the other nerves of the body, and by means of plexuses supplies all the internal organs; these plexuses take the name of the artery with which they are connected.

Fig. 146.



The *cranial* ganglia of the sympathetic are five in number, viz. : *ganglion of Ribes*,<sup>1</sup> which is small and situated upon the anterior communicating artery; a filament of it<sup>2</sup> joins the sixth nerve,<sup>8</sup> which communicates with the carotid plexus.<sup>3</sup> The *carotid plexus* surrounds the carotid artery in the carotid canal, and frequently contains a ganglion called after *Laumonier*. This plexus is joined by the deep petrosal branch of the vidian nerve, and was formerly considered the origin of the sympathetic. The *lenticular* ganglion is small and

flattened, reposing between the optic nerve and the external rectus muscle.<sup>4</sup> It communicates with a branch of the nasal nerve,<sup>5</sup> and a branch of the third, called ciliary ;<sup>6</sup> a small filament<sup>7</sup> passes from this ganglion to join the carotid plexus. The *spheno-palatine* ganglion is called also Meckel's ganglion.<sup>9</sup> From this are given off the vidian nerve,<sup>14</sup> the deep petrous branch of which joins the carotid plexus, as has been mentioned, and the superficial petrous,<sup>16</sup> which enters the hiatus Fallopii, and emerging at the glenoid fissure as the chorda tympani,<sup>12</sup> descends in connexion with the gustatory nerve<sup>19</sup> to join the *submaxillary ganglion*.

The *ganglion of Meckel* communicates with the superior maxillary nerve by means of its two ascending branches, called *pterygo-palatine* ; one of its spheno-palatine branches,<sup>12</sup> called naso-palatine,<sup>13</sup> joins its fellow in the foramen incisivum, to form the ganglion of Cloquet, or naso-palatine ganglion. Its descending branches<sup>11</sup> supply the palate, gums, and fauces.

The otic ganglion, is a small oval ganglion adhering to the inner surface of the inferior maxillary nerve, below the foramen ovale ; it sends branches of communication to the superior and inferior maxillary, to the vidian and tympanic nerves, and it also supplies the tensor tympani and the tensor palati muscles.

#### CERVICAL GANGLIA.

These are three in number. The *first*<sup>1</sup> is a long, gray, spindle-shaped ganglion extending to the lower border of the third cervical vertebra, behind the sheath of the vessels of the neck. Its branches are numerous, and some are very soft, hence termed *nervi molles*. They communicate with the anterior trunks<sup>4</sup> of the first, second, and third cervical nerves ; by an ascending branch<sup>2</sup> with the carotid plexus, and by a descending branch<sup>3</sup> with the second cervical ganglion. Its internal branches<sup>5</sup> join the facial, eighth, and ninth nerves, and the pharyngeal plexus. A number of branches join to form the *superior cardiac nerve*,<sup>6</sup> which descends behind the vessels and joins the cardiac ganglion.

The *middle cervical* ganglion is usually small and sometimes wanting. It rests upon the inferior thyroid artery in front of the fifth or sixth cervical vertebra. It is often called the *thyroid* ganglion. Its branches join the superior and inferior cervical ganglia, and the anterior trunks of the third, fourth, and fifth cervical nerves ; it also sends the *middle cardiac nerve*<sup>7</sup> to join the cardiac plexus.

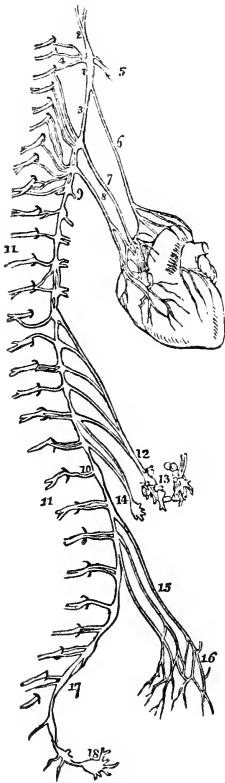
The *inferior cervical ganglion* is larger than the last, and is situated in front of the root of the transverse process of the seventh cervical vertebra. Its filaments join the sixth, seventh, and eighth cervical nerves, and also form the *inferior cardiac* nerve, which joins the middle cardiac nerve and the cardiac plexus.

The *cardiac ganglion* is situated beneath the arch of the aorta.

Its branches form the *cardiac plexus* in conjunction with the par vagum and descendens noni; from this plexus are derived the filaments which supply the heart.

#### THORACIC GANGLIA.

Fig. 147.



These are twelve in number, situated at the intervertebral spaces. They are small and connected with each as well as with the anterior trunks of the spinal nerves. The great *splanchnic*<sup>43</sup> is formed by filaments from the sixth to the tenth ganglion; it descends in the posterior mediastinum, and pierces the diaphragm at or near the foramen aorticum, to form the semilunar ganglion. The *lesser splanchnic nerve*<sup>44</sup> is formed by filaments from the tenth and eleventh ganglia; it pierces the diaphragm and joins the semilunar ganglion and the renal plexus.

The *semilunar ganglion* consists of a number of smaller ganglia formed upon filaments of the splanchnic nerve after it has entered the abdomen; they are arranged in a crescentic manner,<sup>45</sup> and situated upon the aorta and cœliac axis.

The *solar plexus* is a network on the sides of the aorta, and extending as far as the renal arteries. It is a number of filaments connecting the portions of the semilunar ganglia; and from it proceed smaller plexuses, which accompany the large arterial trunks; thus, the *hepatic plexus* is the intertexture which surrounds the hepatic artery, and is distributed to the liver, gall-bladder, &c. The *splenic plexus* accompanies the splenic artery and supplies the spleen; thus also, is distributed, the renal, mesenteric, and other plexuses.

#### LUMBAR AND SACRAL GANGLIA.

The *lumbar ganglia* are four or five in number, which are united with each other and the spinal nerves. They form a plexus upon the aorta, which receives filaments from the solar and hypogastric plexuses.

The *hypogastric plexus* is formed by branches of the lumbar and aortic plexuses and filaments from the *sacral ganglia*. From it are supplied all the viscera of the pelvis. The *sacral ganglia* are three



or four in number. The last is called *impar* or *azygos*, being situated in the median line of the coccyx, and constituting the *terminating ganglion* of the sympathetic.

## SECTION VII.

## ORGANS OF SENSE.

## NOSE.

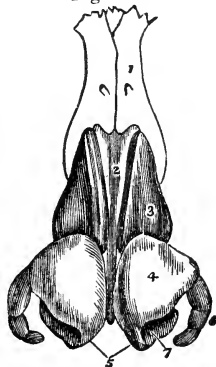
The nose consists of two portions, an external projection upon the face, and an internal cavity. The *external* portion is formed by the nasal processes of the superior maxillary bones, the nasal bones, and by five cartilages, two of which are placed upon either side and one in the middle. The *cartilaginous septum* is placed in the median line;<sup>2</sup> it is thick, flat, and triangular, uniting by its superior edge, with the ethmoid, and by its inferior edge with the vomer. Its anterior edge unites with the *lateral* and *alar* cartilages. It frequently deviates from the median line. The *lateral* cartilages<sup>3</sup> are triangular, one being placed on either side, attached above and behind to the bone, in front with the septum, and below with the alar cartilage. The *alar* cartilages<sup>4</sup> are two in number; they form the lower portion of the nose, and the opening called the nostril. It is an irregular, semi-elliptical cartilage, and has a number of small pieces of cartilage attached to it, by which the nostril is kept open. These cartilages are held together by a fibrous tissue. The skin which covers the nose is thick and strong, and covered with numerous sebaceous follicles, which are frequently recognised by their being discoloured. The hairs visible in the nostril are termed *vibrissæ*.

The *cavity* of the nose is lined by a membrane called *pituitary*, or *Schneiderian*, which is thick, soft, and red, owing to its vascularity, and largely supplied with nerves, being the seat of smell. It lines the meatuses of the nose, and is continuous with the mucous membrane of the mouth, lachrymal canal, Eustachian tube, and frontal sinus. It is supplied by the first and fifth pairs of nerves.

## THE EYE AND ITS APPENDAGES.

The *eyeball* is a sphere, of about one inch in diameter, antero-posteriorly, and somewhat less transversely. It is surrounded by a fibrous capsule, which is continuous with the sheath of the optic nerve behind, and the cartilages of the eyelids in front. All the muscles of the ball of the eye lie behind, and perforate it, in order to be inserted into the sclerotic coat.

Fig. 148.

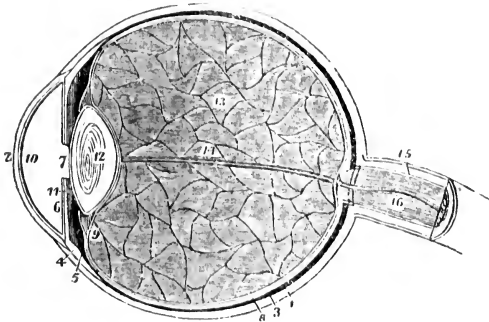


The *sclerotic coat*<sup>1</sup> is a dense, fibrous, white membrane, thinner in front, where it receives the cornea, than it is behind, where it is perforated by the optic nerve. The circular edge in contact with the cornea is bevelled. This external surface is anteriorly covered by the *conjunctiva*, and posteriorly by fat. Its internal surface is connected with the choroid coat. It is perforated by numerous small foramina transmitting arteries and nerves.

The *cornea*<sup>2</sup> fills up the opening in the anterior part of the sclerotica, and forms about one-sixth of the whole eyeball; it is more convex than the sclerotica, and therefore forms a projection in front. It is transparent and apparently homogeneous, but is in fact composed of numerous laminae, between which there is a slight quantity of fluid. It is covered anteriorly by the conjunctiva, and posteriorly by the epithelium of the aqueous humour.

The *canal of Schlemm* is a venous sinus, near the border of the cornea.

Fig. 149.



The *choroid coat*<sup>3</sup> is a thin, vascular tunic of the same extent as the sclerotica, with which it is in contact externally. It is filled with a black colouring matter called *pigmentum nigrum*, and consists principally of arteries and veins. It is traversed by several nerves. Its internal layer is composed principally of arteries, and called *membrana Ruyschiana*; externally it is composed principally of veins, called *vasa vorticosa*.

The *ciliary ligament*<sup>4</sup> is a flat, gray, delicate ring, at the junction of the cornea and sclerotica, which unites the external border of the iris and the ciliary body.

The *ciliary body*<sup>5</sup> is formed by the anterior portion of the choroid coat, in contact with the ciliary ligament, and from it proceed seventy or eighty short folds, called *ciliary processes*, which converge and are smaller behind than they are in front; they surround the lens.

The *ciliary muscle* is a small, gray structure, behind the ciliary ligament,<sup>a</sup> and covering the outside of the ciliary processes. Its contraction presses the lens<sup>a</sup> towards the cornea.<sup>b</sup>

The *iris*, (fig. 149,) is a thin, circular membrane,<sup>6</sup> consisting of contractile tissue, and forming a vertical septum, between the anterior and posterior chambers of the eye. It is perforated nearly in the centre by a foramen called the *pupil*,<sup>7</sup> which in fœtal life is closed by the *membrana pupillaris*. Its external border is attached to the ciliary ligament. The anterior surface is flat, of a bluish or brown colour, speckled and striated;

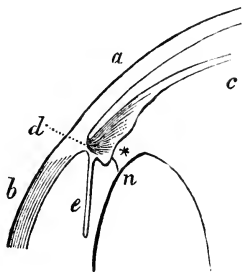
towards the pupil the colour is deeper. Its posterior surface (sometimes called the *uvea*), is covered with a thick layer of pigmentum nigrum, and is in contact with the ciliary processes. It may contain a few muscular fibres in its structure. It is supplied by the ciliary arteries, branches of the ophthalmic, and by the ciliary nerves, which pass from the lenticular ganglion through the choroid coat to be distributed upon it.

The *retina*,<sup>8</sup> is a soft, white membrane within the choroid coat, and is considered by some to be an expansion of the optic nerve, and by others as a distinct nervous structure in connexion with the optic nerve. Internally it is in contact with the vitreous humour. It commences at the optic nerve, and terminates anteriorly by a jagged edge, called *ova serrata*, behind the ciliary body. It is thicker behind than it is in front. When perfectly fresh it has a pinkish tint, and is semi-transparent. Its inner surface is of a fibrous character, consisting of radiating tubular fibres of the optic nerve. Its external surface consists of a finely granulated matrix, interspersed with very delicate vessels. The *optic nerve*,<sup>15</sup> enters the globe of the eye on the inner side of its axis, and the point where it is connected with the retina is incapable of vision. Directly in the axis there exists upon the retina the yellow spot of *Sæmmering*, a slight elevation with a minute perforation in its summit. The central artery of the retina enters through the optic nerve, and traversing the vitreous humour, supplies the retina and lens.

*Membrana Jacobi*.—Is a thin lamina, existing between the choroid and the retina, consisting of a number of club-shaped rods, interspersed with transparent cells.

The *vitreous humour*<sup>13</sup> has a transparent, jelly-like appearance, and is of a globular form. It consists of a viscous fluid, held in cells formed from the hyaloid membrane, which surrounds it. It is colourless, and its structure is best exhibited by freezing.

Fig. 150.



The *canal of Petit*,<sup>9</sup> is formed between the laminæ of the hyaloid membrane, and surrounds the edge of the lens.

The *zone of Zinn*, is a circle of plaitings upon the vitreous humour, which dove-tail with the ciliary processes.

The *crystalline lens*<sup>12</sup> is a double convex lens, whose posterior surface is more convex than its anterior. In childhood it is spherical, and in old age it is flattened. It is transparent and soft, and surrounded by a capsule which contains a thin fluid, called *liquor Morgagni*. It consists of concentric laminæ, having a tendency to divide into three equal segments.

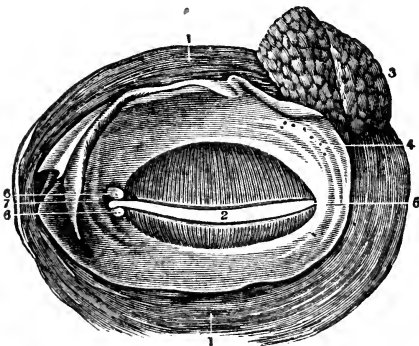
The *aqueous humour*<sup>10</sup> is a transparent fluid, occupying the anterior and posterior chambers of the eye, bathing the posterior surface of the cornea, and the anterior surface of the capsule of the lens. It is from four to five grains in quantity. This is said to be secreted by the membrane of Demours, which lines the whole of the anterior and posterior chambers. This membrane can only be traced upon the posterior surface of the cornea.

The *eyebrows* are two elevations of the skin covered with short, stiff hairs, protecting the eye from too strong a light, and from the perspiration flowing down the forehead; they materially affect the expression of countenance. The space between the two is called *glabella*.

The *eyelids* or *palpebræ*, consist of skin, muscular fibres, cartilage, and mucous membrane; and when in contact, leave a triangular canal, which passes transversely between them. Their edges are covered with *cilia*, or eyelashes, which are short, stiff, curved hairs, protecting the eyeball.

*Tarsal cartilages*.—Are two in number. That of the upper lid is larger than that of the lower; they are crescentic in shape, and attached by the external and internal palpebral ligaments.

Fig. 151.



*Conjunctiva*.—Is a soft mucous membrane lining the lids, and covering the anterior surface of the ball, forming a fold called *plica semilunaris*, near the inner canthus. It is vascular, and well supplied with nerves.

*Meibomian glands*.—Are twenty or thirty small yellow thread-like glands, between the conjunctiva and the pos-

terior surface of the lids, discharging by numerous orifices along the edges of the lids a viscid fluid which prevents the overflow of tears at night.

*Caruncula lachrymalis.*<sup>7</sup>—A small, red elevation, in the internal canthus, about the size of a grain of wheat; consisting of an aggregation of small glands, and often furnished with hairs.

*Lachrymal gland.*<sup>3</sup>—A lobulated gland, about the size of a filbert, and of a light pink colour, situated in a fossa on the roof of the orbit, near the external angular process. It consists of two portions, viz., orbital and palpebral. It discharges tears by ten or twelve ducts,<sup>4</sup> whose orifices open upon the upper and outer part of the conjunctiva.

*Lachrymal canals.*—These open by two small orifices upon a papilla at the inner part of each lid, called *puncta lachrymalia.*<sup>6</sup> The tears enter these orifices and are conveyed along a bent canal into the lachrymal sac.

*Tensor tarsi* or *Horner's muscle.*—(Fig. 152.)—Arises from the os unguis,<sup>4</sup> and is inserted by two divisions<sup>5</sup> into the orifices of the lachrymal canal. Its nasal face adheres to the lachrymal sac.

*Lachrymal sac and nasal duct.*—Is a continuous tube contained in the passage formed by the nasal process of the superior maxillary, the unguiform, and inferior turbinated bones. Its external coat is fibrous, and its internal mucous; it is larger above than it is below, and opens into the inferior meatus of the nose. The mucous lining forms a semicircular fold or valve.

The muscles: *Levator palpebræ superioris.*<sup>4</sup>—*Origin*, near the optic foramen. *Insertion*, by a broad aponeurosis into the upper lid. It draws the lid upwards.

The *four straight muscles*, arise around the optic foramen; and are inserted, by tendinous expansions, within a few lines of the cornea. They are called superior,<sup>9</sup> inferior,<sup>13</sup> internal,<sup>10</sup> and external.<sup>11</sup>

The *superior oblique muscle*,<sup>5</sup> arises from the edge of the optic foramen, and plays over a tendinous pulley<sup>6</sup> upon the orbital ridge of the frontal bone; is inserted into the sclerotica beneath, and beyond the superior rectus.

Fig. 152.

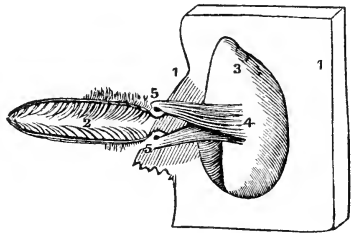
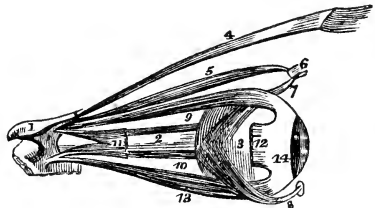


Fig. 153.



The *inferior oblique*,<sup>s</sup> arises from the nasal process of the superior maxillary bone; and passing below the inferior rectus, is inserted beyond it, into the sclerotica.

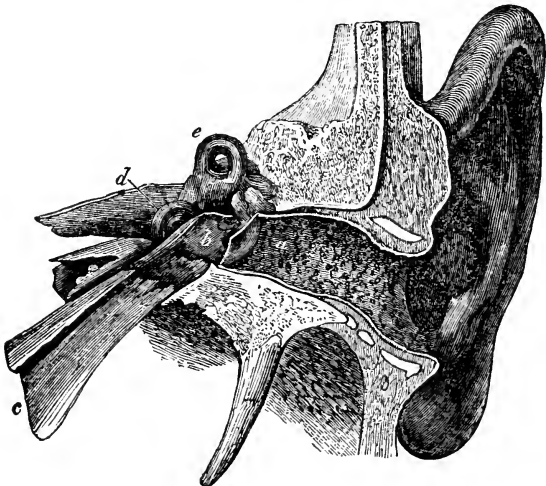
#### THE EAR.

The organ of hearing is composed of three parts; the External Ear, the Middle Ear, or tympanum, and the Internal Ear, or labyrinth.

The *external ear* consists of two parts, the *pinna*, which is movable upon the side of the head, and the *meatus*, a tube leading from it.

The *pinna* has a number of ridges and hollows upon its surface; these are: a prominent rim or *helix*; and within it another curved prominence, the *anthelix*, which bifurcates above, so as to enclose a space, called the *scaphoid fossa*, and describe a deep, capacious, central cup, the *concha*. At the end of the helix, in front of the concha, is a small detached eminence, the *tragus*, so named from its bearing a tuft of hair, resembling a goat's beard. Opposite this, behind and below the concha, is the *antitragus*. Below is the

Fig. 154.



pendulous *lobe*, composed of dense areolar and adipose tissues. The *concha* is imperfectly divided into an upper and lower part, by the anterior curved extremity of the helix.

The *skin* of the pinna is thin, and contains an abundance of sebaceous follicles.

The *fibro-cartilage* is an oval, elastic plate, of a yellowish colour, and attached by an *anterior ligament*, which is triangular, broad, and strong, to the zygomatic process, and by the *posterior ligament* to the mastoid process.

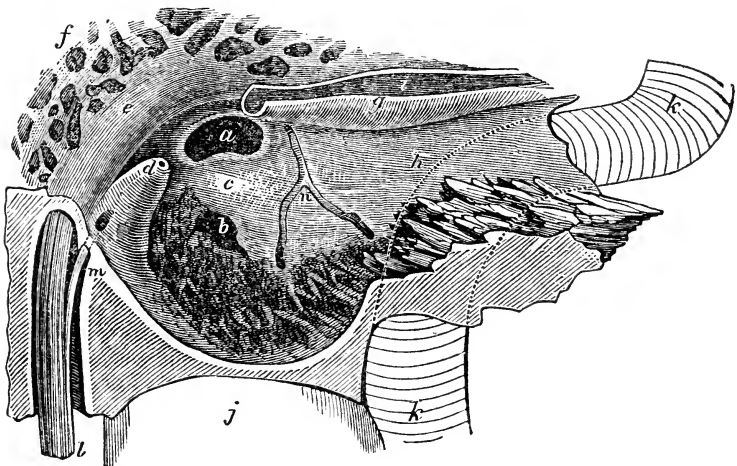
The *muscles* are, the *major helix*, which is narrow, about half an inch long, thin, and situated at the arched superior and anterior part of the helix, its fibres being vertical. The *minor helix* is very small, and situated at the inferior and posterior arch of the helix. The *tragicus* is three-cornered, tolerably thick, with vertical fibres, upon the tragus. The *antitragicus* is narrow and short, and passes from the antitragicus to the antihelix. The *transversus auriculæ*, is transverse on the posterior surface of the ear, extending from the convexity of the concha to the external part of the antihelix. The *dilatator conchæ* extends from the meatus auditorius to the anterior part of the tragus, which it draws forwards, and thus dilates the concha. The *obliquus auriculæ* is upon the internal surface of the ear, between the elevations of the fossa innominata and the concha.

The *meatus*<sup>a</sup> is a cartilaginous tube, lining a bony canal, of about one inch in length, narrow in the middle, and curved downwards; the skin lining it is covered with hairs, and glands secreting wax.

The *middle ear* or *tympanum*<sup>b</sup> is an irregular, bony cavity, in the petrous portion of the temporal bone, and bounded in front by the membrana tympani. It is filled with air, which enters by the Eustachian tube;<sup>c</sup> and contains a chain of small bones, and openings into the mastoid cells.

<sup>d</sup> *Membrana tympani*.—The drum of the ear is a thin, semi-trans-

Fig. 155.



parent, oval membrane, separating the cavity of the tympanum from the external ear. Its internal surface is slightly convex, and attached to the handle of the malleus. It is directed obliquely downwards and inwards, and it consists of three laminæ, the middle of which is strong and fibrous, and attached to the rim of the bone. The external surface is a continuation of the cuticle, and the internal of the mucous membrane, lining the cavity.

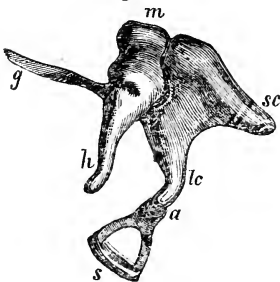
The internal wall of the tympanum has two orifices of communication with the internal ear; the *fenestra ovalis*,<sup>a</sup> an oblong opening leading to the vestibule, and the *fenestra rotunda*,<sup>b</sup> opening into the cochlea; both of these are closed by membrane, which prevents the escape of fluid contained in these inner chambers, and communicates vibrations to it. The fenestra ovalis is also closed by the foot-piece of the stapes. Between the fenestra is the promontory, an elevation corresponding to the first turn of the cochlea, and furrowed with two or three grooves for the nerves, which form the anastomosis of Jacobson. The *pyramid*<sup>a</sup> is a small conical projection behind the fenestra ovalis, presenting a small orifice at its summit, through which emerges the tendon of the stapedius muscle, which is contained within, to reach the neck of the stapes. At the base of the pyramid is an aperture through which the chorda tympani enters the tympanum; thence this nerve passes forwards between the handle of the malleus and the long arm of the incus, and emerges through a canal close to the Glaserian fissure. Above the pyramid an arched prominence<sup>e</sup> indicates the course of the aqueduct of Fallopius, close to the tympanum, and behind this is the free communication with the mastoid cells. At the upper part of the tympanum is the cochleariform process, which bounds the canal of the tensor of the tympani muscle. Below this is the commencement of the *Eustachian tube*, which is a straight canal, about two inches long, at first bony, then cartilaginous, and opening by a trumpet-shaped orifice into the pharynx, behind the inferior turbinated bone.

The *Bones* of the tympanum are four in number;<sup>1</sup> the *malleus*, or

hammer, has a *head*,<sup>m</sup> separated by a *neck* from a *handle*,<sup>h</sup> which is imbedded in the drum of the ear. A slight conical projection from the neck, called *processus brevis*, receives the insertion of the tensor tympani muscle. The *processus gracilis* is long and thin, and extends from the neck forwards and outwards to enter the glenoid fissure. The back of the head articulates with the incus.

The *Incus* or anvil resembles a molar tooth. Its body articulates with the malleus. Its *short crus*<sup>c</sup> is di-

Fig. 156.



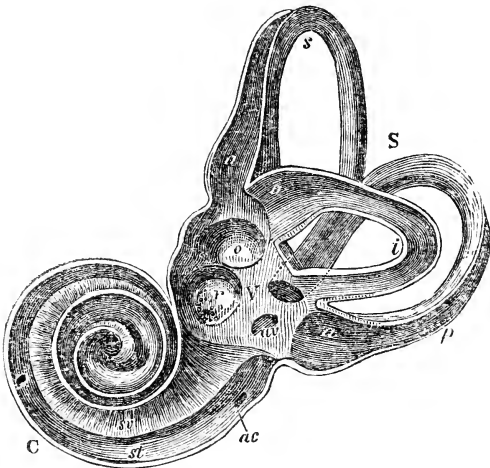


rected backwards, and projects at the mastoid cells. Its *long crus*<sup>lc</sup> has a hooked apex, which is bent backward, and in contact with a small lenticular bone, called *orbiculare*,<sup>a</sup> which is often fused into the incus.

The *stapes* or stirrup has its base or foot-piece<sup>s</sup> fitting the fenestra ovalis; one of its sides is more curved than the other, and its head is in contact with the orbiculare.

The *muscles* moving these bones are the *tensor tympani*, arising from the spinous process of the sphenoid and the Eustachian tube, and passing through that canal above the Eustachian tube, to be inserted into the upper part of the handle of the malleus, which it draws inward, and thus stretches the membrane of the tympanum. The *laxator tympani* arises from the spinous process of the sphenoid bone, and passes through the glenoid fissure, to be inserted into the *processus gracilis* of the malleus. There is sometimes another and lesser *laxator tympani*. The *stapedius* arises from the interior of the pyramid, and its tendon escapes from its summit, to be inserted into the neck of the stapes.

Fig. 157.



The *Internal ear*, or *labyrinth*, consists of three parts, the *vestibule*, (V,) the *semicircular canals*, and the *cochlea*.<sup>c</sup>

The *vestibule* is a small, three-cornered cavity, behind the internal wall of the tympanum; into it open the *semicircular canals*,<sup>s</sup> by five orifices behind, and the *cochlea*,<sup>c</sup> by a single one in front.<sup>a</sup><sup>c</sup> On its outer wall is the *fenestra ovalis*, and on its inner, several minute holes, including the *macula cribrosa*, for the entrance of a portion of

the auditory nerve. The *aqueduct* of the vestibule also penetrates it, from the posterior surface of the petrous bone. It also contains two depressions called *fossa hemispherica*, and *fossa semi-elliptica*.<sup>o</sup>

The *semicircular canals*<sup>s</sup> are three curved cylinders of half a line in diameter, whose extremities open into the vestibule by five orifices, each extremity being expanded like a flask and called *ampulla*.<sup>a</sup> Two of these canals<sup>s</sup> are vertical, and one is horizontal.<sup>o</sup>

The *cochlea* resembles a snail-shell, and consists of a conical canal, which makes two turns and a half spirally around an axis called the *modiolus*, which is a porous mass of bone, whose base is perforated by the filaments of the cochlear nerve. The *tube* of the cochlea is divided into two passages by the *lamina spiralis*, which terminates at the apex with a hook, called *hamulus*; which is covered by the *cupola*. The upper passage of the canal is called *scala vestibuli*, and the lower is the *scala tympani*. These passages communicate by an opening at the apex called *helicotrema*. The *scala vestibuli* opens into the vestibule, and the *scala tympani* through the *fenestra rotunda* into the *tympanum*. The *aqueduct* of the cochlea opens by one extremity into the *scala tympani*, and by the other upon the inferior surface of the petrous bone.

THE MEMBRANOUS LABYRINTH has the same shape as the bony cavities which it lines, and consists of a delicate membrane composed of several layers, containing the limpid fluid of Cotunnius, and the two small calcareous masses called *otoconites*.

THE AUDITORY NERVE divides in the *meatus auditorius internus* into a vestibular and cochlear branch.

THE END.

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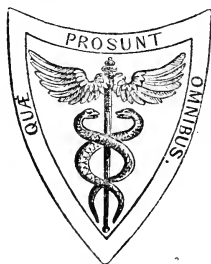
A  
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VARIOUS BRANCHES OF MEDICINE.

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PHILADELPHIA:  
LEA AND BLANCHARD.

1848.

Entered, according to Act of Congress, in the year 1848,  
BY LEA AND BLANCHARD,  
In the Clerk's Office of the District Court for the Eastern District of  
Pennsylvania.

C. SHERMAN, PRINTER,  
19 St. James Street.

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# PHYSIOLOGY.

---

**PHYSIOLOGY** is that science which treats of the actions or functions peculiar to living *organized* beings during the continuance of *health*, or *normal* life.

These actions, when they occur in a disturbed or irregular manner, constitute *disease*, or *abnormal life*; and become the subject of the science of Pathology. Every living being is *organized*,—that is, composed of different parts or *organs*, each of which has its definite structure, by which it differs from other parts, and is capable of fulfilling a certain end. The complex matter, which enters into the composition of an organized being, or *organism*, is called *organic* matter, and is obtained by its proximate analysis. By its ultimate analysis, this matter is resolved into its elementary principles, or *inorganic* elements, such as constitute other objects in the universe.

The mineral kingdom does not exhibit the same distinctness and variety of structure, in the component parts of its various bodies, nor is there any adaptation of these parts to separate functions; they are, therefore, called *unorganized* or *inorganic*, and are, by chemical analysis, resolved into those simple elements which admit of no farther subdivision.

Organized bodies are found in one of two states or conditions, viz., that of *life*, or *death*. That of life, is a state of action, or of capacity for action. That of death, is one in which all vital action has ceased, and to which the disintegration of the organized body succeeds as a natural consequence.

An organized body in a state of *active* life, exhibits certain processes by which its growth and nutrition are provided for, and which enable it to resist the destructive influence of surrounding agents. The object of these processes, is to promote the development, and to preserve the integrity of the body itself. The simplest animal or vegetable, is an illustration of this remark.

The very processes which denote vital activity, may be sometimes temporarily suspended, even in fully formed animals and vegetables; and in such instances, life may be said to become *dormant*. Of this we have an example in the ordinary wheel animalcule, which,

although apparently killed by the drying up of the fluid in which it had been immersed, will speedily renew its active movements on being again supplied with water.

Organized bodies are capable of being resolved by chemical analysis, into the inorganic simple elements; but the list of substances obtained from this source, is small in comparison with those found in the inorganic world, being only about seventeen. Of these, four alone, are considered *essential*, viz., carbon, oxygen, hydrogen, and nitrogen. Two, at least, of these will be found in every organic compound. The other simple substances are found in smaller quantities, and are less extensively diffused; these may be called its *incidental*, or *non-essential* elements. These are, sulphur, phosphorus, chlorine, sodium, calcium, potassium, magnesium, silicon, aluminum, iron, manganese, iodine, and bromine; the last two are obtained almost exclusively from marine plants and animals. Between these elementary substances and the *organized* animal, or vegetable structure, there exists a class of compounds, called *proximate principles*, or *organic compounds*, or *organizable substances*. These are obtained in the first stage of chemical analysis of the various animal and vegetable tissues, and may be resolved by further analysis into their simple elements. For example, by the first analysis of *muscle*, we obtain the *proximate principle*, called *fibrin*, which is its chief constituent; subsequently, by the analysis of *fibrine*, we obtain the simple elements, oxygen, hydrogen, carbon, nitrogen, and sulphur, in certain proportions. So, on the other hand, by synthesis, the inorganic elements will produce the organic compound fibrine; from which again, the organic *structure* muscle is obtained. This latter, however, has never been effected in the laboratory, but solely in the living body.

The true proximate principles are those substances which are first obtained by the analysis of the organized textures; such are, gluten, starch, and lignine, from the vegetable; and albumen, caseine, or fibrine, from the animal textures. From these again are derived a great variety of products by various processes, owing to the tendency which their elements have to form new combinations. For example: by boiling starch in dilute acids, it becomes converted into a kind of gum, and starch sugar. A large class of organic compounds is thus formed, which it seems proper to distinguish from the true proximate principles, under the name of *secondary organic compounds*.

In analyzing both the primary and secondary organic elements, they are found, in the majority of cases, to be composed of three or four essential elements; although in the secondary organic products of the vegetable class, we meet a few instances of binary compounds of simple elements.

When an organic substance, which is so constructed as to form part of a living organism, is examined, it is found to possess some very distinctive characters. It contains water in considerable proportion; its form is more or less rounded, and free from angularity, and it is never crystallized. When it is necessary that it should possess considerable hardness, the amount of water is small, and an inorganic material is combined with the organic matter, as the phosphate of lime with gelatine in bones, or the silex with the epidermic tissues, in plants.

An organized body is composed of parts which differ from each other in structure and function; it may be subdivided into a series of textures, each differing from the others in physical and vital properties. When a great variety of textures exist in an animal, it is an indication of a high degree of organization.

The simplest and most elementary organic form, is that of a cell containing another within it, (*nucleus*,) which again contains a granular body, (*nucleolus*.) (Fig. 1.) This appears to be the primary form which organic matter takes as it passes from the condition of a proximate principle to that of an organized structure.

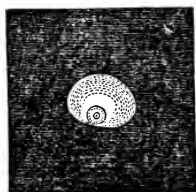
In some animals and vegetables, the whole body is composed of cells of this kind, and in the development of the embryo, all the tissues, however dissimilar, are composed of cells which are afterwards metamorphosed into the various structures that make up the perfect being.

Every organized body has a definite form and size; it has also its origin from parents, and has an allotted time to live; and after death it passes by decomposition into the simpler combinations of the inorganic elements.

Organized bodies grow by materials which are deposited within, and carried to the different parts of the structure by a vital process. They have also the power of repairing parts lost either by injury or disease. Parts that have been removed, may be replaced by a process of growth in the plant or animal, and this process is the more energetic in proportion as the structure of the organized body is more simple. The part that has been separated, however, in the higher orders, perishes; but in the lower orders, it often happens that the severed portion becomes a new and independent being, as is the case with the hydra, in the animal kingdom, and with certain members of the vegetable kingdom, cuttings of which will often produce a similar plant to that from which it was stricken.

Organized bodies have the power of appropriating or assimilating to their own textures, other substances, both organic and inorganic. By virtue of this process, plants and animals are continually adding

Fig. 1.



to themselves new materials by which they are nourished. Plants derive their nourishment from the inorganic world, from the excretions of animals, and from decaying organic matter. Animals, on the other hand, can be nourished only by organic matter, either animal or vegetable. Both possess the power of rearranging the constituents of these substances into forms identical with those of the elements of their various tissues.

But whilst new matter is being deposited, the old particles must be thrown off, otherwise the growth would be unlimited; and if excretion alone went on, disorganization would very soon occur. In both operations, new combinations are continually taking place as it were, in opposite directions; in the one, from the simple to the complex organized parts; in the other, from the complex constituents of the textures, to the simple organic or inorganic compounds.

From the *decomposition* of animal and vegetable matters, a great variety of products results. This decomposition is of two kinds, distinguished by the names of *fermentation* and *putrefaction*; the former term has been limited by Liebig to the decomposition of substances devoid of nitrogen, and the latter to that of azotized substances. The products of this decomposition are nitrogen and hydrogen, (which partly escape in a free state), water, carbonic acid, carburetted hydrogen, olefiant gas, ammonia, cyanogen, prussic acid, phosphuretted hydrogen, and hydrosulphuric acid; while in some cases the elements reunite in different proportions, so as to form a new organic compound, as in the production of sugar from starch in the saccharine fermentation. Sometimes from one organic substance two new compounds are generated, one organic, the other inorganic; as in vinous fermentation, during which carbonic acid and alcohol are formed from sugar.

The conditions more or less necessary for the spontaneous decomposition of organic matter, are moisture, the access of atmospheric air, and a certain temperature. The first and last are always necessary, the second not invariably.

The gaseous products of the decomposition of animal matter, and of the human body in particular, are carbonic acid, sometimes nitrogen, hydrogen, sulphuretted hydrogen, phosphuretted hydrogen and ammonia. Acetic acid is also formed, and sometimes nitric acid.

By contrasting the characters of organized bodies as described, with those of the inorganic world, the distinction between the two may be seen. Inorganic bodies are either acriform, liquid, or solid; they are irregular in shape, and generally angular. No distinction of parts or organs is to be found in the mineral substance; its minutest fragment is in every respect of the same nature as the largest mass. Inorganic bodies are unlimited in size and duration, continuing for ages without augmentation or waste, provided no mechanical or chemical agent be brought to act upon them. There is in them

no growth from internal deposition; they increase, if at all, by particles deposited without; there is no power of reproducing themselves, or repairing lost parts, no excretion, no assimilation. The constant round of actions witnessed in the living organized structure, and which is called *life*, in them is wanting. The affinities of their component elements being satisfied, all remains at rest. Change is the exception; rest, the law. Whilst in organized bodies, *rest* is the exception, *change* the law.

#### DISTINCTIONS BETWEEN ANIMALS AND VEGETABLES.

Under the head of *organized bodies* are included both animals and vegetables; and it is therefore desirable to point out some of the characteristic differences between these two kingdoms. Development, growth, excitability, propagation and decay are the general phenomena and properties of all organized bodies, and are the results of organization; but there are other properties peculiar to animals, which may therefore be termed *animal*, in contra-distinction to the general *organic* properties; these are *sensation* and *voluntary motion*. Plants, it is true, are not entirely destitute of motion; their organization is attended with internal motions, such as the circulation of the sap; moreover, they turn spontaneously to the light; their roots seek the most nutritious soil, and some even perform evident movements which seem to be spontaneous, as if they indicated sensibility. Such movements are seen in the sensitive plant and in the Venus' fly-trap. These, however, are strictly *organic* and result from physical changes produced directly in the part impressed. Plants are *irritable* but not *sensible*. Irritability must not be confounded with sensibility. Plants cannot be said to possess sensibility unless they manifest consciousness.

The presence of a *stomach* is another characteristic of animals. This may be a mere result, however, of the nature of their food. Vegetables obtaining their food in a liquid or gaseous form, do not require a cavity for its reception. The only instance in which such an organ may be supposed to exist is in the case of the pitcher-plant, in which the leaves are so arranged as to form cavities for the retention and solution of the bodies of insects; the dissolved food is then absorbed into the plant.

Animals, on the contrary, cannot live on inorganic materials, they can only employ them as food after they have been united into certain peculiar organic compounds. Now, as they cannot incorporate any alimentary substances into their own tissues until they have been reduced into a fluid form, they require a cavity, the stomach, to effect this reduction.

Another difference is observed in the manner in which the first development of the germ takes place. The first nisus of animal de-

velopment is towards the formation of a stomach, for the internal reception and digestion of food ; whilst the first processes of vegetable evolution tend to the production of a leaf-like membrane, which, like the permanent *frond* of the lower classes of plants, absorbs nourishment by its expanded surface only. The seed of the plant and the egg of the animal consist principally of a store of nourishment prepared by the parent for the supply of the germ, which is introduced into the midst of it. In both instances, the first development of the germ is into a membranous expansion, which absorbs the alimentary materials with which it is in contact, and prepares it for the nourishment of the embryonic structure. In plants, this membranous expansion absorbs by its *outer* surface only, which is applied to the albumen of the seed. In animals, the expansion is developed in such a manner, that it surrounds the albumen, inclosing it in a sac, of which the inner surface only is concerned in absorption, and becomes the temporary stomach of the embryonic structure.

The *circulation* is much more simple in plants than in animals, and is, in them, never provided with a special organ for the distribution of the sap ; they have no heart.

The function of *respiration* has usually been enumerated among the distinctive characteristics of animals and plants, it being supposed that oxygen is absorbed and carbonic acid evolved by the former, and a converse change effected in the surrounding air by the latter. This, however, is not correct, the products and process of respiration being the same in both ; whilst the absorption of carbonic acid and elimination of oxygen which take place only in daylight, is much more analogous to the *digestion* of animals. Lastly, plants having only one mode of manifesting life, namely, by vegetation, do not require manifold organs in addition to their roots, stem, and leaves, and, with the exception of the organs of fructification, present merely a repetition of perfectly similar parts, in all of which the simple relation of branches to leaves is the same, and even the sexual organs are evidently allied to the leaves, and in some cases are transformed into them. In animals, on the contrary, the reciprocal action of circulation, respiration, and the nervous system is actually necessary to life. The respiratory movements are dependent on nervous influence ; but the nerves do not exert this influence unless supplied with blood which has been aerated in the lungs ; and the blood again is not sent to the different organs, and therefore not to the nerves, unless the contractions of the heart are performed ; while the heart in its turn is dependent on the influence of arterial blood and the nerves. The brain, heart, and lungs, therefore, may be likened to the main wheels of the animal machine, each acting on the other, and all set in motion by the change of material which takes place in respiration.



## ELEMENTARY PARTS OF ANIMAL STRUCTURE.

The animal body is composed of *fluids* and *solids*. The former constitute the blood, chyle, lymph, and the secretions of the various glands; the latter, the various textures and viscera. The proportion of fluids far exceeds that of solids, though it is a difficult matter to form a positive estimate. Richerand says they are in the proportion of six to one; Chaussier of nine to one. The latter found that a dead body which weighed one hundred and twenty pounds, after desiccation in an oven weighed only twelve. Blumenbach possessed the entire *perfectly dry* mummy of a Guancho, which with all the muscles and viscera, weighed only seven pounds and a half.

Water is one of the most important of the constituents of the human body; it enters largely into the composition of all the fluids, and gives flexibility and softness to the various solid textures. It is also a solvent of many organic matters, and either in solution, or suspension, serves to carry them to the various textures and organs.

It has been already shown that there exists between the inorganic elements and the organized animal or vegetable structure a class of compounds called *proximate principles*, and that from these a great variety of products could be obtained owing to the tendency which their elements have to form new combinations, and that these latter were called *secondary organic compounds*. The following table exhibits these two classes of substances.

## PROXIMATE PRINCIPLES.

Albumen.	} Compounds of proteine.
Fibrine.	
Caseine.	
Gelatine.	
Chondrine.	
Elaine.	
Stearine.	
Margarine.	
Hæmatosine.	
Globuline.	

## SECONDARY ORGANIC COMPOUNDS.

Urea.	} In the urine.
Uric or lithic acid.	
Cholesterine; in the bile.	
Biliary matters.	
Pepsine; in the gastric juice.	
Sugar of milk.	
Lactic acid.	

(Todd and Bowman.)

*Albumen*.—Exists in two forms, *fluid* and *concrete*. In the latter form, when pure, it is perfectly white; hence its name (albus, white); it is found *solid* in the brain, spinal cord and nerves, and in the mucous membranes, which are thence called albuminous tissues. It is *fluid* in the serum of the blood, the lymph and chyle, and in many of the secretions. It is coagulable by heat, acids, and corrosive sublimate, but not *spontaneously*.

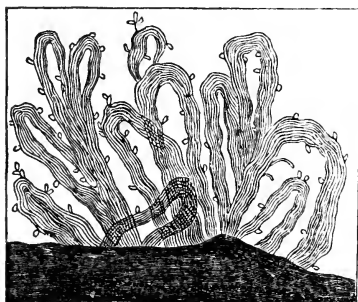
*Fibrine* is found in solution in the chyle, lymph, and blood. It is the basis of the muscles, in which it is found in a solid form. It is one of the most abundant of the animal substances. It may be

obtained by stirring blood as it is flowing, or by washing a clot in clean water so as to dissolve out the colouring matter.

Fibrine is white, solid, flexible, and slightly elastic; insoluble in water, alcohol, and acids, but soluble in caustic potassa. Chemically speaking, fibrine does not differ essentially from albumen. Physiologically, the great variation lies in the *spontaneous* coagulation of the fibrine, and when coagulated it is found to possess a definite *fibrous* arrangement, the fibres crossing each other in every direction.

Fibrine is the plastic element of the blood, and with the serum constitutes the liq. sanguinis; it forms the buffy coat of the blood, and is found in those exudations which take place either in inflam-

Fig. 2.



mation, or from a peculiar formative action, destined to repair an old tissue, or produce a new one; under these circumstances, it is often called *coagulable lymph*. (Fig. 2.) Caustic potassa, carb. potass., chloride of sodium, and many neutral salts, when mixed with blood, will prevent the coagulation of fibrine.

*Caseine* has many properties in common with albumen and fibrine. It exists in greatest abundance in milk, and is

the basis of cheese. Its occurrence in other fluids has not been positively detected. It may be obtained by allowing milk to remain at rest till it is coagulated, skimming off the cream, then washing and drying the clot.

Caseine is very perfectly coagulated by the action of *rennet*. This coagulating power is not due to the acid of the stomach, but to the pepsine resident in it. It is not coagulable by heat, but is readily precipitated by the addition of an acid. It contains sulphur, but no phosphorus.

*Proteine*.—If albumen, fibrine, or caseine, be dissolved in caustic potassa, and acetic acid be added to the solution, a precipitate takes place of a translucent, gelatinous material. This substance was called *proteine* by Mulder, the discoverer, because it was supposed to be the starting point or basis of all the tissues (from  $\pi\rho\omega\tau\epsilon\upsilon\omega$ , I take the first place).

The precipitate is the same no matter which of the substances above named be taken, be it animal or vegetable. They are looked upon therefore as modifications of *proteine* by the addition of certain proportions of phosphorus or sulphur, or both.

Dried *proteine* is a hard, brownish-yellow substance, without taste,

and insoluble in water and alcohol. It unites with oxygen in definite proportions, so as to form a *binoxide* and *tritoxide*. These are formed in the lungs from fibrin, which, in a moist state, possesses the property of absorbing oxygen. The tritoxide, especially, is formed every time that the blood passes through the lungs, and given out again when it returns to the system. A much larger quantity is formed also during the inflammatory condition, constituting the *buffy coat*.

*Pepsine* and *Pyin* are also included under the head of proteine compounds by some authors, although the existence of this substance in them is denied by many others. The first is a peculiar substance thrown off from the mucous lining of the stomach, and the second is also a peculiar substance found in *pus*. Mulder regards it as a *protoxide of proteine*. Proteine undergoes decomposition very readily when acted on by other chemical substances, especially by alkalis. This is a property which must be continually acting in the living body; since the blood is known to have an alkaline reaction.

*Gelatine* is the chief constituent of the cellular, or areolar tissue, skin, tendons, ligaments, and cartilages: it is also contained in large quantities in bones. It is obtained by boiling any of the above substances, and allowing the solution to cool. Glue is an example of impure gelatine. It contains *no proteine*, hence it has been concluded that it cannot yield albumen, fibrine, or caseine. It is insoluble in cold water, alcohol, and ether, and has a strong affinity for tannin. The process of tanning leather results from this affinity. Proteine cannot be obtained from gelatine, but it is probable that it or its compounds have yielded gelatine, for the gelatine of the chick must be produced from a compound of proteine.

*Chondrine* resembles gelatine in many respects, except that it is not precipitated by tannin, and yields a precipitate to acetic acid, alum, acetate of lead, and protosulphate of iron, which do not disturb solutions of gelatine. It is obtained by boiling the permanent and temporary cartilages; also from the cornea, and gelatinizes when cool.

*Elaine*, *stearine*, and *margarine* are proximate principles of fat. The first gives fluidity, the second is the solid ingredient, and the third is of medium consistency. Stearine is but sparingly present in human fat.

*Hæmotosine* is the red colouring matter of the blood contained in a capsule which is composed of *globuline*. The latter is regarded by some chemists, as a proteine compound.

In regard to the *secondary organic compounds*, they are transformed by some unknown chemical agency, from the elements of the tissues, to be excreted from the system by particular organs. There is reason also to believe, that, at least with respect to some of them,

the elements of the food contribute immediately to their formation. Of this latter hypothesis the bile is supposed to be an example.

Further, in regard to the particular tissues from which these compounds are formed, Dr. Prout suggests that urea is derived from the gelatinous, and uric acid from the albuminous tissues, whilst the fatty materials are supposed to form some of the constituents of the bile. The particular compounds will be treated of under the head of secretions.

### CLASSIFICATION OF THE TISSUES.

From the proximate principles described above, are developed the various tissues of the body. In combining to form the different structures the solids are arranged in a variety of ways. Of these the chief are in filaments, or elementary fibres, tissues, organs, apparatus, and systems. By *filament*, is meant the elementary solid. A *fibre* consists of a number of filaments united together. By the union of tissues, *organs* are formed. A number of different organs united to accomplish one end constitute an *apparatus*. When a number of organs of similar or analogous structure are united for one end, they form a *system*. Schwann advanced the doctrine that *all* the tissues of the body were formed from *cells*. It has been shown, however, by subsequent research, that this assertion was rather too hasty; that although many tissues retain their original cellular type throughout life, and many more are formed from cells which are afterwards metamorphosed, there are some in which no other cell-agency is employed than that concerned in the elaboration of the plastic material. This is the case in certain forms of the very delicate structureless lamella known by the name of *basement membrane*, found beneath the epidermis and epithelium, in which no vestige of cell structure can be seen, but which appears rather to resemble that of which the cell walls are themselves constituted. At other times it seems to be composed of the coalesced nuclei of cells whose development has been arrested. In regard to the fibrous tissues a doubt also exists as to whether they are developed by a metamorphosis of cells, or whether they are not, like basement membrane, produced by a consolidation of a plastic fluid which has been elaborated by cells.

The following arrangement of the human tissues, is that adopted by Dr. Carpenter, and expresses their fundamental relation to the elements above alluded to, viz. : *membrane*, *fibres*, and *cells*.

*a.* Simple membranous tissues.—Of these there are scarcely any examples in the human body except in the capsule of the lens, and the posterior layer of the cornea. The walls of the primary organic cells are also composed of it; and it is employed in forming muscle, nerve, and the adipose and tegumentary tissues. Its principal cha-

racter is extension, but its ultimate arrangement defies the highest powers of the microscope.

*b.* Simple fibrous tissues.—Under this head are included the white and yellow fibrous tissue and the areolar tissue. These are extensively used for connecting different parts, or for associating the elements of other tissues. The ligaments of joints are composed of the white, or yellow fibrous tissues; and areolar tissue surrounds and connects the component parts of nerves, muscles, vessels, &c.

*c.* Simple cells floating separately and freely in the fluids, as corpuscles of the blood, lymph, and chyle.

*d.* Simple cells developed on the free surfaces of the body, as epidermis and epithelium.

*e.* Compound membrano-fibrous tissues, composed of a layer of simple membrane, developing cells on its free surface, and united on the other to a fibrous or areolar structure, as the skin, mucous membranes, serous and synovial membranes, lining membrane of blood-vessels, &c.

*f.* Simple isolated cells, forming solid tissues by their aggregation, as fat cells, the vesicles of gray nervous matter, absorbent cells of the villi, the cellular parenchyma of the spleen; the cells being held together in all these cases by the blood-vessels and areolar tissue which pass in between them. In cartilage, and certain tissues allied to it in structure, the cells are united by intercellular substance, either homogeneous, or of a fibrous character.

*g.* Sclerous or hard tissues, in which the cells have been more or less consolidated by internal deposit, and more or less completely coalesced with each other, as the hair, nails, &c. These may be more properly ranked under the epidermic tissues, but the result is more characteristically seen in bones and teeth. The sclerous tissue contains a large proportion of inorganic material to which it owes its hardness. It differs from all the other tissues except cartilage and fibro-cartilage, which for hardness might be classed with it.

*h.* Simple tubular tissues, formed by the coalescence of the cavities of cells, without secondary internal deposit, as the capillary blood-vessels and smallest lacteals and lymphatics.

*i.* Compound tubular tissues, in which, subsequently to the coalescence of the original cells, a new deposit has taken place within their cavities. In the tubuli of the white nervous matter, and in those of the least perfect form of muscular fibre, the secondary deposit has only a granular or amorphous character; but in the striated muscular fibre it is composed of minute cells.

Other classifications of the tissues have been adopted by different physiologists and general anatomists, among these Haller described only *three*, the *nervous*, the *muscular*, and the *cellular*; from these all the organs are formed by the association of the first two tissues, or by the last alone. The limits of a work like this will not admit of an

examination of all these different classifications. That one has been adopted which seems to be most generally received.

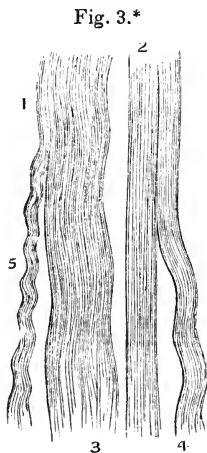
The elementary membrane was alluded to and described, as far as seemed requisite, in the commencement of this article; we proceed at once, therefore, to the consideration of the second group of tissues, the *fibrous*.

#### OF THE SIMPLE FIBROUS TISSUES.

Under this head are included two kinds of texture, resembling each other only in the fact that they present to the eye a *fibrous* aspect. They differ in their ultimate structure, colour, and physical properties. They are both used in connexion with the skeleton, and are concerned in the mechanism of animal motion and locomotion. They are known as the *white* and *yellow fibrous tissues*.

It will be remembered that there is reason to doubt whether they are generated by a metamorphosis of cells, or whether they are not produced by the consolidation of a plastic fluid which has been elaborated by cells; the latter is the more probable hypothesis.

The *white fibrous tissue* is found in textures requiring great flexibility, strength, and an unyielding firmness; such as ligaments, tendons, fibrous membranes, aponeuroses, &c. It presents itself in the form of inelastic bands, somewhat wavy in their direction, sometimes arranged side by side, at others, disposed on different planes, and interlacing and crossing in various directions. (Fig. 3.) It is *inelastic*, and under ordinary circumstances, *inextensible*; contains but few vessels, and no nerves, at least they have never been satisfactorily discovered. It seems entirely destitute of any vital properties; and its chemical nature is such that it needs very little interstitial change to maintain its normal composition. It yields gelatine in considerable quantity by boiling. When treated with acetic acid it immediately swells up and becomes transparent.



When a solution of continuity takes place in this tissue it is readily repaired by the interposition of a new substance, in every respect resembling the original, save, that it wants the peculiar glistening aspect, and is more bulky.

*Yellow fibrous tissue*, differs from the last in colour, and in the possession of *great elasticity*. It consists of bundles of fibres covered

\* 2. Straight appearance of the tissue when stretched. 1, 3, 4, 5. Various wavy appearances which the tissue exhibits when not stretched.

by a thin sheet of areolar tissue; the fibres are either round or flattened, brittle, and disposed to curl at the end. (Fig. 4.) It is found in the middle coat of the arteries, in the chordæ vocales, the ligamentum nuchæ, the ligamenta subflava, in the crico-thyroid membrane, and in the longitudinal bands of the trachea and its branches. It undergoes little or no change by boiling, and is unaffected by acetic acid; it resists putrefaction, and preserves its elasticity during a long period.

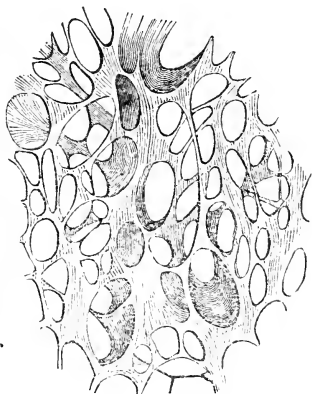
Fig. 4.



Both these varieties may be detected in the tissue now generally designated as *areolar*, formerly *cellular*. This is formed by the crossing and interlacing of minute fibres and bands interwoven in every direction, so as to leave innumerable interstices which communicate with each other: this may be proved by filling them with air or water, as occasionally happens in the living body in anasarca and traumatic emphysema. (Fig. 5.)

These interstices are not cavities possessed of definite limits, because they are open on all sides. The application of the term *cell* to them, is, therefore, inappropriate. The term *cellular* is more applicable to those tissues which consist of a congeries of distinct cells.

Fig. 5.



The *areolar* tissue is one of the most extensively diffused of all the elements of organization, being found in every part of the fabric, except in the compact portion of bone, teeth, and cartilage. It does not exist in the brain either, except around the minute vessels. Its great use is to connect together organs, and parts of organs which require a certain degree of motion upon each other. To do this, it is placed in their interstices, and is more or less lax, and more or less abundant, according to the particular exigency of the part.

It has scarcely any *vital* properties, but possesses the physical properties of extensibility and elasticity. It has neither contractility nor sensibility, the nerves which it contains, being merely distributed in it in their route to other organs.

Areolar tissue is readily regenerated when destroyed, and yields gelatine very readily by boiling. The interstices are filled during

life with a fluid resembling dilute serum, which soaks out of the blood-vessels by the mere physical process of *transudation*; a morbid increase of this fluid occasions the condition called *anasarca*, which is recognised by the skin pitting under the pressure of the finger.

#### SIMPLE CELLS FLOATING IN THE ANIMAL FLUIDS.

Of these we have examples in the corpuscles of the *blood*, *chyle*, and *lymph*. The corpuscles of the blood consist of an investing capsule composed of *globuline*, and a contained fluid, secreted in the interior of the cell, of a red colour, called *hæmatosin* or *hæmatin*. In shape they are somewhat disc-like, the sides are concave, and there is a bright spot in the centre, which by many has been regarded as a nucleus. The form of the disc is readily altered by reagents, the membrane of the cell-wall being readily permeable by liquids either inwards or outwards, as the relative density of the contents of the cell and the surrounding fluids may direct.

It is supposed that these cells contain a nucleus, though it cannot be distinctly brought into view in the corpuscles of human blood, as it can in that of the oviparous vertebrata. Dr. G. Q. Rees states that he could distinguish a nucleus on the ruptured cell-walls, although they escape observation when within the corpuscles in consequence of their high refractive power.

Their size varies in the same individual, and they bear no constant relation to the size of the animal. In man their average diameter is about 1-3200ths of an inch.

*Chemical composition.*—*Globuline* is a proteine compound, and does not differ essentially from other substances that result from the organization of the proteine compounds. *Hæmatine*, when separated from albuminous matter, is of a dark brown hue, its formula is C. 44, H. 22, N. 3, O. 6, F. 1. The red colour is not due to the presence of iron, since, as Scherer has shown, it may be entirely dissolved out without destroying the colour.

In regard to the *origin* of the red corpuscles there is considerable difference of opinion. Most physiologists look upon them as nucleated cells, having the power of reproducing themselves, either by splitting up the disc and nucleus into six or seven segments, or, as Dr. Rees has observed, by an hour-glass contraction of the corpuscle, by which two unequal-sized circular bodies were eventually produced from each.

In the formation of the embryo, they have an origin common to that of all the other tissues. In the embryo of the bird, they are formed in that portion of the germinal membrane known as the *vascular layer*; this consists of delicate cells very uniformly disposed, and whilst capillary vessels are formed by the union of the



cavities of these cells, their walls being absorbed at the points of contact, the *blood discs* seem to be developed from the granules or cell-germs they contain. These corpuscles are larger in the embryo than in the adult, which fact is an argument in favour of the independent circulation in the fœtus.

According to Dr. Carpenter, the *uses* of the red corpuscles are now definitely settled. Since they are confined nearly entirely to the vertebrata, and are absent in the embryo of higher animals at an early period of their development, the inference appears highly probable, that they are not essential to growth or nutrition. On the other hand, as they are found most abundant in those classes of vertebrata which possess the highest temperature, and are known to undergo important changes in the pulmonic and systemic capillaries,—it seems highly probable that their office is, to convey oxygen into the system, and carbonic acid out of it; serving, in fact, as the medium for bringing the tissues into relation with the air, the influence of which is necessary for the maintenance of their vital activity.

Besides the cells which have been described as floating in the blood, viz., the red corpuscles, there are also found both in this fluid and in the *chyle* and *lymph*, certain *colourless* corpuscles which are observed to be present in the blood, both of the vertebrata and invertebrata. From the latter fact it would not be wrong to infer that the function of the latter must be of a *general* character, and immediately connected with the nutritious properties of the circulating fluid, whilst the function of the red corpuscles must be of a limited character, being required only in a portion of the animal kingdom. The dimensions of these corpuscles are nearly constant throughout the different classes of vertebrata; their diameter being seldom more than 1/3000th of an inch; hence it would seem improbable that the one would ever be converted into the other. They have no distinct nucleus, but are studded with minute granules which may occasionally be seen in active motion within them, and which are discharged when the corpuscles are treated with liq. potassæ. In the circulating blood, they are always found on the *outside* of the current where the motion of the fluid is slow.

The *function* of these colourless corpuscles, both in the blood and in the chyle and lymph, seems to be, the *elaboration of plastic fibrine from unorganizable albumen*. They are always found most abundant where these processes are going on, in the fluids in which they are contained, and their number is always in proportion to the *amount* of fibrine. They are looked upon as cells of a transitional character, precisely such as those developed in the germinal vesicle for the elaboration of its contents. They are not in themselves destined to form an integral part in any permanent structure, but, after attaining a certain maturity, reproduce themselves and disappear,

successive generations thus following each other until the end is accomplished for which they were first produced.

#### OF CELLS DEVELOPED ON FREE SURFACES.

Of these we have examples in the cells composing the *epidermis* and *epithelium*, two structures which are essentially alike in their origin, mode of development, situation, and individual history; they differ, however, in the purposes which they respectively serve in the economy.

The *epidermis* is the cellular covering of the external surface, the *epithelium* is the corresponding covering of the internal cavities. They both consist of cells, which are developed from the subjacent membrane, which are nourished by its vessels, and which are, after a time, cast off from its free surface, to be replaced by a succeeding generation.

The *epidermis* is not permeated by either vessels or nerves, but consists solely in a congeries of nucleated particles arranged in laminæ. Those that lie deepest and rest immediately on the cutis are small granules scattered in a homogeneous matrix. Those of the next layer are rounded cells of transparent membrane, in which similar granules can be seen. In the succeeding layers these cells are more and more compressed as they are nearer to the surface; and on the surface they are mere flattened scales.

The superficial scales are being constantly shed; and new ones are as constantly formed below from germs, which are supplied by the basement membrane. The soft layer immediately in contact with the true skin was formerly called *rete mucosum*, but it is now proved to consist of the same elements with the ordinary *epidermis*. The *epidermis* varies in thickness in different parts, according to the amount of pressure or friction to which it is subjected.

The *use* of the *epidermis* is to protect the true skin from mechanical injury, and from the irritating effects of exposure to atmospheric vicissitudes.

Mixed up with the *epidermic* cells, we find the *Pigment cells*, or those which contain the peculiar colouring matter of the races. The black colour is caused by the presence within them of a number of flat or oval granules, which are transparent, and exhibit an active movement when set free from the cell. The chemical nature of this pigment is unknown; it includes, however, a larger proportion of carbon than most other organic substances—every 100 parts containing  $58\frac{1}{2}$  of carbon.

Exposure to light increases the development of these pigment cells, as is seen in freckles, tan, and the swarthy hue obtained by exposure in tropical climates. The latter is doubtless the cause of the blackness of the negro's skin, operating through successive generations.

The *nails* and *hairs* are also modifications of epidermic cells—for *description of which see Anatomy*.

The *epithelium* is the layer of cells which covers the internal free surfaces of the body. In some instances it serves, as the epidermis, to protect the subjacent membranes; in others, it takes an important part in some of the organic functions.

In the arrangement of the epithelial cells, two principal forms are seen, viz.: the *tessellated* or *pavement-like epithelium*; and the *cylindrical*, or *cylinder epithelium*.

The tessellated, covers the serous and synovial membranes, the lining membrane of blood-vessels, and the ultimate follicles or tubuli of the glands connected with the skin or mucous membranes. It is called *tessellated*, from the fact, that the cells which compose it are polygonal, and arrange themselves like the pieces of marble in a tessellated pavement. Sometimes, however, the cells retain their rounded form, and are separated by considerable intervals.

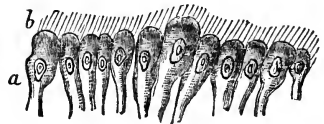
The *cylinder epithelium* is so called because the component cells are cylinders, and arrange themselves side by side, one extremity resting on the basement membrane, while the other forms part of the free surface. It is found in the mucous membrane of the alimentary canal, from the cardiac orifice downwards; in the larger ducts of the glands which open into it; or, upon the external surface.

Both these forms of epithelium are frequently seen to be fringed at their free extremities with delicate filaments, termed *ciliæ*, from their resemblance to an eyelash. These, although exceedingly minute, are of great importance in the economy, through the extraordinary motor power with which they are endowed (Fig. 6). In form the ciliæ are usually a little flattened, and tapering gradually from base to point. Their size is variable, ranging from 1·5000th to 1·13000th of an inch in length.

When in motion they present the appearance of a field of wheat over which the wind is blowing, first depressed, and then returning to its original state. The direction of this motion is towards the outlets.

The *cause* of ciliary motion is unknown, it is not dependent on muscular action, since it continues after separation, and contains not even a fibrilla of muscle. It seems to be entirely *molecular* and independent of muscular influence, and of both the vascular and nervous systems. It continues many hours after separation from the rest of the system has taken place, and when all supply of blood to the parts endowed with it has been cut off. It resists the action of

Fig. 6.\*



\* a. Nucleated cells resting on their smaller extremities; b. Ciliæ.

narcotics, which affect powerfully the nervous system; and even electricity, which destroys muscular contractility, does not affect the action of ciliæ. It continues much longer in cold-blooded than in warm-blooded animals. The *function* of the ciliæ seems to be, to propel the secretions, which would otherwise accumulate on these membranes, towards the outlets.

The epithelium cells, like the epidermic, are being constantly cast off and renewed from the subjacent surface; but the rapidity of this renewing process varies according to the particular function of the part.

#### OF THE COMPOUND MEMBRANO-FIBROUS TISSUES.

This division includes the structures made up of the elementary components of the body, viz. : membranes, fibres, and cells, in their simplest forms. These are the serous, synovial, and mucous membranes.

The serous and synovial membranes are essentially alike in their minute structure. On their free surface is a single layer of *epithelium*, the particles of which are polygonal in shape, and of transparent texture. This rests upon a continuous transparent *basement membrane* of extreme tenuity. Beneath this is a layer of *areolar tissue*, which constitutes the chief thickness of the membrane, and gives it its strength and elasticity. This areolar tissue is traversed by a network of capillary vessels, lymphatics, and nervous filaments in varying number; and is the bond of union with the tissues beneath. It is commonly known as the *subserous tissue*.

The physical and vital properties of serous membranes are precisely those of areolar tissue. They are elastic, but not contractile, and have very little sensibility, except when inflamed. They are bedewed with a secretion which resembles the serum of the blood. That of the synovial membranes and bursæ mucosæ has from 6 to 10 per cent of additional albumen. It escapes from the blood-vessels by simple *transudation*.

Serous membranes are recognised by the fact, that they always form shut sacs. The peritoneum of the female is the only exception to this rule. At two points this membrane is open, where it communicates with the canal of each Fallopian tube at its dilated extremity.

The *mucous membranes* may be said to consist of the three parts described in the serous, viz. : *epithelium*, *basement membrane*, and the *submucous areolar* tissue. The mucous membrane is continuous with the external skin, and by some is considered as identical. It is recognised by the fact that it lines the *outlets*, and never occurs as a shut sac. It is abundantly supplied with blood-vessels, absorbents, and nerves. The first two are very numerous, the last not so much so, hence the sensibility of this structure is usually low.

The areolar tissue of mucous membranes usually makes up the

greater part of their thickness; and is so distinct from the subjacent layers as to be readily separated from them. The elasticity of these membranes is dependent upon the presence of the yellow fibrous tissue in the areolar tissue.

Mucous membranes are very speedily regenerated whenever they have been destroyed either by injury or disease. They constitute the medium through which all the changes are effected that take place between the living organism and the external world.

The character of the secretions of mucous membranes varies in almost every part, and is dependent upon the properties of the epithelial cells which cover them. In the ultimate tubuli of glands, these cells are found to contain the peculiar substances which characterize the secretion. They are not mere protective agents, as the epidermic cells are, but, in the case of the glands, they are concerned in elaborating their peculiar secretions, and in the mucous membrane of the small intestine, in effecting the absorption of nutrient materials.

In the bronchio-pulmonary and gastro-intestinal mucous membrane, we meet with the peculiar secretion called *mucus*, which is intended to lubricate the parts on which it is thrown out, and to protect them from the action of irritating substances. It is also found in the ducts of glands, and in the urinary and gall-bladders, but is generally mixed with the secretions of these parts.

Mucus is a viscid, colourless, or slightly yellow fluid, not miscible with water, and containing a substance called *mucin*, upon which its characteristic properties depend. This appears to be an albuminous compound, altered by the presence of an alkali. Mucus contains, also, a small proportion of solid matter, and some salts, resembling those of the blood, and epithelial scales, together with peculiar corpuscles called *mucus corpuscles*.

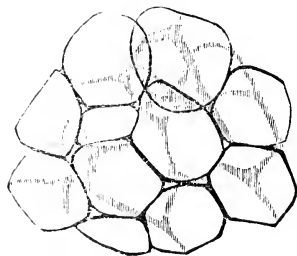
#### OF SIMPLE ISOLATED CELLS, FORMING SOLID TISSUES BY THEIR AGGREGATION.

The cells of this class begin and end their lives as such without undergoing any transformation, but instead of lying upon free surfaces, or being cast off from them, they form part of the substance of the fabric. Two examples of this kind are found in the cells developed at the extremities of the intestinal villi, and those which exist at the terminal extremities of the hepatic ducts. Both these sets of cells seem to have the power of *selecting* from the fluids presented to them certain materials which they deliver up, to the absorbents in one case, and the hepatic duct in the other. An analogous set of cells are found at the extremities of the fœtal tufts in the placenta, which have a like power of selecting nutritious materials from the maternal blood for the nourishment of the fœtus.

The *fat-cells*, of which adipose tissue is composed, also permanently exhibit the original type of structure in its simplest form.

This tissue is usually diffused over the whole body, either in the areolar tissue, or in small clusters covered by the common envelope; and even in cases of great emaciation there is some fat always left, especially at the base of the heart, around the great vessels, &c.

Fig. 7.



Fat-cells are spherical or spheroidal; when closely pressed together they assume a polyhedral form. (Fig. 7.) Large masses of fat are often formed by their aggregation, the component parts being held together by areolar tissue, and also by the blood-vessels which ramify minutely among them, forming a capillary network upon the smallest lobules, and even between the individual cells. This tissue contains neither lymphatics nor nerves.

The *fat* is contained in the interior of these cells, where it is deposited from the blood-vessels. Its consistence varies according to the proportion of the organic elements entering into its composition. These are elaine or oleine, stearine, and margarine; the last two, which are solid when separated, being dissolved in the former at the ordinary temperature of the body. The oil thus formed in the interior of the cells is prevented from escaping, by the moistening of the cell-walls by the watery fluid circulating through the vessels. All the substances above named are regarded by chemists as *salts*, being compounds of the oleic, stearic, and margaric acids with a base, called from its sweet taste, glycerine.

The fat is analogous to the starch of vegetables, and has a like use, viz.: to supply elements of nutrition, when other sources are cut off. It also answers the important purpose of retaining the animal temperature by its non-conducting properties; and the still more important object of serving as a kind of reservoir of combustible matter against the time of need. Fat appears to be deposited only when an excess of non-azotized alimentary matter is introduced into the body, over and above the wants of the system.

*Cartilage* in its simplest form consists merely of nucleated cells, and greatly resembles the cellular tissue of plants. In other forms, however, the cells are imbedded in an intercellular substance, or *matrix*, called *chondrine*. This substance bears a strong resemblance to gelatine, but requires longer boiling in water to effect its solution. It is not precipitated by tannic acid, but *is*, by acetic acid, alum, acetate of lead and proto-sulphate of iron. It agrees more nearly with the proteine compounds, in composition, than gelatine, and may be considered as an intermediate stage between the two.

Cartilage, in general terms, may be considered a *non-vascular* substance, considerable masses of it existing unpenetrated by a single

vessel. They are, however, surrounded by numerous blood-vessels, which form large *ampulle*, or dilatations at their edges, or on their surfaces, from which they derive their nourishment by imbibition.

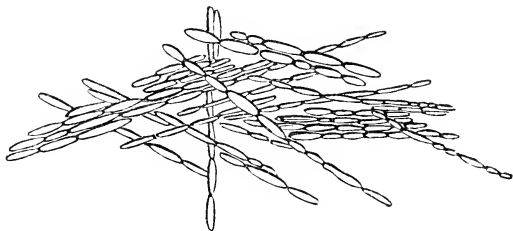
Cartilage is insensible; neither nerves nor lymphatics can be traced into its substance, and it is doubtful whether it is ever replaced by a similar structure when once destroyed.

*Fibro-cartilage* is a compound of white fibrous tissue and cartilage in varying proportions. When the intercellular substance assumes a fibrous arrangement, surrounding the cells, it is known by this name. In some instances the fibrous structure is developed so much at the expense of the cells, that the latter disappear altogether, and the whole structure becomes fibrous. This structure is seen in all those cartilages which unite the bones by synchondrosis, as in the vertebral column and pelvis. The *reticular* structure is seen in the concha auris and in the epiglottis.

The *cornea*, according to the researches of Messrs. Todd and Bowman, is a peculiar modification of the white fibrous tissue, in which the fibres, which in the sclerotic have been densely interlaced, flatten out into a membranous form, so as to follow the curvatures of the cornea, and constitute a series of more than sixty lamella united to one another by delicate processes extending from one to the other.

The resulting areolæ lie in superposed planes, the contiguous ones of the same plane being for the most part parallel, but crossing those of the neighbouring planes at an angle, and seldom communicating with them. (Fig. 8.)

Fig. 8.



The resulting areolæ lie in superposed planes, the contiguous ones of the same plane being for the most part parallel, but crossing those of the neighbouring planes at an angle, and seldom communicating with them. (Fig. 8.)

The *crystalline lens* has long been known to be fibrous. The fibres are united into laminae by means of numerous teeth or sinuosities at their edges which lock into one another. They originate in cells, several of which coalesce to form one. After the lens is fully formed it is not permeated by blood-vessels; these being confined to the capsule. It consists chiefly of albumen in its soluble form, and is coagulated by heat. The latest analyses represent the substance of the lens as consisting of that modification of albumen called globuline. The *vitreous humour* is an example of a very loose form of cellular tissue. The cells have no open communication with each other, and contain a fluid holding a small quantity of albumen and saline matter in solution. It is nourished by the vessels which are minutely distributed upon its general surface, there being none distributed through its substance for this purpose.

TISSUES CONSOLIDATED BY EARTHY DEPOSIT.—BONES AND TEETH.

For a full description of these tissues, see ANATOMY. Articles Bone, Teeth.

#### SIMPLE TUBULAR TISSUES.

Of these we have examples in the smaller capillary vessels, and probably also in the smallest lymphatics and lacteals. They seem to be formed by the coalescence of the cavities of the cells, produced by the absorption of the cell-walls at the point of contact.

In all the higher animals, in their adult condition at least, the capillary circulation is carried on through tubes having distinct membranous walls. These tubes are formed from cells, like the straight and anastomosing ducts of plants. In the walls of these tubes cell-nuclei may be constantly found; and these are too far apart to warrant the idea, that they are the nuclei of epithelial cells, such as line the larger vessels.

These vessels have a claim to be regarded among the elementary parts of the fabric, since they are formed independently of the larger trunks, and have little in common with them in function. All those changes which take place between the blood and surrounding parts, by which nutrition, secretion, and respiration are accomplished, occur during the movement of the blood through these vessels, the larger vessels merely bringing to them a constant supply of fresh blood, and conveying from them that which has been impoverished in the foregoing processes.

The diameter of the capillaries varies in different animals according to the size of the blood-corpuscles. Thus, they are larger in the frog than in man, in whom they average from 1-3700th to 1-2500th of an inch. In the living subject, it may be stated, they may be seen to vary their diameter at different times, so as to accommodate themselves to the varying supply of blood. They seem to have a distributive power of their own, entirely independent of the heart's action, but influenced by the attraction existing between the tissues and the constituents of the blood. The capillary vessels are first formed in the *vascular layer* of the germinal membrane, entirely by the coalescence of cells, which send off prolongations in various directions, like the radii from a star. By the junction of these prolongations a network of tubes is formed, at first, irregular in size, but afterwards becoming more equalized.

In newly-forming tissues, much the same arrangement takes place, the prolongations coming in contact with the vessels of the surrounding parts.

The opinion, that the *white tissues* are nourished by vessels conveying white blood is no longer tenable. Some of the white tissues, such as cartilage, are entirely destitute of vessels; and in others the supply of blood is so scanty, as not to communicate to them any decided hue. What have been considered as white vessels, are



merely those of very minute size, which, admitting only a single row of blood corpuscles, do not contain a sufficient amount of colouring matter to affect the light transmitted through them.

## COMPOUND TUBULAR TISSUES.

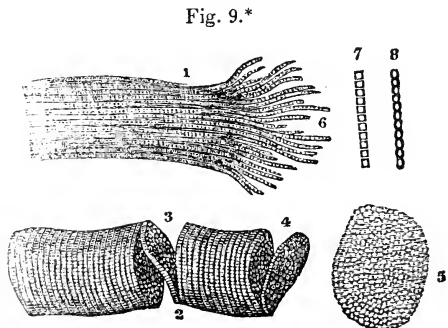
Examples of these are seen in the *muscular* and *nervous* tissues, in which, after tubes have been formed by the coalescence of the cells, their interiors are filled up with a secondary deposit. The functions of these two tissues are widely different. The *muscular* is that by which all the sensible movements of the body are effected. The *nervous* is that by which sensations are received; and by which the instincts, emotions, or volitions excited by these sensations, act upon the muscles.

The ultimate structure of these two tissues is alike; both consist of *tubes* formed by the coalescence of cells. The difference between them exists in the nature of the internal deposit.

There are two forms of muscular tissue,—in one the ultimate fibrils are marked by transverse striæ, or bands; in the other, they are plain, or unstriated. The former, or the striped fibres, are found in all the voluntary muscles, or, as they are sometimes called, the muscles of animal life. The latter are seen in those muscles which are concerned in the organic or vegetative functions. They are not so readily called into action through the agency of the nervous system, as the striped muscles, but are more readily excited by stimuli applied directly to themselves.

An ordinary muscle is seen, even by the naked eye, to consist of bundles of fibres, arranged with great regularity, in the direction in which the muscle is to act. These fibres are arranged in *fasciculi*, or bundles, connected together by means of areolar tissue. Each fibre presents two sets of markings, or striæ, one set *longitudinal*, the other *transverse*. By close examination the individual fibre may be separated into fibrillæ by the splitting of its contents in a longitudinal direction. (Fig. 9.) These fibrillæ present a *beaded* appearance, caused by the peculiar arrangement of the contents of the tube.

It frequently happens, that when force is applied to a fibre, its contents separate in the direction of the trans-



\* 1. Longitudinal cleavage. 2, 3, 4. Transverse cleavage forming disks. 5. A detached disk showing the sarcous elements. 7, 8. Separated fibrillæ showing the beaded enlargements.

verse striæ, quite as frequently as in the longitudinal direction, thus forming a series of *discs* as seen in fig. 9. If a general disintegration took place along all the lines in both directions, there would result a series of particles, which have been called *primitive particles*, or *sarcous elements*, the union of which constitutes the mass of the fibre.

According to the opinion of Messrs. Todd and Bowman, (in which they are supported by Muller, Lauth, and Schwann, the cross-stripes of the fibres are formed by the apposition side by side of the dark points seen on the separated fibrillæ.

The elements of the muscular fibre are held together by a tubular sheath adapted to its surface and adhering to it; this is called the *sarcolemma*, or *myolemma*. It is a transparent, very delicate, but tough and elastic membrane, which isolates the fibre from all other tissues. It has nothing to do with the production of the transverse striæ. Neither is it perforated by either nerves or blood-vessels.

Muscular fibres are rather polygonal than cylindrical, owing to the pressure to which they are subjected by juxtaposition. Their average diameter in man is about 1-400th of an inch, being rather larger in the male than in the female.

The fibrillæ, when examined, are found to present an alternation of dark and light spots, corresponding with the transverse striæ of the fibre, and the lighter intervals between them. Each dark spot is surrounded by a pellucid border; the whole constitutes a complete, though minute cell, and the entire fibrilla may be considered as *made up* of a linear aggregation of such cells. The dark spot within the bright border is the cavity of the cell, filled with a refracting substance. When the fibrilla is relaxed, the longitudinal diameter of these cells is greatest; when contracted, the transverse. Thus the act of muscular contraction seems to consist in a change of form in the cells of the ultimate fibrillæ, consequent upon an attraction between the walls of their two extremities or their nuclei. This corresponds with the contraction of certain vegetable tissues, the component cells of which change their form when irritated, and thus produce a movement.

When muscular fibre contracts therefore, it is not thrown into zigzag lines, since fibres in this state, cannot be supposed to exercise any force of traction, but it is shortened in length by the approximation of its elements, at the same time that the transverse diameter is increased.

Muscles grow by an increase, not of the *number*, but of the *bulk* of their elementary fibres; the number of fibres probably remains the same through life, as it was in the fœtus. Notwithstanding the energy of its growth, and the constant interstitial changes, it is doubtful whether muscular tissue is ever regenerated where loss of substance has taken place. It is generally replaced by areolar tissue, which gradually becomes condensed, but never *contractile*.

The great property of muscular tissue is that of *contractility*, by

which is meant, *the power of moving responsive to irritation*. It is not the mere mechanical power by which elastic substances shorten themselves on the removal of a distending force, but it is an endowment responsive to appropriate stimuli, and diminishing or disappearing with the healthy state of the tissue. Elasticity is a mere physical property. Contractility is a *vital* property.

Whatever is capable of inducing contraction in muscles, when applied to them, is called a stimulus. Chemical agents, mechanical applications, and irritating substances are included under this head. In the living body the ordinary stimulus exciting contraction is the *nervous influence*. Muscular contraction, however, is not *dependent* on this influence, since it can be excited after all connexion with the nervous centres has been destroyed, and even in a single isolated fibrilla.

The contractility of a muscle may be exhausted by repeated exercise, as well as by the continued application of any of the above stimuli, but it may be recovered again, provided sufficient interval of rest be afforded to it. "In regarding contractility, therefore, as a property of living muscular fibre *in general*, it is meant that it resides in it as a property, without which it would not be muscle; and in such a manner, that no particle, however microscopic, can be detached from a muscle which does not of itself, and independently of the rest, possess this property as long as it possesses vitality."

Muscles are abundantly supplied with blood-vessels and nerves. The capillary vessels ramify in the spaces between the fibres, but never penetrate the sarcolemma, the nutritive materials being probably supplied by the selecting power of cells. The nerves are *motor nerves*, and they are exceedingly abundant, terminating in the substance of the muscle *in loops*. The muscles of *organic* life are but little influenced by nervous power, but depend for their stimulation upon the presence of substances brought immediately into contact with them. The muscles therefore have but little sensibility.

Every fibre of the striated muscles is attached by its extremities to white fibrous tissue; through the medium of which it exerts its contractile power on the bone, or other substance to be moved: the union of all these white fibres constitutes the *tendon*. The muscular fibre ends by a perfect disc, and with the whole surface of this disc the tendon is connected and continuous, with it and the sarcolemma.

Muscular contraction is accompanied by the production of *sound* and *heat*, both of which are probably produced by the movements of the neighbouring fibres upon each other. The heat may also be produced by the chemical changes resulting from the disintegration of the muscular tissue consequent upon its use. This elevation of temperature is sometimes as high as 2° Fahr.

The *rigor mortis*, or the stiffening of the body after death, is due to the contraction of the muscles, and, like the coagulation of the blood, is the last act of their vitality. Where the individual has died of a wasting disease, it comes on early, and lasts but a short time,

and the reverse obtains where death has occurred during full health. As the rigor mortis comes on the contractility of the muscle departs. Its cause is obscure, and may be complex, but its resemblance to the contraction of fibrine after recent coagulation is strongly marked.

The muscular fibres of *organic life* are very different, not only in structure, but also in function, from those already described. They consist of a series of tubes, which are not marked by transverse lines, and in which the longitudinal striæ are very faint. These tubes are usually much flattened, and cannot be shown to contain distinct fibrillæ. They are generally smaller than those of animal life, and sometimes present markings indicative of a granular deposit. The nodosities upon their surface are the nuclei of their original components. (Fig. 10.) The peculiarity of these fibres is, that they are very little subjected to nervous influence, and that when stimulated to contraction by an irritant, they perform a series of vermicular movements gradually decreasing in intensity till perfect rest takes place. They are found in the intestinal canal, ducts of glands, middle coat of the arteries and bronchial tubes, &c.

Fig. 10.\*



In every case muscular action must alternate with intervals of rest. It is in these intervals that the reparation of the disintegrated tissue takes place, and that the muscle recovers its contractility.

The mechanical arrangement of the muscles upon the skeleton is usually accompanied with a loss of power, but with a gain of velocity. The locomotive framework may be regarded as a series of levers, of which the fulcrum is generally a joint. In most cases the muscles are attached near the fulcrum, as in the biceps. By this arrangement a contraction of a single inch in the muscle, moves the hand through the extent of a foot, but then the hand moves only with one twelfth of the power exerted by the muscle.

The *nervous structure* as it appears in the nervous trunks is another example of the tubes with a secondary deposit. This is seen in the *white* or *fibrous matter*, wherever it occurs in the body, and also in the fibres of the *great sympathetic*. In the ganglia we find the other form of nervous substance, known by the name of the *gray* or *vesicular*. Wherever these two kinds are united together, they constitute a *nervous centre*.

The ultimate nerve fibre—such as is seen in the spinal nerves—is distinctly tubular. It consists of an external thin and delicate membrane, which is nearly or quite homogeneous. It forms one complete sheath, isolating the contained matter in its whole course from its central to its peripheral extremity. This is called by Todd and Bowman the *tubular membrane*.

\* 4. A muscular fibre of organic life with two of its nuclei (from the bladder). 5. The same from the stomach.

Within the tubular membrane lies a more opaque substance known as the *white substance* of Schwann, and within this again is a transparent material which has been called the *axis cylinder*. The whole of the contained substance is exceedingly soft, and may be made to pass from one part of the tube to another. A bundle of nerve-fibres, surrounded and connected by areolar tissue, constitutes a nerve.

The other form of fibrous matter is that which is seen in the great sympathetic system, and which is known as the *gelatinous nervous fibre*. These fibres contain nothing analogous to the white substance of Schwann, and are devoid of the whiteness which characterizes the tubular fibre. The gray colour of certain nerves depends upon the presence of

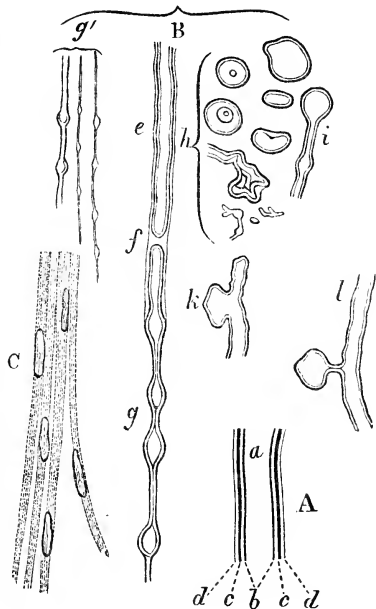
a large proportion of gelatinous fibres. Hence, they are sometimes called *gray fibres*. They are smaller in diameter than the tubular fibres, ranging from  $\frac{1}{80000}$  to  $\frac{1}{40000}$  of an inch. (Fig. 11.)

The remaining element of the nervous structure is what is called the *gray* or *vesicular*. This is found in the *nervous centres*, but never in the nerves, properly so called. It consists of *cells* or *vesicles* containing *nuclei* and *nucleoli*. The walls of each vesicle are extremely thin and delicate, and contain a soft but tenacious granular mass. In some vesicles we find a number of pigment granules exterior to the nucleus, giving a dark colour to a portion of the vesicle.

Another form of nerve vesicle, is that called the *caudate*, which is characterized by one or more *tail-like* processes extending from it. They contain nuclei and nucleoli, and pigment granules. These caudate processes either serve to connect other vesicles, or else they become continuous with the axis cylinder of the tubular fibres.

\* A. Diagram of tubular fibre of a spinal nerve:—*a*. Axis cylinder. *b*. Inner border of white substance. *c. c.* Outer border of white substance. *d. d.* Tubular membrane. *B*. Tubular fibres; *e*, in a natural state, showing the parts as in *A*. *f*. The white substance and axis cylinder interrupted by pressure, while the tubular membrane remains. *g*. The same, with varicosities. *g'*. Varicose fibres of various sizes, from the cerebellum. *C*. Gelatinous fibres from the solar plexus, treated with acetic acid to exhibit their cell-nuclei.

Fig. 11.



The *fibrous* matter is produced as the muscular fibre, by the coalescence of cells, in which a secondary deposit takes place. The *vesicular* by a succession of cells like those of epithelium.

The chemical constitution of nervous matter is as follows :

Albumen,	.	.	.	.	.	7.00
Cerebral fat,	}	Stearine,	4.53	}	.	5.23
		Elaine,	0.70			
Phosphorus	.	.	.	.	.	1.50
Osmazome,	.	.	.	.	.	1.12
Acids, salts, sulphur	.	.	.	.	.	5.15
Water,	.	.	.	.	.	80.00
						100.00

(Vauquelin.)

The amount of phosphorus varies at different times of life, and is exceedingly small in idiotcy. According to L'Heritier's analysis, the *minimum* is found in infancy, old age, and idiotcy; and the *maximum* of water in infancy.

The *nervous structure*, like the muscular, is constantly undergoing the process of disintegration and renewal, every exercise of this system being accompanied by a loss of its substance, requiring new material to compensate for it. This renewal takes place in the intervals of rest. As in the muscular system, its waste is represented by the amount of urea in the urine, so in the nervous system, its waste is represented by the amount of phosphatic depositions; the latter being always increased under mental exercise. Persons, therefore, whose mental faculties are much excited, require as nutritious a diet as those who gain their "living" by the sweat of their brows.

In regard to the regeneration of nervous structure when it has been destroyed, it is now believed, on the authority of Schwann, Steinruch, and Nasse, that the *white* or *tubular* matter may be restored, they having discovered, that in the uniting substance between the ends of a divided nerve, true nerve-fibres may be developed. Perfect restoration, however, does not always take place, owing most probably to the fact, that the central and peripheral portions of the same fibres do not always meet again.

In regard to the *gray* or *vesicular* matter we are not so well informed. When a portion of the brain is removed in animals, its place is supplied by new matter; but whether this becomes true cerebral substance remains to be proved; from the great activity of its nutritive processes, there seems reason to believe that its loss is repaired by similar matter.

Those nerve-fibres which originate in the brain, and are distributed to the muscles, have no proper *termination*, they form *loops*, which either return into themselves, or join others formed by the ultimate ramifications of the main trunks. They never anastomose with each

other, but each runs a separate and distinct course. Those fibres which originate on the periphery and run towards the brain and spinal cord, also form loops in these centres.

Wherever the *vesicular* matter is found, it is looked upon as a *generator* or *originator* of nervous influence; whilst the *white* or *tubular*, is the *carrier* of that influence to the various parts of the system. The former, having the higher set of functions, receives by far the larger quantity of blood.

*Plexuses* are formed by the free interchange of fibres from several neighbouring nerves. Four or five nerves, for instance, proceed from the spinal cord and are plaited up together like the strands of a coach whip. From the plexus thus formed, certain nerves emerge which are composed of fibres from several of the original trunks. The advantage of this arrangement is, that not only are nerves of different endowments joined together, but the injurious effects which would otherwise result from lesion of the spinal cord, are obviated; for the nerves which come off below the injured part, all receiving filaments from those which are above, the nervous influence is thus transmitted unimpaired to all those parts supplied by filaments from below the point of lesion.

#### OF THE DEVELOPMENT OF TISSUES FROM CELLS.

It has been seen that there is reason to doubt whether cells are concerned in the development of all the tissues, further than in the part which they take in elaborating the fluid from which the tissues are derived, some of the structures seeming to be produced by a consolidation of the plastic fluid which has been elaborated by their agency. Many of the component structures, however, owe their development to the agency of cells, and of these we shall now speak.

Cells are formed in two ways, either in a previously existing, structureless fluid called a *blastema*, or within the interior of previously existing cells. In the first method, when a plastic fluid is in contact with a living structure it is seen to become opalescent; this change in colour is owing to the deposition within it of a number of small granules called *nucleoli*; several of these aggregate themselves together and form what is called the *nucleus*, within the interior of which the *nucleolus* can still be seen. This nucleus is also called the *cytoblast*, (from *κυτος*, a vesicle, and *βλαστος*, a germ,) or *cell-germ*. From the side of this nucleus a thin transparent membrane is next seen to project in the manner of a watch-crystal from the dial; this gradually enlarges till at last the nucleus is seen only as a spot on its wall. The whole is then called a *nucleated cell*, or *germinal cell*. The fluid in which the granules are first deposited is called the *cytoblastema*.

In the *second* method, or the *endogenous* development as it is called, the *nucleus* seems to perform an important office. Each granule of which it has been shown to consist, has the power of

developing a cell, so that the parent cell becomes filled with one or more generations of new cells, which may either disappear entirely, as in the case of the ovum, or by the rupture of the original cells the contents may be scattered and undergo an independent development. Sometimes several nucleoli are seen within one nucleus; and sometimes several nuclei within one cell.

Cells are concerned not only in the function of nutrition in the development and restoration of parts, but also in several other organic processes; for instance in absorption and secretion, the elaborating and selecting processes of which, we shall hereafter see, are performed by their agency.

Each cell is an independent organ; it lives *for itself* and *by itself*, and is dependent upon nothing but a due supply of nutriment and of the appropriate stimuli for the continuance of its growth and for the due performance of its functions, until its term of life is expired. The nucleus and cell-wall differ from each other in chemical composition, though both seem to be concerned in the development of tissues. The cell-wall is a proteine compound.

In the formation of tissues, the cells undergo changes which may be described under two heads: *first*, Those affecting the cell-membrane; and *secondly*, Those in which the nucleus is concerned. In the fibrous tissues, the cell-membranes become elongated, and so folded and divided as to give the appearance of subdivision into minute threads or fibres. In the compound tubular tissues, as muscle and nerve, the cells are joined end to end, and the partitions at each extremity being removed, a tube is formed, in which the proper deposit of muscular or nervous matter takes place.

In the simple tubular tissues, as in the capillaries, the tubes are also formed by the coalescence of the walls of the cells at several points owing to their elongation, here and there into pointed processes, which unite and form the ramifications of the vessels.

The metamorphoses of the nucleus, although equally important, are much less numerous. In some cases it sends out radiating prolongations causing it to assume a stellate form, which is the case in bone cells. In other cases it appears to resolve itself into a fasciculus of fibres; and this, according to Henlé, is the origin of yellow fibrous tissue. The tubuli of the dental structure are formed by its separation into a number of distinct fibres, each composed of a linear aggregation of granules. Lastly, according to Dr. Carpenter, it may disperse itself still more completely into its component granules, by whose reunion, certain peculiar vibrating filaments (the so-called spermatozoa,) may be formed, possessing motor powers and destined to perform most important offices in the function of reproduction.

The development of cells goes on during the life of the organism at every period of its existence. They are found floating in immense numbers in the blood, chyle and lymph; and even in diseased



secretions as pus. In the inflammatory process they are developed in great quantities; and even the malignant growths, such as cancer and fungus hæmatodes which infest the body, owe their development to the same agencies. In short, the nucleated cell is the agent of most of the organic processes, both in the plant and animal, from the time of their earliest development, to their full maturation and decline.

### PHYSICAL AND VITAL PROPERTIES OF THE TISSUES.

The tissues present manifest differences among themselves, not only in their anatomical structure, but in their properties. These properties may be divided into *physical* and *vital*. The *physical* are those which are dependent solely on the peculiar arrangement or mode of cohesion of the constituent particles of the tissues as well as upon their chemical constitution, and are found as distinctly in the dead as in the living texture. The *vital* properties are those which exist only during the life of the *organism*, and which cease whenever molecular life departs.

The most striking of the physical properties, are *elasticity*, *flexibility*, *extensibility*, and *porosity*.

*Elasticity* is that property by which a tissue reacts, after a stretching or compressing force has been withdrawn. It is strongly marked in the yellow ligament constituting the *ligamenta subflava*, which is as elastic as India rubber. It is also seen in the middle coat of the arteries, and in the cartilage of the ribs, and on the articular faces of the bones.

*Extensibility* is implied in elasticity; but there are some tissues which are extensible, but not elastic; such yield only to a long-continued distending force; of this, we have an example in the resistance offered by a fibrous membrane to the growth of a tumour.

*Flexibility* is seen in the white fibrous tissues, which are flexible, without being either extensible or elastic. We have examples of this property in *the tendons*.

*Porosity*. The property of permeability by fluids, is possessed by the tissues even after death, and is termed porosity, or *imbibition*. Animal tissues owe their softness to the watery fluids which they contain, and which fill their pores.

If a solution of any salt, or of sugar, is poured into a glass tube closed below by a piece of bladder, the particles of the solution permeate the pores of the bladder, but do not pass through it. If the tube thus filled is placed in a vessel containing distilled water, the fluid gradually rises within the tube, and sometimes to the extent of several inches, while, at the same time, it is found that a portion of the solution has passed from the interior of the tube to the water external to it.

Dutrochet has named the phenomena above described, *endosmose* and *exosmose*. The term endosmose, or *imbibition*, being applied

to the current from *without* to *within*, while *exosmosis*, or *transudation*, signifies the passage of the fluid from *within* to *without*.

In order that these phenomena may present themselves, the fluids must be of *different densities*, and miscible with each other; and under these circumstances the current is most rapid, as a general rule, from the *rarer* to the *denser* fluid, and it continues until the fluids are of equal density on both sides.

There must also be an *affinity* between the membrane and the fluid, otherwise no current will take place.

It is not membranes only which are endowed with this property; very thin plates of slate, or of baked clay, produce the same effect, though in a more feeble degree. Calcareous and siliceous laminæ have no effect of this kind. In membranes, endosmosis is produced till they begin to putrefy, when the phenomenon entirely ceases, and the liquid which had risen in the tube descends, and filters through the membrane.

Of all the *organic substances* soluble in water, *albumen* produces endosmosis with the greatest force. It has also been proved by Dutrochet, that, all other things being equal, the force which produces endosmosis is proportional to the excess of the density of the interior liquid over that of the water. Various theories have been produced to account for these phenomena. Dutrochet's hypothesis, that electric action is concerned with these phenomena, has not been confirmed. The theory of Poisson, that endosmosis depended on capillary attraction, is, according to Matteucci, inadmissible. "Poisson supposed that the least dense liquid entered the capillary tubes of the membrane, and that this capillary thread, drawn down by the pure water, and up by the denser liquid, must be elevated in virtue of molecular attraction. But this explanation is inadmissible, when we consider that alcohol, which is lighter than water, produces endosmosis; and that certain calcareous and siliceous stones, placed under the same conditions as membranes and plates of clay, do not give rise to the same effects."\* According to the same author, up to the present time there is no satisfactory theory of endosmosis, though many physiologists accept that of *capillary attraction*.

"Experiment proves that the current of endosmosis is not produced by the least dense liquid, nor by the most viscid one, nor by that which is endowed with the greatest force of ascent in capillary tubes. The current is in general determined by the liquid which has the greatest affinity for the interposed substance, and by which it is imbibed with the greatest rapidity. In fact, it is evident that the membrane imbibes the two liquids unequally; and that the one which is imbibed with the greatest facility, ought to mix with, and augment the volume of the other."†

\* Matteucci's Lectures, p. 39.

† Op. cit., p. 39.

Poisseeuille found by experiment, that there was endosmose through animal tissues, from the serum of the blood to Seidlitz water, and to solutions of sulphate of soda and common salt. This is precisely what happens when these substances are used internally as medicines: the rejected excrements contain large quantities of albumen. In this case, it must be admitted that endosmose takes place through the capillary vessels of the intestine, from the serum of the blood to the saline solution introduced into the intestinal canal. The experiments of Poisseuille have been confirmed by Bachetti, who also proved that the rapidity of endosmose is considerably increased, when one of the fluids is in motion and constantly renewed, as is the case with the blood circulating through the capillaries. The most remarkable fact discovered by Poisseuille, is that of the influence exercised by the muriate of morphia. When this substance is added to saline solutions, it very considerably weakens the endosmose from the serum to the solution, and ultimately changes the direction of the current. This has also been confirmed by Bachetti, and upon this is based an hypothesis as to the *modus operandi* of morphia, and of the preparations of opium in diarrhœa, as well as of the constipation they produce.

The animal membranes exercise the property of *porosity*, or imbibition, in reference to *gases* as well as fluids; and the tendency of dissimilar gases to become diffused among each other, manifests itself even through compound textures. As was shown to be the case with liquids, there is a double current, when two dissimilar gases are separated by a porous septum, and the predominant current is that which has the greatest attraction for the septum. In respiration, this phenomenon occurs at every inspiration through the walls of the pulmonary air-cells and the plexus of capillaries distributed upon them.

It was said that all gases were not equally transmissible. The experiments of Professor Mitchell have demonstrated this fact: and the following list shows their comparative transmissibility, beginning with the most powerful: *Ammonia, sulphuretted hydrogen, cyanogen, carbonic acid, nitrous oxide, arsenuretted hydrogen, olefiant gas, hydrogen, oxygen, carbonic acid, and nitrogen.*

The experiments of Brunner and Valentin have led to the interesting result, that when two gases are placed on opposite sides of an animal membrane, the relative proportions absorbed and exhaled, will be inversely as the square roots of their specific gravities. Thus, if we have oxygen on one side, and carbonic acid on the other of an animal membrane, the volume of oxygen that passes inwards will exceed that of the carbonic acid that passes outwards, in the proportion of 1174 to 1000. The application of this to respiration is easy.

Endosmose does not explain all the phenomena of absorption, but

merely that of those fluids which require no change or elaboration ; when elaboration is demanded, a vital action becomes necessary.

*Vital properties of the tissues.*—The vital properties are those which belong only to *living* organized products, and they manifest themselves by a change in their molecules, resulting from a stimulus applied. This change may be evident from a visible alteration in the tissue stimulated, or it may show itself through a secondary influence exerted upon some other texture or organ, with which the stimulated tissue may be in connexion.

These properties exist in two tissues, viz., in muscle, and in nerve. When seated in *muscle*, it is called *contractility*, and is characteristic of that tissue. When in nerves, it is manifested in three ways : first, by its inducing contraction in the muscle supplied by it ; secondly, by exciting contractions in muscles not supplied by it, through a change effected in the nervous centre with which it is connected ; thirdly, by its exciting sensation.

The same stimuli which are capable of developing muscular contractility, will produce these effects in nerves, and the parts well supplied with nerves are said to be highly endowed with sensibility, while the nerves concerned in ministering to sensation are called *sensitive*.

From these it will be seen that *two* vital properties are described by Physiologists, to wit, *sensibility* and *contractility*. The first being resident in nervous tissue, the second in muscular. A vital property, however, is one possessed by *every* living organized being, *vegetable* as well as *animal*. As vegetables have no nervous system, they cannot possess sensibility, and as this latter is a function of one particular part of the nervous system, viz., the brain, the term *irritability* or *excitability* will, perhaps, better express the property. Plants are *irritable*, but not *sensible*, inasmuch as they have no consciousness. Muscles, also, when separated from the body, are irritable, but not sensible. Hence *irritability*, *excitability*, *contractility*, or *incitability*, as the property has been variously termed, may be considered as the only *vital property* that is possessed by all living organized beings.

These properties are entirely dependent on the nutrition of their respective tissues ; they quickly vary with the state of that function, and when it ceases in death, they vanish with it.

## SPECIAL PHYSIOLOGY.

### GENERAL CONSIDERATION AND CLASSIFICATION OF THE FUNCTIONS.

IN every living structure of a complex nature, we see a great variety of actions resulting from the exercise of the different properties of its several component parts. A general survey of these, with reference to their mutual relations to each other, will show that they may be associated into groups, each consisting of a set of actions, which, though different in themselves, concur in effecting some positive and determined purpose. These groups and actions are termed *functions*. A function may be defined *the action of an organ or system of organs*. Thus respiration is a function; its object is the conversion of venous into arterial blood, and its instrument is the lungs.

On further examination of these functions, we find that they are susceptible of some degree of classification. There is a set which is found to be possessed by *all* living organized beings, vegetable as well as animal; these are called the *organic* or *vegetative*. These may be again subdivided into those concerned in the maintenance of the structure of the individual, or the *nutritive*, and those to which the preservation of the species is due, or the *reproductive*. There is then a set which is possessed by animals alone, in addition to those belonging to vegetables, these are called the *animal functions*, or the *functions of relation*, and are dependent for their exercise upon the existence of a nervous system, *the presence of which latter in an organized being marks the distinction between an animal and a vegetable*. The *animal functions* render the individual conscious of external impressions, and capable of executing spontaneous movements.

These two sets of functions, the *organic* and *animal*, are mutually dependent on each other, the organic supplying the material necessary for the repair of the instruments of the animal; whilst the animal functions, in which are included sensation and voluntary motion, are essential to enable the individual to obtain that material which the plant, from the different provision made for its support, can obtain without any such assistance. In the animal body, all the functions are so completely bound up together, that none can be suspended without the cessation of the rest.

## TABLE OF FUNCTIONS.

	ORGANIC.	ANIMAL, OR OF RELATION.
Nutritive.	1. Digestion.	1. Sensation.
	2. Absorption.	2. Muscular motion.
	3. Respiration.	3. Mental manifestation.
	4. Circulation.	
	5. Nutrition.	
	6. Secretion. <i>&amp; excretion</i>	
	7. Calorification.	
Reproductive.	8. Generation.	

Three of these have been called the *vital* functions, viz., innervation, circulation, and respiration; these constitute the vital tripod, the maintenance of which, is essential to life.

## ORGANIC FUNCTIONS.

## DIGESTION.

The first of the organic functions may be defined as that by which the *food or aliment* is “reduced to such a condition that the nutritive material can be separated from it.” In animals, the food being for the most part in a solid form, requires to be brought to a fluid state before it can be inservient to nutrition, hence the necessity for a digestive process.

In the animal body, aliment is demanded for four different purposes. *First*, for the original construction or building up of the organism. *Second*, to supply the loss occasioned by the continual decay, even when in repose. *Third*, to compensate for the waste occasioned by the active exercise of the nervous and muscular systems. *Fourth*, to supply the materials for the heat-producing process, by which the temperature of the body is kept up.

The amount required for these several purposes, varies according to the condition of the body as regards exercise or repose, external heat and cold, and the age of the individual, a larger quantity being demanded in youth in proportion to the size of the body, than in manhood. Any drain upon the system also increases the demand.

There can be no universal law laid down as to the amount required, so much depending upon the external conditions in which the individual may be placed. The diet scale in the British navy allows to each man from 31 to 35½ ounces of dry nutritious matter daily; of this 26 oz. are vegetable, and the rest animal, 9 oz. of salt meat, or 4½ of fresh meat, being the allowance of the latter. A mixed diet seems to be absolutely indispensable, where such a variety of tissues have to be repaired. The disastrous effects resulting from the long-continued use of one kind of food, are to be attributed not so much

to the quality or quantity, as to the absence of variety in the aliment supplied.

Aliments have been variously classified; Prout divides them into the following groups. *Aqueous*, including water, either alone, or holding important elements in suspension or solution. *Saccharine*, including sugars, starch, gums, and vinegar. *Oily* or *oleaginous*, including the various fats, oil, and alcohol. *Albuminous*, including all those substances which contain nitrogen—such as fibrine, gelatine, albumen, caseine, and vegetable gluten. All the materials which make up this group are derived generally from the animal kingdom, with the exception of the last, which is contained in great abundance in wheat. Similar, if not identical, principles exist in vegetables.

In milk we find a natural combination of all the various substances which contain nitrogen, and this is the only instance in which nature has provided a single article of food for the support of the animal body in which such an union exists.

Liebig divides aliments into two classes. *Azotised*, and *non-azotised*. The azotised products are for the nutrition and reparation of the animal tissues, hence he calls them "*plastic elements of nutrition*." The non-azotised substances are designed chiefly, according to him, to supply the materials for animal heat and respiration, hence he calls them "*elements of respiration*." The unconsumed material being deposited as fat.

Dr. R. D. Thomson proposes to call the azotised, *nutritive elements*, and the non-nitrogenised, *calorificient*.

The organic compounds enumerated would be of little service without the admixture of certain inorganic substances, which also form a part of the animal frame, and which are constantly being voided by the excretions. These are *chloride of sodium*, which enters into the composition of the gastric juice, and the bile; *phosphorus*, which is found in the osseous and nervous tissues; *sulphur*, found in the albuminous tissues; *lime*, which is required for the consolidation of bone; and lastly, *iron*, which will hereafter be shown to be an essential constituent of hæmatosine.

The digestive apparatus varies greatly with the habits of the animal, and with the nature of the aliment with which it is supplied; thus in *carnivorous* animals it is exceedingly simple, because the food requires to undergo little change before it is fitted for nutrition. In the *ruminantia* the food is macerated in a complex stomach, prior to, as well as after it has been subjected to a more complete mastication than is employed in other animals; because the aliment contains but little nutritive matter, which is with difficulty separated from it. In the *omnivorous* animal the digestive apparatus is midway between those above described.

Modifications also occur in the masticatory process; the vegetable

feeder requiring a more complicated dental apparatus; the carnivora being provided with teeth of a simpler construction, but more fitted for seizing and tearing their prey. In the omnivorous animal we find both the cutting and grinding teeth. In birds there are no teeth; and mastication, properly so called, is effected in the stomach, a portion of which (the gizzard) acquires a great increase of muscular power, and is lined by a dense cuticle, and thus becomes a powerful organ for triturating the food, the bird swallowing pieces of flint or other hard substances to aid in the mechanical reduction.

*Hunger and thirst.* The want of solid aliment is indicated by the sensation of *hunger*; and that of liquid by *thirst*. The former of these sensations is referred to the stomach, and the latter to the fauces; but, although these sensations may be caused by the condition of the parts mentioned, they are really indicative of the wants of the system at large.

The nerve which is instrumental in the sensation is probably the *vagus* by its gastric branches, but there is no reason for denying to the sympathetic nerve distributed to the stomach, some share in this phenomenon; the latter probably conveys the wants of the system to the stomach, while the former is the medium by which those wants are expressed. Section of the *vagus* abates, if it does not entirely arrest the sensation of hunger. The same is true of the introduction of matters not alimentary into the cavity of the organ.

*Thirst* results from a peculiar state of the mucous membrane of the digestive tube, but more especially of the mucous membrane of the mouth and fauces, caused by the imperfect supply of liquid. Thirst is perhaps more immediately connected with the wants of the general system than hunger, since the relief that is afforded by the introduction of liquid into the stomach is immediate, and may be fully accounted for by the instantaneous absorption of the fluid into the veins. Any excess in the amount of fluid excretions will increase this sensation, as is also the case when stimulating or irritating articles of food have been used; the purpose of this increase is obviously to cause ingestion of fluid, by which they may be diluted.

The process of digestion may be divided into the following stages: 1st. *Prehension of food*; 2d. *Mastication and insalivation*; 3d. *Deglutition*; 4th. *Chymification*; 5th. *Action of small intestine*; 6th. *Defecation*.

*Prehension*, or the taking of food into the mouth, is performed mainly by the hand, assisted by the lips and cheeks, as well as the anterior teeth and the tongue.

*Mastication* has for its object the comminution of the food so that it can be readily acted upon by the solvent juices of the stomach. The contact of the solid food with the interior of the mouth excites the act of mastication, performed by alternating contractions of the muscles which pull the lower jaw upward, downward, backward,



forward, and laterally by acting on the bone in which they are implanted. By the motion of the lower teeth upon the upper the food is comminuted. During mastication the food is mixed with the saliva and fluids of the mouth, which latter cavity is closed anteriorly and posteriorly during the process.

The disintegration of the food by mechanical reduction, is manifestly aided by *insalivation*; and the admixture of saliva appears further, to have the effect of commencing the transformation of the starchy particles of the food into sugar. From experiments of Bernard and Barreswil, it appears that saliva, when acidulated, possesses the same power of acting on azotised compounds as that which characterizes gastric juice; consequently when introduced into the stomach, the saliva may afford important aid in the digestive process.

*Deglutition.*—The food, comminuted and moistened in the mouth by the means above mentioned, is prepared for the action of deglutition. In this there are *three* stages. In the *first*, the particles of the food, collected to a bolus, glide between the surface of the tongue and the palatine arch, till they have passed the anterior arch of the fauces. This is a purely voluntary movement. In the *second*, the bolus is carried past the constrictors of the pharynx. In the *third*, it reaches the stomach through the œsophagus. These three acts follow each other with extreme rapidity.

During the *second* stage of deglutition, the tongue, the muscles of the anterior and posterior half arches, the superior muscles of the soft palate, and the constrictors of the pharynx, are all in action. In this stage, by the retraction of the tongue, and the elevation of the larynx, the epiglottis is pressed over the rima glottidis, which is also closed during this process.

The communication between the fauces and posterior nares is cut off by the muscles of the posterior palatine arches, which contract in such a manner, as to cause the sides of the arch to approach each other like a pair of curtains, and to the cleft between the two sides, the uvula is applied like a valve. Some of these acts may be performed voluntarily, but the combination of the whole is automatic, and under the presidency of the *reflex system* of nerves.

In the *third* act, in which the food passes through the œsophagus, every part of that tube as it receives the bolus, and is dilated by it, is stimulated to contract.

The movements of the œsophagus are entirely involuntary and rhythmical in their character; in the act of vomiting they are inverted. At the point where the œsophagus enters the stomach,—the cardiac orifice of the latter,—there is a sort of sphincter. This opens when there is sufficient pressure made upon it by the accumulated food, and afterwards closes so as to retain the food in the stomach. The opening of the cardiac orifice is one of the first acts

in vomiting. When the sphincter is paralysed by division of the pneumogastric nerve, the food regurgitates into the œsophagus.

*Chymification.*—As soon as the bolus has entered the stomach it is subjected to several agencies, all of which are more or less concerned in effecting its solution. It is exposed in the first place, to the movements of the stomach, which have for their object to produce the thorough intermixture of the gastric juice with the alimentary mass. The fibres of the muscular coat of the stomach are so arranged, as to shorten its diameter in every direction; by the alternate contraction and relaxation of these bands, a great variety of motion is induced. This contraction is due to the stimulus of the food; and when the aliment is difficult of digestion, the muscular coat is proportionately stimulated. These movements are also increased by the action of the respiratory muscles. The contraction of the muscular fibres extends also to those of the two orifices of the stomach so as to prevent the escape of the food. This is particularly the case as regards the pyloric orifice in the first period of digestion.

The bolus, in the next place, is exposed to the action of the *gastric juice*, a pure colourless and slightly viscid fluid, having a distinctly acid reaction, which has been observed to distil from the surface of the mucous membrane and mingle with the food. The exudation of this fluid is *always* excited by the contact of any foreign substance, but it is never present in the organ when empty, the sole contents being then a little viscid mucus. According to the analysis of Professor Dunglison, the gastric juice contains free muriatic and acetic acids, phosphates and muricates of potassa, soda, magnesia, and lime. According to the experiments of Blondlot, its acid reaction is due to the presence of the super-phosphate of lime, while Professor Thomson and MM. Bernard and Barreswil attribute it to the presence of lactic acid, the existence of which in the healthy stomach has been positively denied by Liebig.

The gastric juice is secreted through cell agency, by follicles of a tubular shape, resting upon the sub-mucous tissue, having their open ends towards the cavity of the stomach.

But diluted acids, of themselves, have no power in chymifying alimentary substances, although their presence in the gastric fluid is essential to its action. The active agent is an organic compound obtained from the mucous membrane of the stomach, to which the name of *pepsine* has been given. It is a proteine compound in a state of change, and it seems to act in precisely the same manner as the diastase does in the conversion of starch into sugar. In so doing, it acts as a sort of *ferment*, having the power of exciting change in another substance, in which it does not itself participate. Pepsine undergoes no change itself, and forms no combinations with the substances on which it acts, but merely disposes them to solution in

the acids of the stomach, with which they form definite chemical compounds.

The quantity of gastric juice prepared, is regulated by the *wants of the system*, and not by the amount of food taken; hence all that is taken over and above these wants will act as a source of irritation.

All substances are not equally soluble in the juices of the stomach; in general terms it may be said, that animal food is more soluble than vegetable, though there are exceptions to this rule. Of the *saccharine group*, sugar is generally converted into *lactic acid* during its passage along the intestinal tube, and is probably absorbed in this form unless it have been administered for a long time. The particles of starch, when their envelopes have been ruptured, are converted into *dextrine* and *grape sugar*; and this is gradually converted into *lactic acid*, in which state it is absorbed. It is now certain that the substances of this class may be converted into oleaginous compounds, though the mode and situation in which this change occurs is not certainly known; probably it is by the action of the bile, the long-continued contact of which with saccharine matter occasions the conversion of part of it into an adipose compound.

The substances of the *oleaginous* class do not undergo much change in the stomach, except a minute subdivision of their particles in the form of an emulsion. When the bile is mixed with them they form a saponaceous compound which is more readily absorbed by the chyliiferous vessels.

The *albuminous* and *gelatinous* articles undergo no other change than one of simple solution.

*Lastly*, the bolus is exposed to the *temperature* of the stomach, which is about 100° Fahr. It was found by the experiments of Dr. Beaumont that the gastric juice had very little effect in dissolving alimentary matters, when the temperature was below this. Hence the taking of cold drinks during digestion is extremely prejudicial to this act.

The fluids taken into the stomach are for the most part absorbed from it, and do not even pass the pylorus. The solids, with the exception of the insoluble parts, are reduced to a substance called *chyme*, the consistence of which will of course vary with the amount of fluids taken. In general it is grayish, semifluid, and homogeneous, with a slightly acid taste and smell. When the food has been of a rich character it resembles cream; when of a farinaceous order, it resembles thin gruel.

The time occupied in the reduction varies, according to the nature of the food, from three to five hours; and it is now generally conceded that this reduction is a true *chemical solution*, and not a process of *putrefaction*, *trituration*, or *fermentation*.

The gas contained in the stomach during digestion is generally very small in quantity. Magendie and Chevreul obtained some from

the stomach of an executed criminal, and found it to consist of Oxygen, 11·03, Carbonic acid, 14·00, Hydrogen, 3·55, Nitrogen, 71·45.

*Action of the small intestine.*—The passage of the chyme through the pyloric orifice is at first slow; but when the digestive process is nearly completed, it is transmitted in larger quantities. The movements by which this passage is effected are of a peristaltic character, each one being preceded by a series of slighter movements in the opposite direction. The chyme is mingled in the duodenum with the biliary and pancreatic secretions, which effect an immediate alteration in its sensible and chemical properties. When mingled out of the body, as was done by Dr. Beaumont, the chyme is separated into three parts; a reddish-brown sediment,—a whey-coloured fluid in the centre,—and a creamy pellicle on the top. The central portion, and the creamy pellicle, seem to constitute the materials from which the chyle is elaborated; the creamy matter consisting of the oleaginous particles, and the whey-like fluid containing proteine compounds, saccharine, and saline matters in solution; while the sediment, consisting of the insoluble matter of the food and of biliary matter, is probably excrementitious.

The contents of the alimentary canal become more consistent, and obtain more of the fæcal character as they pass down the intestinal tube; during which time there is also mixed with them, the secretions of the various follicles; of Brunner, in the duodenum; Lieberkuhn, in the whole route; and Peyer, at the termination of the ilium. The last have no excretory orifice, but discharge their secretion by cell agency. In the neighbourhood of these glands the fæcal matter obtains its characteristic odour, probably from their secretion, which is depuratory.

The movements of the intestinal canal are dependent upon the contraction of its muscular coat, and are directly excited by the contact, either of the fæcal matter, or of the secretions poured into it. This movement is called the *peristaltic action* of the bowels. It is not dependent on nervous influence, as is seen from the fact, that it will continue after all nervous communication has been cut off. The influence of the emotions upon this movement is probably due to the sympathetic nerve which is distributed to the whole intestinal tract.

*Defecation.*—The large intestines act as a reservoir and excretory canal for the fæces. And as the passage through them is not so rapid as in the small intestine, the fæcal matter accumulates until the desire to expel it arises. The contractions of the muscular coat of the large intestines are wholly without the domain of the will; but the involuntary escape of the fæces is prevented by the action of the sphincter ani muscle, which is partly under the influence of the reflex system of nerves. The concurrence of the voluntary muscles with the action of the intestines, is necessary to overcome the contraction

of the sphincter. The act is finally accomplished, principally by a contraction of the diaphragm and abdominal muscles upon a full and sustained inspiration, the glottis being closed so as to prevent the escape of the air contained in the lungs.

#### ABSORPTION.

Absorption is that function, by which nutritive, or other matters, are taken up and carried into the circulation. There are two great divisions of this function: 1st. *External absorption*, or the *absorption of composition*, which obtains from without the organs the materials intended for their composition. 2d. *Internal absorption*, or, the *absorption of decomposition*, which takes up from the organs the old, or effete matter that has to be replaced by new.

By *external absorption* is meant that which takes place from the external surface of the body, including the skin, and the mucous membranes of the digestive and respiratory passages. By *internal*, or *interstitial absorption*, is meant that which takes place from the component tissues of the organs themselves, and from the interior of shut sacs.

The great agents of external absorption are the veins and chyloferous vessels; of internal absorption, the lymphatics. In the chyloferous and lymphatic vessels the fluid is always found to possess the same general properties. In them, therefore, an action of elaboration or selection must have taken place; and the vital agents that are concerned in this elaboration are *cells*.

The veins, on the other hand, exert no selecting power, but receive into their interior by imbibition, any fluid that possesses the proper degree of tenuity, which is then carried along with the current of the circulation. Watery fluids when taken into the stomach, in this manner enter the circulation. Matters which find their way from the stomach or intestines into the circulation, by permeating the coats of the capillaries, do not pass directly from the intestinal veins into the vena cava; they circulate through the liver before reaching the general circulation. Magendie has observed, that in their transit through the liver the properties of many substances are altered, at all events they become so thoroughly mixed with the blood in their route through the portal system, that their possibly injurious influence upon the centre of the circulation is in a great measure, obviated. Substances that require digestion, on the other hand, must pass through the chyloferous vessels and thoracic duct before being mixed with the blood.

*Alimentary, or digestive absorption*, which is included under the head of *external absorption*, is executed in the small intestines, and is exercised upon the food after it has been subjected to the digestive process. The vessels that are concerned in it are the *lacteals*, or absorbents of the intestinal walls. These are engaged almost exclu-

sively in the absorption of *nutritious materials*; other articles finding their way into the circulation through the veins. The lacteals commence in the *villi* of the mucous lining of the intestinal tube, below the point where the ductus communis choledochus and pancreatic duct open into the duodenum. Each lacteal tube commences in a single villus, by a *closed extremity*, and the trunk that issues from each villus is formed by the confluence of several smaller branches which anastomose freely with each other, forming *loops*, so that there is no proper free extremity in any case, nor do the lacteals *ever commence by open orifices upon the surface of the intestinal canal*. (Fig. 12.)

Fig. 12.

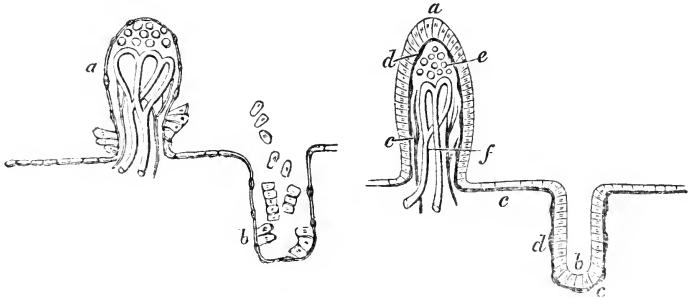


These loops are imbedded in a mass of cells at the extremity of each villus which *select* the nutritive elements from the materials of the intestinal canal and when full, yield their contents to the absorbent vessels either by bursting, or deliquescence. Their place is then supplied by fresh cells, and the process is continued so long as there is any nutritive material present. After this the villi, which were then turgid, become flaccid, and the epithelium, which was removed during the process of absorption, is again renewed, and the lacteal vessels become the *lymphatics* of the intestinal canal, to effect its interstitial absorption. (Fig. 13.)

\*

Fig. 13.

†



The villi are also abundantly supplied with blood-vessels, which are supposed to afford the materials for the development of the cells,

\* Diagram of mucous membrane during digestion and absorption of chyle; *a*, a villus, turgid and erect; its protective epithelium cast off from its free extremity; its absorbent vesicles, its lacteals, and its blood-vessels turgid; *b*, a follicle discharging its secreting epithelial cells.

† Diagram of mucous membrane of jejunum, when absorption is not going on; *a*, protective epithelium of a villus; *b*, secreting epithelium of a follicle; *c*, *c*, *c*, primary membrane, with its germinal spots or nuclei, *d*, *d*; *e*, *e*, germs of absorbent vesicles; *f*, vessels and lacteals of villus.

as well as to be concerned in the absorption of those fluids which require no elaboration.

The fluid that is found in the lacteals is called *chyle*, and is almost invariably the same in composition, no matter how great the diversity of food from which it is obtained. From this fact the inference is drawn, that the lacteals (or rather the absorbent cells amongst which they originate) have the power of *selecting* the particles of which the chyle is composed; while they reject any other ingredients which may be contained in the fluid of the intestines.

The milky colour of the chyle is owing to the presence of minute corpuscles called *chyle globules*. It also contains fat, albumen, fibrine, and salts in varying quantities.

The course of the chyle, after leaving the intestinal canal, is through the chyloferous vessels and ganglia of the mesentery, into the receptaculum chyli or commencement of the thoracic duct, along which it passes to enter the circulation at the point where the left internal jugular and subclavian veins unite. During this passage it undergoes several marked changes in its physical and vital properties. When it first leaves the intestine its principal constituent is *fat*; if examined in the lacteal vessels of the mesentery, at a point between the mesenteric ganglia and the receptaculum chyli, the fat will be found to have diminished in quantity, while *albumen* will be in maximum quantity and *fibrine* in medium quantity; and a slight coagulability will also be manifested. The chyle taken from the thoracic duct contains little or no fat, a medium quantity of albumen, and a maximum quantity of fibrine, and is now distinctly coagulable, and has a slight rosy tint. These circumstances have given rise to the belief that the chyle, as it proceeds, becomes more and more animalised, or transformed into the nature of the being to be nourished. MM. Tiedmann and Gmelin infer that it is to the action of the mesenteric glands, that the chyle owes these important changes in its nature;—the fluid in its passage through them, obtaining from the blood circulating in them, the new elements which animalise it.

The *chyle corpuscles* are supposed by Dr. Carpenter to originate in the mesenteric ganglia and to be the altered epithelium cells which line the lacteals in their course through these bodies. Their function is, according to this author, to convert the albumen into fibrine, since they are found to be most abundant where this process is going on.

*Internal, or interstitial absorption*, is effected by agents strongly resembling those concerned in the absorption of chyle. One part of the apparatus, the thoracic duct, is common to both. The lymphatics are distributed through the greater part of the body, especially upon the skin. They have never been found to commence by closed or open extremities; but seem to form a network from which the trunks arise. In their course they pass through glands, called lymphatic glands, which exactly resemble in structure and function those of the mesentery. The same agents,—cells,—are probably concerned

in the elaboration of the *lymph*, as of the *chyle*, and the fluid thus formed is likewise a nutritive fluid, being mingled with the chyle in the thoracic duct. So that what is true of *chylosis*, is also true of *lymphosis*, both forming a part of the nutritive operations.

The lymphatics, however, sometimes take up materials that are not inservient to nutrition, as bile, pus, the venereal and other virus that may be brought in contact with them. But these facts merely prove that the walls of the lymphatics are permeable by such substances, for thin fluids will always enter those vessels that present the thinnest walls and the greatest surface. As this is the case with the lymphatics upon the surface of the body, it explains the phenomena of absorption through that surface. In the lungs and in the intestinal canal, the veins are most numerous, hence these are the recipients of the thin fluids. In both cases the fluids soak in by imbibition. In the case of the absorption of pus, the probability is that the absorbents must have been laid open themselves by the ulcerative process, since the pus-globule is too large to have gained admittance in any other way.

It is difficult to speak with certainty of the *source* of the matters absorbed by the lymphatics. Their contents bear a close resemblance to the fluid element of the blood, or "liquor sanguinis" in a state of dilution. Dr. Carpenter supposes them to consist of the residual fluid, which, having escaped from the blood vessels into the tissues for their nutrition, is now to be returned to the former. They may also include those particles of the solid frame-work which have lost their vital powers, and are therefore not fit to be retained as components of the living system, but are not yet so far decayed as to prevent their serving as materials for reconstruction after being again subjected to the organizing process.

The same author says further, that if this view of the function of the lymphatics be correct, it follows that we must attribute to the blood-vessels the absorption of the truly effete particles; and in this there would seem to be no improbability, since we know that the venous blood contains the elements of two important excretions, that of the liver and that of the lungs, in far greater proportion than arterial blood; and there is also in the former fluid a certain amount of "ill-defined animal principles" that seem ready to be thus thrown off.

The lymph very closely resembles the chyle, the main difference being in their colour, the lymph being nearly colourless. Both contain the same ingredients, but not in the same proportions, the chyle abounding most in organic elements. Both contain peculiar corpuscles, and are capable of self-coagulation, in fact each may be looked upon as imperfectly elaborated blood.

The movements of the chyle and lymph in their respective vessels is due partly to vis à tergo, but mainly to the contractility of the middle coat. Both sets of vessels are supplied with valves which prevent a retrograde movement.



The absorption that takes place through the skin, or *accidental absorption*, as it is called, is effected by the agency of the lymphatics also, which are here very abundantly distributed. In this case there is no selection, the fluids passing in by simple imbibition. In the pulmonary mucous membrane, as in the digestive, thin fluids are taken up by the veins. In general, wherever a thin fluid is placed in contact with an extended surface, it will be taken up by those vessels that present the largest surface and the thinnest walls. The rapidity of this absorption through the skin and mucous membrane, is greatly influenced by the condition of the blood-vessels; being very great when the vessels are drained of their contents, and proportionately small when they are full. The presence, or absence of the epidermis affects it as might be readily inferred. The external integument, so long as it is covered with the epidermis, absorbs with extreme slowness; the epidermis removed, however,—by means of a blister,—and the vascular lamina of the corium exposed, absorption goes on with extreme rapidity. It is upon this fact that what is called the *endermic* method of exhibiting medicines depends.

In regard to the absorption of fluids from serous cavities it is remarked, that imbibition does not explain all the phenomena; the probability is that the lymphatics under certain circumstances are also concerned. If the fluid in the veins be more concentrated than those to be absorbed, then imbibition is sufficient. But, if, on the contrary, the external fluid is equally concentrated with that contained in the interior of the vessels, the two fluids ought to pass through the membrane in both directions with equal rapidity. And if the fluid in the vessels be less concentrated of the two, it will exude in greater quantity so as to increase the amount of the effused fluid. A collection of fluids in the pleura, or peritoneum, containing albumen and salts in the same state of concentration as these substances exist in the blood, would not be diminished in quantity by imbibition alone; there would be merely an interchange of the saline matters contained in the external fluid and in the blood, while the bulk of the former would remain the same. The probability is, therefore, that in this case there would be other agents than the blood-vessels concerned in the absorption, viz: the lymphatics. It is possible that the process of endosmosis may be modified by a peculiar attraction exerted by the tissues on the fluids circulating in them; an attraction, by the agency of which the fluids in the tissues may be retained while the external fluid is absorbed, so that merely absorption, and not an interchange of fluids, as is the case under ordinary circumstances, is the result.

## RESPIRATION.

Respiration is that function by which venous blood is converted

into arterial; carbonic acid, given off from, and oxygen taken into the system. In the higher classes of animals the whole of the circulating fluid is sent through special organs formed on the same general principle as the secreting glands, which fulfil incessantly an office the most essential to life; these organs are the lungs. In the lungs, the mass of the circulating fluid, which had been changed in the periphery of the body into venous blood, mixed with the lymph from all parts, and the newly-elaborated chyle, is brought into intimate contact with the air of the atmosphere, the effect of which is to restore to the blood its bright colour, and to give to it the arterial character which is alone competent to minister to nutrition, and to impart to the nervous system and locomotive apparatus their proper stimulus. The arterial blood, thus changed, also supplies to the secretory apparatus the material for the exercise of its function. All that is necessary then for these purposes is, that the blood should be exposed to the influence of the atmospheric air, or air dissolved in water, through the medium of a membrane that shall permit the diffusion of gases; an interchange then takes place between the gaseous matters on the two sides,—carbonic acid being exhaled from the blood and replaced by oxygen.

The extrication of carbonic acid is effected in a manner that renders it subservient to the introduction of oxygen, which is required for all the most active manifestations of vital power; and it is in these two actions conjointly, not in either alone, that the function of respiration essentially consists. It will be remembered that the carbonic acid passes out through the animal membrane by exosmose, and the oxygen passes in by endosmose.

The sources of the carbonic acid given off in respiration are three-fold, 1st. The continual decay of the tissues; which is common to all organized bodies; which is diminished by cold and dryness, and increased by warmth and moisture; which takes place with increased rapidity at the approach of death; whether this affects the body at large, or only an individual part; and which goes on unchecked when the actions of nutrition have ceased altogether.

2d. The metamorphosis, which is peculiar to the nervous and muscular tissues; which is the very condition of their activity, and which therefore bears a direct relation to the degree in which they are exerted.

3d. The direct conversion of the carbon of the food into carbonic acid; which is peculiar to warm-blooded animals; and which seems to vary in quantity in accordance with the amount of heat to be generated.\*

The organs of respiration are always formed upon the same

\* For a more detailed account of these sources of carbonic acid, of which the above is merely a recapitulation, see Carpenter's Principles of Human Physiology, 3d American Edition, p. 570 and seq.

general plan, being essentially membranous prolongations of the external surface, adapted by its permeability and vascularity to bring the blood into close relation with the surrounding medium.

As this medium may be either air or water, we find two principal forms of respiratory organs, one of which is adapted for each. In aquatic animals the membrane is usually prolonged externally into tufts or fringes, each one of which is supplied with arteries and veins, during the circulation through which the aeration is accomplished. These organs are called *gills*.

In air-breathing animals the aerating surface is reflected inwardly, forming passages or chambers in which the air is received, and on which the capillary vessels are distributed.

In insects we find a series of tubes called *tracheæ*, ramifying through the body and carrying air to every part of it.

In regard to the human lung, according to the observations of Mr. Rainey, a bronchus, when traced from its commencement to its termination, is seen in the first part of its course, to be more or less cartilaginous; it then becomes destitute of cartilage, retaining, however, a perfectly circular form and having no air-cells opening into it; farther on, being still circular, numerous air-cells open into it; lastly, the air-cells increase so much in number, and open into the bronchus so closely to one another, that the tube can no longer retain its circular form, but becomes reduced to an irregular passage running between the cells, and ultimately reaching the surface of the lobule, ends by forming a terminal air-cell.

The air-cells are small irregularly shaped cavities, having usually four or five unequal sides; those which are situated close to the small bronchial passages open into them by well-defined circular apertures, while those at a distance from these passages open one into the other, as in the lung of the frog and serpent; in fact each lobule of the lung of the mammal and man, with its bronchial passages and appended cells, may be regarded as a repetition of the whole lung of the frog.

The sides or walls of the air-cells are formed of a thin transparent membrane, and the capillary vessels are so placed between the walls of two adjacent cells as to be exposed on their two sides to the action of the air. The number of capillary plexuses is not the same as that of the air-cells, one network passing between and supplying several cells; or in other words, one terminal branch of the pulmonary artery supplies the plexuses of several cells.

It has been calculated by M. Rochoux that as many as 17,990 air-cells are clustered around each terminal bronchus, and that their total number amounts to 600 millions.

The *foetal* lungs, according to Mr. Rainey, prior to respiration are distinctly seen, when injected, to possess air-cells fully formed, and

surrounded, as in the animal which has respired, by plexuses of blood-vessels.

The chemical process of respiration is not essentially dependent on the respiratory movements. They merely serve to expel the air, (or water) which has undergone the change induced by the chemical process constantly carried on between it and the blood, and to renew the supply of fresh air or water.

The lungs, by their internal surface, offer an immense expansion for the action of the blood and air on each other; and, as they are never completely emptied by the act of expiration, this action is constant. By the contraction and dilatation of the chest, the motions of which the lungs follow, a portion of the altered contents of the pulmonary reservoir is first expelled, and then a new supply introduced, to undergo change in its turn.

According to the inquiries of M. Bourgeroy the development of the air-cells continues up to the age of thirty, at which time the capacity of respiration is greatest; it subsequently decreases, especially in persons who suffer from cough. The violence of such expiratory efforts frequently causing rupture of the air-cells, thus gradually producing that emphysematous condition of the lungs so common in elderly people. The power of increasing the volume of air by a forced inspiration is much greater in young than in old persons, and is twice as great in males as in females of the same age, a circumstance which is evidently connected with the extent to which muscular efforts can be carried in these classes respectively.

*Movements of respiration.*—These may be divided into two classes, those of *inspiration* and those of *expiration*. By the first is meant the action by which air enters the lungs; by the latter, the act of expelling from the lungs the air received in inspiration.

In mammalia generally, as well as in man, inspiration and expiration are performed by the dilatation and contraction of the cavity of the thorax. As soon as the walls of the chest are drawn wide asunder, and the thorax dilated, the external air rushes through the trachea and its branches into the air-cells, distending them in proportion to the dilatation of the thorax, thus keeping the surface of the lung accurately in contact with the thoracic walls in all their movements. This contact, however, can only take place while the thoracic cavity is closed on all sides, so that the air cannot exert any pressure on the *outer* surface of the lung, by which that upon the inner would be balanced. Hence it is, that in penetrating wounds of the chest, the lungs cannot be fully distended by inspiration, because the air entering through the wound into the cavity of the pleura balances the pressure of the air on their inner surface; the lungs, in such a case, remain collapsed, although the thoracic parietes dilate.

*Inspiration.*—The diaphragm contributes the principal share to

the dilatation of the chest during inspiration. In its relaxed state this muscle is arched; by contracting it becomes more plane; and by this flattening of its arch, the capacity of the thorax is increased, at the same time that the abdominal viscera are pressed upon from above, so as to produce the protrusion of the abdomen observed during inspiration. (Fig. 14.)

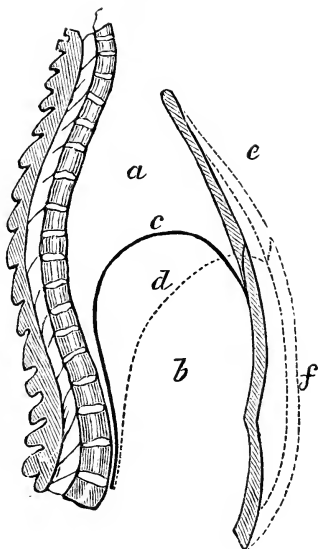
In a natural, tranquil inspiration, the dilatation of the chest is effected almost entirely by the diaphragm. The lateral dilatation, as in deep inspiration, is performed principally by the action of the intercostal muscles, assisted also by the scaleni, the levatores costarum, the serratus posticus inferior, and the thoracic muscles generally. In the old, inspiration is mainly accomplished by the diaphragm, in consequence of the ossification of the cartilages of the ribs.

The number of inspiratory movements vary greatly under different circumstances. In general it may be stated from 14 to 18 usually occur in a minute; of these the ordinary inspiration involves but little movement of the thorax; but a greater exertion is made at about every fifth recurrence.

The average numerical proportion of the respiratory movements to the pulsations of the heart, is about 1 to 5 or  $4\frac{1}{2}$ , and when this proportion is widely departed from, there is reason to suspect some disorder of the respiratory apparatus or the nervous system.

*Expiration*, when perfectly tranquil, may be the result of the mere collapse or elastic reaction of the parts recovering their natural state, after the active dilatation they have undergone; in fact, tranquil respiration seems to consist more in the periodic action of the muscles of inspiration, than in the alternate action of antagonising muscles. Among the elastic components of the respiratory organs may be mentioned the cartilages of the ribs, the cartilages of the bronchial tubes, and the capsule of elastic tissue described by M. Bazin, which invests the lungs, and sends prolongations inwards, and the elasticity of the air-cells themselves. The muscles which are concerned in expiration are the abdominal, which draw down the

Fig. 14.\*



\* Section of thorax and abdomen. a. Thorax. b. Abdomen. c. Relaxed diaphragm. d. Contracted diaphragm.

ribs, and by compressing the abdomen force the viscera up against the relaxed diaphragm, and thus diminish the cavity of the thorax from below. These are the *recti*, *obliqui*, and *transversi abdominis*, the *quadratus lumborum*, the *serratus posticus inferior*, the *sacro-lumbalis*, and the *longissimus dorsi*.

If the whole time occupied by a respiratory act, from the beginning of one inspiration to the beginning of the next, be represented by 10, the inspiratory movement may be estimated at 5; the expiratory at 4; while the remaining 1 will be occupied by the period of repose which succeeds expiration.

The *capacity* of the lungs varies very much in different individuals. According to Mr. Hutchinson, by this term is meant "that quantity of air which an individual can force out of his chest by the greatest voluntary expiration, after the greatest voluntary inspiration." This author has shown that in health, this capacity bears a very constant relation to the height of the individual. Thus the mean "capacity" of 172 males under the height of 5 ft. 8 in. is 220 cubic inches, whilst that of 82 males from 5 ft. 11. to 6 ft. is 255 cubic inches. For every additional inch of height (from 5 to 6 ft.), 8 additional cubic inches are given out by a forced expiration. The exceptions to this occur among stout and corpulent individuals, whose capacity stands lowest. The size of the chest, therefore, is not always a criterion as to the capacity of expiration. Mr. Hutchinson also found that the full expiratory force of a healthy man is commonly one-third greater than his inspiratory force.

According to the experiments of Mr. Coathupe, about  $266\frac{1}{3}$  cubic feet, or 460,224 cubic inches of air, pass through the lungs of a middle-sized man in 24 hours; reckoning the average number of inspirations at 16 per minute, this would give 20 cubic inches as the amount inhaled at each.

*Residuary air.*—According to the calculation of Sir H. Davy, the human lung, after the strongest expiration, still contains 35 cubic inches of air, and after an ordinary expiration, 108 cubic inches. This (air) is called the residuary air, and upon it depends the lightness of the lungs, which enables them to float upon water; in fact, when once these organs have been distended by a full inspiration, no mechanical, or other power can dislodge the air so as to cause them to sink in water. Upon this circumstance was based the hydrostatic test of infanticide. The residuary air also gives rise to the tympanic resonance on percussion.

In the act of inspiration the air within the lungs is alternately increased and diminished in amount; and thus a regular exchange is secured. This exchange, however, affects only a portion of the contained air at a time, and this proportion appears to vary according to the frequency of the respiration. Indeed, if it were not for the tendency of gases to mutual diffusion, the air in the remote cells might never be changed. Probably about one-eighth of the whole

contents is changed at each inspiration. As long as the residuary air contains any oxygen, aeration of the blood will take place, provided always the heart continues to act; but as soon as the contained oxygen is consumed, asphyxia begins to occur, unless a fresh supply is obtained. The residuary air will probably support life about three minutes.

*Influence of the nerves on respiration.*—The source of the nervous influence on which the different respiratory movements depend, is one and the same, although the nerves implicated in these movements are very various. The *medulla oblongata* is the source from which the nervous influence for the respiratory motions is derived, and the spinal cord is, as it were, the trunk of the nerves which arise from it. If the spinal cord is divided above the point where the dorsal nerves are given off, the motions of the ribs and abdominal muscles are paralysed, while the other respiratory movements continue. If it is cut above the origin of the phrenic nerve, then the diaphragm is paralysed, while the nerves given off from the *medulla oblongata* itself still continue to exert their function. Injury of the *medulla oblongata* arrests instantly all the respiratory movements, both those dependent on the *par vagum*, and those on the spinal nerves.

The respiratory movements are partly voluntary, partly involuntary. Partly voluntary, in order that they may be inservient to the production of vocal sounds, and to the actions of speech, singing, &c. Partly involuntary, lest in sleep, or in moments of forgetfulness, the movements of respiration should be suspended, and fatal results ensue.

The combined action of the respiratory muscles is under the influence of that portion of the nervous system called the *reflex*; a part which does not involve the will, or even sensation, and which may continue to transmit its influence when all the other parts of the nervous centres have been removed. The principal excitor, or *afferent* nerves, are the *par vagum*, and the sensory branches of the fifth pair, the former conveying impressions from the lungs, the latter from the general surface. If the *par vagum* be divided on both sides, the movements of respiration are greatly diminished in frequency.

*Chemical phenomena.*—The prominent phenomena in respiration are, the removal of a certain quantity of oxygen from the air, and its replacement by carbonic acid; and the change in colour of the blood from a dark venous hue, to a bright scarlet or arterial. The relative proportions of oxygen inhaled and of carbonic acid exhaled, are to each other inversely as the square roots of their specific gravities; that is, the quantity of oxygen absorbed will exceed that of carbonic acid given off in the proportion of 1174 to 1000. Carbonic acid contains precisely its own volume of oxygen; consequently, of

the 1174 parts of oxygen absorbed, 1000 are again excreted as carbonic acid, leaving 174 parts, or nearly 15 per cent. to be accounted for. Some of this unites with the sulphur and phosphorus of the original components of the body; the remainder most probably enters into combination with the hydrogen of the fatty matter, thus forming part of the water exhaled by the lungs.

Of the nitrogen which enters so largely into the composition of atmospheric air, a small portion only is absorbed, in consequence of the difficulty with which it passes through animal membranes; its main use in the atmosphere being to dilute the oxygen. The exhalation and absorption of nitrogen appear usually to balance each other, so that the amount of this gas in the respired air undergoes little or no change.

The quantity of carbonic acid exhaled varies at different times, and under different circumstances. The mean of a great number of observations gives about 160 grains of carbon per hour as the quantity set free by an adult; this would give 8 oz. Troy in the 24 hours. The amount varies with the development of the body, and with the sex. In males, the quantity increases from eight years of age till thirty, it remains stationary till forty, and then decreases till old age, when it little exceeds that at ten. An extraordinary development of the muscular system is always accompanied by the extrication of a larger quantity; the reverse is also true.

In females there is the same proportional increase till puberty, from which time it remains stationary during the menstrual life; after which it increases. After fifty, it decreases as in men. During pregnancy the amount of exhalation is increased, and the same takes place whenever the menses are temporarily arrested.

The quantity exhaled is also increased by cold, exercise, or a full meal, and by many of the exanthemata. It is diminished in typhus fever, in chronic diseases of the respiratory organs, and in sleep.

Independently of these variations, there is a difference in amount in accordance with the time of day, being least at midnight, gradually increasing till midday, then again declining till midnight.

The sources of the carbonic acid have been already adverted to. It is not formed in the lungs as was originally supposed, but in the tissues themselves, as is shown by the facts that venous blood contains a larger amount of this gas than arterial; and that an animal placed in hydrogen, or nitrogen, still continues to evolve carbonic acid.

In regard to the change of colour effected by respiration, it must be regarded as a purely physico-chemical phenomenon, inasmuch as the same changes will take place in blood exposed to the air out of the body, even through the medium of a thick membrane, such as a bladder. The precise cause of the change of colour is as yet unsettled. By Liebig it is supposed that the iron in the red corpuscles



is the real agent in the respiratory process, and that the corpuscles are the carriers of oxygen into the system, and of carbonic acid out of it. He supposes the iron to exist in the form of protoxide in venous blood, united with carbonic acid, forming a carbonate of the protoxide of iron; in the lungs, the carbonic acid is given off, leaving the protoxide, which by union with half an equivalent of oxygen, is converted into the peroxide, at the same time that the colour is changed to arterial. In the systemic capillaries the reverse takes place,—the oxygen being imparted to the tissues, and replaced by the carbonic acid, which is given up by them to be conveyed out of the system.

Mulder, Scherer, and others, account for the change of colour, by a change of *form* in the red corpuscles, which are supposed to be bi-concave, and reflecting bodies in arterial blood, and bi-convex, and refracting bodies in venous blood. Mulder shows that the *colour* is not dependent on the presence of iron, since it is retained when all the iron has been entirely removed.

The presence of a certain amount of saline matters appears, from the experiment of Dr. Stevens, to be essential for the due influence of oxygen upon the colour of the blood; since, if they be deficient, the contact of oxygen will not produce its usual effect.

The blood parts with a considerable amount of water in the lungs, amounting to 16 or 20 ounces in 24 hours. It also absorbs volatile matters from the air. The water contains some animal matters, and has its source, according to Dr. Prout, in the chyle which has just been poured into the blood; probably also it escapes by evaporation through the thin animal membrane.

*Asphyxia*.—If from any cause the supply of oxygen be cut off, a condition ensues to which the name of asphyxia has been given; the essential character of which, is the cessation of muscular movement, and shortly afterwards of the circulation, with an accumulation of blood in the venous system. The time necessary for the production of this state is inversely proportionate to the development of the respiratory function; thus, warm-blooded animals are much sooner asphyxiated than reptiles. In the former, deprivation of air for two minutes is sufficient to produce insensibility and loss of muscular power. The circulation generally fails within ten minutes.

The first effect of non-arterialization of the blood in the lungs, is the retardation of the fluid in their capillaries, an accumulation in the venous system, and a deficient supply to the arterial. The operation of these two causes arrests the action of the heart, although the effect on the two sides is different; the right side ceases to act from over-distention; the left, from deficiency of stimulus to excite the movement. If the stoppage have not been too long, the heart's action may be renewed by artificial respiration; for the replacement of oxygen in the air cells, restores the pulmonary circulation,

and thus, at the same time, relieves the distended right ventricle, and conveys to the left the due stimulus to its action. In conclusion, it may be stated, that the post-mortem appearances are always the same in asphyxiated individuals, no matter what may have been the mode of death.

#### CIRCULATION.

By this term is understood that function by which the nutritive fluid is conveyed to every part of the body through appropriate channels. This distribution is spoken of under the general title of *The circulation of the blood*; the organs and canals by means of which and through which it is accomplished constitute the *vascular system*.

The greater circulation was discovered in the higher animals by William Harvey in 1619, and although it cannot be asserted to be an universal character of all animals, yet at every advance of observation, new traces of vessels are discovered in the most simple beings.

There is a circulation in plants as well as in animals, and its object is the same. There is no central organ, however; the elaborated sap is distributed partly by *vis à tergo*, partly by capillary action, and the influence of light and air upon the leaves, but mainly by the affinity between the elaborated sap and the tissues of the plant.

In the higher orders of animals, there are two distinct circulations, with a heart for each. These two circulations are entirely separate and distinct from each other in the perfect adult, as are also the hearts belonging to each, being merely brought together for economy of material and space. They are called the greater and the lesser; or the systemic and pulmonic.

The course of the blood through these two circuits, may be likened to the figure 8; and the heart is placed at the junction of these. Each system has its own set of arteries or efferent trunks, and veins or afferent trunks; these communicate at their central extremity by the heart; and at their peripheral extremity by the capillary vessels, by which are meant the minutest ramifications of the two systems inosculating into a plexus.

The route of the circulation is as follows: the venous blood is collected in the right auricle, thence it passes through the tricuspid orifice into the right ventricle; thence it is distributed to the lungs through the pulmonary artery to be aerated, after which it is collected by the pulmonary veins and carried to the left auricle, from which it passes through the mitral orifice into the left ventricle, and from thence through the aorta to the system.

The chief impelling power of the circulation, is the rhythmic motion of the heart. This organ is endowed in a remarkable degree with the property of *irritability* or *contractility*; by which is meant

“the capability of being easily excited to movements of contraction alternating with relaxation.” This property is an endowment strictly belonging to the heart, and is not derived from any connexion with the nervous system, since it has been shown to continue after all connexion has been severed. It is retained much longer in the cold-blooded than in the warm-blooded animals; and in the very young animals than in the old.

This movement of the heart cannot be accounted for by the stimulus of the blood, since it will continue when the heart is empty; nor yet by the stimulus of *air*, since it persists even *in vacuo*; and it has been shown above that they are independent of the nervous system; they must therefore depend on the *vis insita*, though the exciting cause cannot be positively determined.

If the heart of a living mammiferous animal or bird is laid bare, the two ventricles are seen to contract together, and the two auricles, with the commencement of the pulmonary veins and of the venæ cavæ also simultaneously, the contraction of the auricles and that of the ventricles *not being synchronous*. The contraction of all the cavities is followed by their dilatation; the contraction is called the *systole*; the dilatation, the *diastole*.

The auricles are but little concerned in the propulsion of the blood, they being mere sinuses or receptacles. The *systole* of the ventricle corresponds with the projection of the blood into the arteries, causing the pulse; whilst the diastole, coincides with the collapse of these vessels.

When the ventricles contract, the blood is prevented from returning into the auricles by the tricuspid valve, on the right side; and by the mitral valve on the left. When they dilate, the blood is prevented from re-entering their cavities, by the semilunar valves at the mouth of the aorta and pulmonary artery. The dilatation of the ventricles may be distinguished into two stages: the first immediately succeeds their systole, and manifests itself in the recession of the heart's apex from the walls of the chest; the second stage is attended with the enlargement of the heart in all directions, and is synchronous with the auricular contractions. It is between these two stages that the interval of repose takes place.

The diastole of the heart, according to Cruveilhier, is an active force, but of its cause no precise account is given. It is supposed to be owing to the presence of the yellow fibrous tissue, interwoven with the muscular substance, upon whose elasticity the first stage of the ventricular diastole is supposed to depend; the second stage being caused by the ingress of blood produced by the auricular systole.

*The impulse of the heart* must not be confounded with the arterial pulse. The heart's impulse is the shock communicated by its apex to the walls of the thorax in the neighbourhood of the fifth and sixth ribs.

*Sounds of the heart.*—When the ear is placed over the præcordial region, two sounds are heard, following each other in quick succession, at each beat of the heart. These sounds are followed by a short interval of repose, after which they recur, again followed by repose, and so on. The sounds are of different lengths; the *first* being the longest. If the whole interval, from the beginning of one pulsation to the beginning of the next, be divided into four equal spaces of time, the first two will be occupied by the first sound, the third by the second sound, while the fourth will represent the period of repose.

The first sound coincides with the systole of the ventricles, the pulse in the arteries, and the impulse against the walls of the chest. The second, with the first stage of the diastole of the ventricles. The first is a dull, prolonged sound, the second is short and sharp, and follows so immediately upon the first, that it can hardly be imagined to occur during the systole of the auricles, as has been supposed.

The *causes* of these sounds have given rise to much discussion. The first is evidently complex, having several elements in its composition. The principal cause of it is found at the orifices of the aorta and pulmonary artery, and is produced by the rush of the blood through these comparatively narrow outlets. Another element is found in the passage of the blood over the rough internal surface of the heart; a third element, in the sound of muscular contraction accompanying the systole of the ventricles; and a fourth in the *impulse* of the heart against the walls of the chest; for when the impulse is prevented, the sound is much diminished.

In regard to the *second* sound, which accompanies the first stage of the *diastole* of the ventricles, there is not so much doubt. It is produced by the sudden shutting down of the semilunar valves at the orifices of the aorta and pulmonary artery, the function of which valves is, to prevent the reflux of the blood into the ventricles during their dilatation.

*To sum up*, the causes of the *first sound*, are: 1st. The rush of blood through the narrow orifices of the aorta and pulmonary artery; 2d. The passage of the blood over the rough internal surface of the ventricles; 3d. The sound of muscular contraction; 4th. The impulse against the chest. The cause of the *second sound* is, the sudden shutting down of the semilunar valves at the orifices of the aorta and pulmonary artery.

The following table from Dr. Carpenter's Human Physiology, will perhaps assist the student in connecting the sounds of the heart with its movements:

<i>First Sound.</i>	Ventricular systole, and auricular diastole. Impulse against the chest. Pulse in arteries.
<i>Second Sound.</i>	First stage of ventricular diastole.
<i>Interval.</i>	Short repose; then auricular systole, and second stage of ventricular diastole.

The *capacities of the different cavities* of the heart are said to vary slightly, as well as the *thickness of the walls*; the right auricle and ventricle are said to be most capacious, while the left auricle and ventricle have the advantage in thickness of their walls; the left ventricle having its parietes nearly three times as thick as the right, since it has to exercise more force in sending the blood to the distant parts of the system.

Each cavity will hold about two fluidounces, but it is probable that the ventricles do not entirely empty themselves at each stroke; they will therefore discharge about  $1\frac{1}{2}$  ounces at each pulsation. Reckoning 75 pulsations in a minute, there will pass through the heart in this time, 112 oz., or 7 lbs. of blood. The whole quantity of blood in the human body is equal to about  $\frac{1}{5}$ th of its weight, or 28 lbs. in a person weighing 140 lbs. This quantity would therefore pass through the heart once in four minutes, and would circulate about fifteen or twenty times in an hour.

Recent experiments would seem to show that this is below the estimate, since substances introduced into the venous circulation have been detected in the remotest parts of the arterial system in less than 30 seconds.

The *force* with which the heart propels its blood has been variously stated. According to Hales, the usual force of a man's heart would sustain a column of blood  $7\frac{1}{2}$  feet high, the weight of which would be about 4 lbs. 6 oz. According to Pousseuille, who caused the blood to act upon a column of mercury, the force of the heart is equal to 4 lbs. 3 oz. The true estimate of this force is found by multiplying the pressure of blood in the aorta into the surface of a plane passing through the base and apex of the left ventricle; according to which it is found to be about 13 lbs.

The *number of contractions* of the heart in a minute, is about 70 or 75. The frequency of its action gradually diminishes from the commencement to the end of life. Just after birth, it ranges from 140 to 130; in old age, 65 to 50. Age, sex, muscular exertion, emotions, and temperament, exert a controlling influence over the heart's action. In persons of sanguine temperament, the heart beats more frequently than in those of the phlegmatic, and in the female sex more frequently than in the male. Its action is also increased after a meal, and by rising from a recumbent, to a sitting or standing posture. The time of day also affects it; the pulse is more frequent in the morning, and becomes gradually slower as the day advances.

In inflammations and fevers, the pulse is much more frequent than during health. When the vital powers decline, it becomes frequent and feeble. In nervous affections, with more oppression than exhaustion of the forces, the pulse is often remarkably slow.

*Movement of the blood in the arteries and capillaries.*—By the

action of the left ventricle, the blood is forced onwards and distributed throughout the whole body, with the exception of the lungs, and passes through the capillaries into the veins.

The pressure of the column of blood against the elastic walls of the arteries, at every contraction of the ventricle, produces what is called the *pulse*. The sensible pulse of the arteries is synchronous, or nearly so, with the contraction of the ventricle; it is somewhat later than the heart's beat, especially in the distant vessels, but the difference of time is scarcely perceptible. In the capillaries and veins, the pulse is no longer perceived.

There is found to be a very close correspondence between the areas of the branches and that of the trunk from which they spring. According to a well-known geometrical law, the areas of circles are as the squares of their diameters. Now, if we add together the squares of the diameters of the branches of a given vessel, we will find that their sum is about equal to the square of the diameter of the parent trunk, showing that the conjoint size of the branches is not greater than that of the main trunk, and that the vascular system cannot be compared to a cone whose apex is at the heart, and whose base is at the circumference of the body, with a regularly increasing surface; but rather to a cylinder, whose diameter is equal throughout, and the pressure upon whose walls is at every point the same.

The arteries are possessed of three coats, an external, cellular; a middle, composed of muscular fibres and yellow fibrous tissue; and an internal, which is serous. Upon the *elasticity* of the yellow fibrous tissue is dependent the property by which the interrupted force of the heart is made equable and continuous, and which is seen most in the large vessels connected with that organ. The *contractility* of the muscular fibres, which they have been shown to possess, is concerned in regulating the flow of blood towards particular organs. Their contractility is most plainly seen at a distance from the heart, where the impelling power of this organ becomes almost null. Under these circumstances, the muscular coat becomes an important adjuvant.

The muscular coat has also another function, that of *regulating* the diameters of the tubes in accordance with the quantity of blood to be conducted through them to any part; this is seen in the enlargement of the uterine and mammary arteries, during pregnancy and lactation, and in their return to their normal size after these periods are over. These changes are due to the contractility of the muscular fibres of the middle coat, probably regulated by the sympathetic nerve, which is minutely distributed upon the vessels. In the permanent dilatation of arteries, however, in parts that are undergoing enlargement, their nutrition is also increased, the walls being thickened as well as extended.

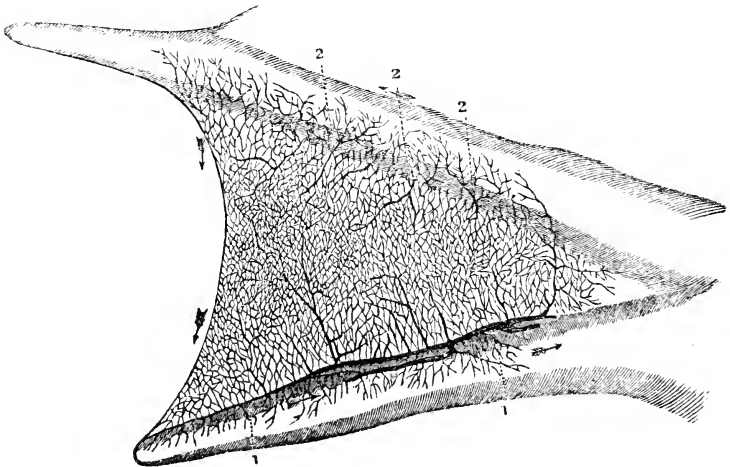
In addition to the elasticity and contractility already described,

experiment indicates the existence of that power of *slow* contraction in the arteries to which the name of *Tonicity* has been given; this, however, does not seem to be anything else than a particular manifestation of the general property of vital contractility, and is quite distinct from ordinary elasticity. The manifestation of this property is seen when a ligature is applied to an artery, the part beyond the ligature becoming gradually smaller, and emptied to a greater or less degree of the blood which it contained. The empty condition of the arteries after death is due to the same cause. It is to the moderate action of the *Tonicity* of arteries, that these contractions upon the stream of blood passing through them, is due. If the tonicity be excessive, the pulse is hard and wiry; but if it be deficient, the pulse is very compressible, though bounding, and the flow of blood through the arteries is retarded.

The smaller arteries in every organ of the body, before they become capillary, are connected by repeated anastomoses with each other, the object of which arrangement is, to supply the circulation to any part, when an important vessel leading to that part is either compressed or obliterated. The capillary system of all connected parts being continuous, all the vessels, whether arteries or veins, are united through its medium.

*Capillaries.*—It has been shown that in all organic textures the transmission of the blood from the minute branches of the arteries to the minute veins is effected by a network of microscopic vessels, in

Fig. 15.\*



\* Shows the blood-vessels and their anastomoses. 1, 1. Veins. 2, 2, 2. Arteries.

the meshes of which the proper substance of the tissues lies. These minute vessels are called *capillaries* from their small size, and they may be seen by the aid of the microscope in the web of the frog's foot, (fig. 15,) in the tail of the tadpole, and the lungs, urinary bladder, or tongue of the frog.

The *size* of the capillaries is proportioned to that of the red particles of the blood, and can be measured in parts finely injected. Their diameter varies from  $\frac{1}{1000}$ th to  $\frac{1}{4000}$ th or  $\frac{1}{5000}$ th of an inch. When filled with blood they are not so much distended as when injected, and have seldom been measured when so filled. No other elementary tissues are much more minute than the capillaries.

Microscopic observations and minute injections have shown that the capillary vessels are merely the fine tubes which form the medium of transition from arteries to veins, and that *no other kind of vessels arise from them*; that the minute arteries have no other mode of termination than the communication with the veins by means of capillaries; in a word, *that there are no vessels terminating by open extremities*. (Muller.) *Serous vessels*, that is, branches of the blood-vessels too minute to allow the passage of red particles, and consequently traversed merely by the lymph of the blood, may *possibly* exist, though they have not been demonstrated. What have probably been mistaken for them, are vessels which are so small as to admit only a single row of blood-corpuscles, the amount of colouring matter in which is not sufficient to tinge the light transmitted through them. The existence of vessels in the substance of the cornea, which were supposed to be *serous* or white vessels, is, according to Muller, very doubtful; they have never been injected.

The existence of membranous parietes in the capillary system has been doubted by many physiologists, but more accurate research seems to establish the fact that such is the case. The fact that fluids injected into the arteries pass into the veins without extravasation, and that currents cross above and below each other without mixing, have been adduced as arguments for the existence of membranous walls. Besides which, Windischmann has dissolved away the other tissues in a delicate membrane found in the ear of birds, leaving the beautiful vascular network, with the meshes empty. Schwann has also discovered by the microscope, that the capillaries have not merely membranous parietes, but a coat in which circular fibres can be distinguished as in the arteries.

The capillary circulation seems to be in a great degree independent of the heart's action, since it has been seen to continue in cold-blooded animals after complete excision of the heart. The emptiness of the arterial system after death, although partly owing to the *tonicity* of the arteries themselves, is commonly more complete than could be thus accounted for, and must therefore be partly due to the capillary circulation. Farther, the process of secretion has also



been seen to continue after death, which could not take place unless the capillary circulation were still continued. In the embryo, the blood circulates *before* the heart is formed; and instances are not wanting in which the heart is entirely absent during embryonic life, and yet the greater part of the organs were well developed. In the latter case the circulation must be due to capillary power. The local determination that takes place whenever the processes of nutrition and secretion are carried on, and the increased rapidity of the movement without corresponding increase of the heart's action, also go to support the idea of an independent capillary power.

These facts, and others to prove that the circulation in a part may be arrested, while the heart is still acting, and the vessels pervious, seem to be favourable to the support of the belief in the existence of such a power.

In regard to the *nature* of the power, it cannot be *mechanical*, since no movement of contraction or dilatation has ever been seen. The conditions under which the power in question uniformly operates, may be thus expressed:—"Whilst the injection of blood *into* the capillary vessels of every part of the system is due to the action of the heart, its rate of progress *through* those vessels is greatly modified by the degree of activity in the processes to which it should be normally subservient in them;—the current being rendered more rapid by an increase in their activity, and being stagnated by their depression or total cessation.

"Thus the capillaries seem to have a *distributive* power over the blood, regulating the local circulation independently of the heart's action, and in obedience to the necessities of each part."\*

The views of Prof. Draper in relation to the dependence of the circulation of the sap in plants upon chemical changes in the circulating fluid, assist to explain very satisfactorily the capillary circulation in animals. A brief and modified summary of these views is here given. Experiments on inorganic bodies show, that if two liquids communicate with each other through a capillary tube, for the walls of which they have an unequal affinity, the liquid which has the greater affinity will be absorbed most energetically, and drive the other before it. This is what seems to take place in the organized tissues, permeated by nutritious fluid. The particles of this fluid, and the solid matter through which it is distributed, have a certain affinity for each other, which is exercised in the nutritive changes, to which the fluid becomes subservient during the course of its circulation. Certain matters are drawn from it in one part to carry on the nutritive process; in another, to accomplish the function of secretion. The fluid, which has given up to one tissue some of its materials, has no longer the same affinity for that tissue; it is

\* Carpenter's Princip. p. 564.

consequently driven from it by the superior attraction then possessed by the tissue for another portion of the fluid containing the required ingredients ; this in its turn is rejected for a fresh supply.

But the fluid, thus repelled from one part, may still be attracted towards another ; because that portion of its contents which the latter requires may not yet have been abstracted ; and thus the flow of the blood is maintained through the capillary network until it is altogether exhausted of its nutritive matter.

Although the circulation is not *dependent* upon nervous power, its influence is nevertheless manifest, as is occasionally seen in the functions of nutrition and secretion, by the control it exerts over the diameter of the blood-vessels. The phenomena of blushing, pallor, and the erection of certain tissues, are also examples of a modified condition of the blood-vessels through the agency of this system.

The *venous system* arises in the small trunks formed by the union of the capillaries ; and it returns the blood to the heart. These vessels are possessed of the same number of coats and the same properties as the arteries, only not so strongly developed. The internal membrane is thrown into valves or folds to prevent the reflux of the blood. The *capacity* of the venous system is said to be considerably greater than the arterial, holding two or three times as much blood as the latter.

The venous circulation is mainly due to *vis à tergo* ; it is assisted, however, by a *vis à fronte*, in the *suction power* of the heart. The *inspiration of venous blood* is also said to assist it. By this is meant the rush of blood towards the chest, in order to supply the vacuum created there by the descent of the diaphragm. That it has some influence is seen in the partial emptying of the veins in inspiration, and their turgidity in expiration. But that it can have no *general* influence over the venous circulation, will perhaps be seen from the fact that the pulmonary circulation, being entirely within the chest, cannot be affected by atmospheric pressure, and also that the circulation of the *fœtus in utero* cannot be affected by any such agency.

*Muscular movements* are among the most important adjuvants to the venous circulation, every contraction being accompanied by a pressure upon the veins of the part ; and as the blood is prevented by the valves from flowing back into the small vessels, it must be driven on towards the heart. This is familiarly seen in bloodletting, every movement of the hand increasing the flow of blood from the orifice.

A few of the peculiarities of the circulation may be mentioned in conclusion. These are first, in the *pulmonary circulation*, in which *venous* blood is sent from the heart, and through a tube which is *arterial* in its structure ; whilst *arterial* blood is delivered to the heart through several venous trunks.

The *portal circulation* is also peculiar in its arrangements, the

venous blood ramifying through vessels disposed like arteries, and having to overcome the resistance of an additional capillary system in the liver, before reaching the heart.

The *erectile tissues* appear essentially to consist of a plexus of varicose veins, enclosed in a fibrous envelope, which plexus, according to Gerber, is traversed by numerous contractile fibres, to the contraction of which is probably to be attributed that obstruction to the return of blood by the veins, which is the occasion of their turgescence. In the penis, according to Muller, there are two sets of arteries, one destined for the nutrition of the organ, the other, by communicating with venous cells, for its erection. In all the erectile tissues, erection may ensue either from local irritation, or as a result of certain emotional conditions of the mind, the influence of which is probably transmitted through the sympathetic nerve.

#### NUTRITION.

According to the definition of Adelon, nutrition is the action by which every part of the body, on the one hand, appropriates or assimilates to itself a portion of the blood distributed to it, and, on the other hand, yields to the absorbing vessels a portion of the materials that previously composed it. The process of nutrition is not an object of microscopic observation; the precise mode, therefore, in which it is accomplished is not accurately known. The *source of all nutrition and of all growth is the blood*, from which materials are shed or separated, to be employed in the renovation and reparation of the tissues. This is obviously only to be accomplished by the parenchyma selecting from the capillaries and intermediate vessels those ingredients that can become inservient to this process. The structure composing every separate portion of the body has, what may be called, an *elective affinity* for some particular constituents of the blood; causing it to abstract from that fluid, and to convert into its own substance, certain of its elements. This *selecting power*, possessed by the component cells of every tissue, is exercised not only upon the materials required for their development, but even upon substances abnormally present in the blood; thus, arsenic will produce irritation of the mucous membranes of the body; and the continued introduction of lead into the circulating system modifies the nutrition of the extensor muscles of the fore-arm, producing the phenomena of *lead palsy*; the existence of this modification is proved by chemical analysis, which reveals the existence of lead in the palsied muscles. Substances thus introduced into the blood affect the symmetrical portions of the body; thus the extensor muscles in *both* arms are paralysed; and the cutaneous eruptions produced by the internal exhibition of certain remedies, are found to be almost precisely symmetrical; the presence of the medicine in the blood

being the occasion of a disordered nutrition of certain parts of the skin; and the selecting power of particular spots being evinced by the exact correspondence of the parts affected on the two sides.

In the process of nutrition is exemplified the fundamental principle of organic assimilation. Each elementary particle of an organ attracts similar particles from the blood; and by the changes it produces in them, causes them to participate in the *vital principle* of the organ itself. Nutrition does not consist merely in the component particles of the organs attracting the fibrin, albumen, and other materials of the blood which flow through them, adding to themselves the matters similar to their own proximate principles, and changing the composition of those which are dissimilar; but the assimilating particles must infuse into those newly added to them their own vital properties. Mere increased size is not nutrition; parts may be increased in size by the deposition of fibrin, as in inflammation, but this fibrine is unassimilated, and not endowed with the vital properties of the tissue in which it is deposited, and in this consists the difference between increased nutrition and increased size. It was said that the source of all nutrition was the blood: a short account of this fluid may be necessary here. The *chyle* and the *lymph*, which are also generally considered as nutritive fluids, have been already described under the head of absorption.

The blood, whilst circulating in the living vessels, consists of two parts,—a thin, transparent, nearly colourless liquid, termed *liquor sanguinis*; and a number of small bodies called the *red corpuscles*, from which the colour of the blood of vertebrated animals derives its peculiar hue; in addition to which are found some *white*, or *colourless* corpuscles.

When the blood has been drawn from the body and allowed to stand, a spontaneous coagulation takes place, dividing it into *crassamentum* and *serum*. The crassamentum, or clot, is formed by the union of the fibrine and red corpuscles, by the entanglement of the latter in the meshes of the former. Whilst the serum is merely the liquor sanguinis deprived of its fibrine. From the fact that the serum coagulates by the addition of heat we know that it contains albumen; by exposure to a high temperature, the animal matter is decomposed, and a considerable quantity of earthy and alkaline salts remain.

The distribution of these constituents in living and dead blood may be seen in the following table.

Living Blood.	<table> <tbody> <tr> <td>{</td> <td>Fibrine,</td> <td rowspan="3">} In solution, forming Liquor Sanguinis.</td> </tr> <tr> <td>{</td> <td>Albumen,</td> </tr> <tr> <td>{</td> <td>Salts.</td> </tr> <tr> <td></td> <td>Corpuscles.—</td> <td>Suspended in Liquor Sanguinis.</td> </tr> </tbody> </table>	{	Fibrine,	} In solution, forming Liquor Sanguinis.	{	Albumen,	{	Salts.		Corpuscles.—	Suspended in Liquor Sanguinis.
{	Fibrine,	} In solution, forming Liquor Sanguinis.									
{	Albumen,										
{	Salts.										
	Corpuscles.—	Suspended in Liquor Sanguinis.									
Dead Blood.	<table> <tbody> <tr> <td>{</td> <td>Fibrine,</td> <td rowspan="2">} Crassamentum, or clot.</td> </tr> <tr> <td>{</td> <td>Corpuscles.</td> </tr> <tr> <td></td> <td>Albumen,</td> <td rowspan="2">} In solution, forming serum.</td> </tr> <tr> <td></td> <td>Salts.</td> </tr> </tbody> </table>	{	Fibrine,	} Crassamentum, or clot.	{	Corpuscles.		Albumen,	} In solution, forming serum.		Salts.
{	Fibrine,	} Crassamentum, or clot.									
{	Corpuscles.										
	Albumen,	} In solution, forming serum.									
	Salts.										

The mean proportion of these different ingredients in a thousand parts of blood may be thus stated: *Fibrine*, 3 parts; *Albumen*, 80 parts; *Red Corpuscles*, 127 parts; *Water and Salts*, 790 parts. These proportions are subject to considerable variations within the limits of health. There is also a small amount of fatty matters and extractive. The following is the analysis of Simon made upon the blood of males: *Water*, 791·9; *Fibrine*, 2·0; *Corpuscles*, 114·3; *Albumen*, 75·6; *Extractive Matters and Salts*, 14·2; *Fatty Matters*, 2·0. There is a greater amount of solid matter in the blood of the male than of the female, except in the case of *albumen*, which is in larger quantity in the female.

Each of the prominent constituents of the blood has been already described in the earlier pages of these divisions, to which the reader is referred.

When the blood is examined shortly after a meal the serum is found to present a milky appearance. According to Drs. Buchanan and R. D. Thompson this appearance is due to the admixture of the *chyle*. The period at which the discoloration is greatest, however, and the length of time during which it continues, vary according to the kind and quality of the food, and the state of the digestive functions. The milkiness seems to be entirely due to the presence of oleaginous matter in the food. The crassamentum of such blood often exhibits a pellucid fibrinous crust, sometimes interspersed with white dots; and this seems to consist of an imperfectly assimilated proteine compound, analagous to that found in the serum. A small quantity of sugar is occasionally found, even in healthy blood, when large quantities of it are taken as food. But commonly it is transformed into lactic acid, or into fatty matter, before it is received into the circulating current.

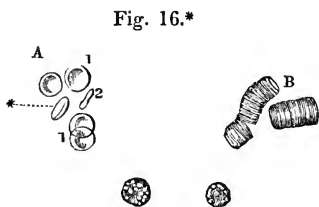
By some high authorities the coagulation of the blood is looked upon as a mere physical process, dependent upon the exposure of the fluid to the air, precisely as some chemical substances are known to solidify under similar circumstances; and the long delay of the coagulation after death is mentioned as confirmatory. By others it is contended that the coagulation is the last act of vitality of the blood, which is evident from the incipient organization which may be detected even in an ordinary clot; and still more from the fact, that if the effusion of fibrine take place upon a living surface, its coagulation in the first act of its conversion into solid tissues possessing a high degree of vitality. If not within the influence of a living surface, it soon passes into a state of decomposition.

The rapidity of the coagulation depends very much upon the circumstances in which the blood is placed. It is accelerated by moderate heat, and retarded, though not prevented by cold. The blood that flows *last* from a vessel coagulates more rapidly, but less firmly, than that first drawn; and in inflammatory blood, in which the fibrine is increased, coagulation is unusually slow.

In certain disordered conditions of the blood the surface of the clot is not unfrequently covered with a layer of fibrine nearly free from colour, and known as the *buffy coat*. This is commonly looked upon as positive evidence of the existence of inflammation. Such is not really the case, however, since it is seen in very opposite conditions of the system, as in chlorosis. In inflammation the amount of fibrine is really increased, and the coagulation of the blood is much retarded. This allows the corpuscles time to sink to the bottom, leaving the upper part of the clot composed of fibrine alone, which is nearly destitute of colour and very tenacious in its character, while the lower part obtains its deep red colour from the presence of the red particles. The layer of fibrine in its slow coagulation undergoes contraction of its edges, thus giving rise to the cupped appearance of inflammatory blood. The buffy coat is also seen in the blood of pregnant females; and also in that of chlorotic patients, in whom the fibrine is *relatively* in excess over the red corpuscles.

In idiopathic fever the amount of fibrine is lessened; should inflammation supervene, however, the fibrine is increased. The increase here is not due to the febrile condition, but to the local inflammation, which, according to Andral, is always accompanied by an increment in the amount of fibrine.

The corpuscles of the blood, in coagulating, apply themselves to each other so as to resemble piles of money. It is said that in inflammatory blood they are more closely applied, and the areolæ between the piles are larger than in healthy blood. Fig. 16 represents this arrangement, and the shape of the corpuscles.



The *materials* of the nutritive process being prepared in the blood, every tissue and every organ attracts from it particles similar to itself, or metamorphoses the proximate principles of the blood into its own elements. The blood is distributed to the tissues by the capillary system of vessels, with a degree of minuteness

varying with the activity of the nutritive operations taking place in the individual parts. It is in the capillary system that all nutrition takes place, the plastic material being selected, as before described, by the component cells of the tissue to be nourished.

The mode in which the tissues are developed by cells, has already been explained. It was then shown that in the production of any

\* A. Blood-corpuscles seen on their flat surface, and edge. B. Congeries of blood-corpuscles in columns.

given form of tissue, nature does not at once unite the organic molecules in that form, but that she first creates in a structureless fluid, or in previously existing cells by a definite process, round vesicles or cells, and subsequently transforms these into the various elements of the organic textures.

The process of nutrition varies greatly according to age, constitution, idiosyncrasy, state of health, &c. It is most rapid in youth, during the growth of the body; it is greatly less in old age; but differs widely with reference to particular organs. Morbid conditions, excessive bodily and mental efforts, the depressing emotions, such as care and sorrow, are all incompatible with perfect and powerful nutrition, and induce wasting of the several organs. As a general rule it may be stated, that the greater the demand for the functional activity of the organ or tissue, the more energetic is its nutrition, and *vice versâ*. Whenever the amount of nutritive material deposited in a tissue or organ is more than sufficient to supply the waste, the part becomes *hypertrophied* or *over-nourished*. The term hypertrophy signifies *excessive nutrition*. It differs from healthy nutrition only in degree. It consists in the augmentation of one or more of the natural constituents of an organ, in such a manner that the newly formed parts are continuous with those already existing, and cannot be anatomically distinguished from them. Hypertrophy is never known to affect the *whole* body, to a degree sufficient to constitute disease. But examples of hypertrophy of particular organs or tissues are very common. *Atrophy*, or diminished nutrition, is exactly the reverse of the condition just described, but is more generally a morbid operation, and may affect either the whole body or individual parts. It takes place whenever the waste of the tissues is more rapid than their replacement by nutrition.

The nutritive operations, by which lost parts are repaired, take place with great activity. In its most perfect form, this process is analogous to that of the first development of the corresponding parts, and its results are as complete in the one case as in the other.

The reparative process was formerly thought to depend on the existence of inflammation; it can be shown, however, that in the majority of instances inflammation is injurious rather than beneficial.

“That the powers of reparation and reproduction are in proportion to the indisposition or incapacity for inflammation; that inflammation is so far from being necessary for the reparation of parts, that in proportion as it exists, the latter is impeded, retarded, or prevented; that, when inflammation does not exist, the reparative power is equal to the original tendency to produce and maintain organic form and structure; and that it then becomes a natural function, like the growth of the individual, or the reproduction of the species.”\*

\* Treatise on Inflammation, p. 7, by Dr. Macartney.

The continual death, or destruction of the individual cells which enter into the composition of the organs or tissues, constitutes what is called, *molecular death*, to distinguish it from *somatic death*, or the death of the *whole body*, which follows upon the cessation of the respiratory and circulatory functions. Molecular death, however, is not always an immediate result of somatic death, since it is known that the lives of individual parts may be prolonged after the suspension of the regular series of their combined operations; so on the other hand, molecular death may take place to a considerable extent, if the function of the part have no immediate relation to the indispensable actions just alluded to, without somatic death necessarily resulting.

There is no valid reason for believing that the processes of nutrition are *dependent* upon nervous influence, although, as before stated, it is known that they may be influenced by it. These processes go on with great regularity and rapidity in the vegetable kingdom, in which nothing approaching to a nervous system exists; and in the animal kingdom they take place long before any nervous system begins to be developed; the conversion of the primary cells into muscular tissue, bone, and mucous membrane takes place in virtue of the inherent properties of the primary tissue itself, since no nervous influence can be supposed to operate, before nerves are called into existence.

#### SECRETION.

Nearly allied to the function last considered (nutrition) is that of *secretion*, which means literally *separation*. In both certain materials are separated from the blood; in nutrition the object of the separation is to build up the living body; in secretion, to get rid of certain useless substances, or to supply certain other combinations that may either directly or indirectly be essential to the economy.

The essential character of the true secreting process seems to consist not so much in the nature of the action itself, for this is identical with that of nutrition, both being effected by a process of cell-growth, but in the position in which the cells are developed, and the manner in which their products are disposed of. In secretion the product of the action of the cells is delivered upon a free surface, communicating, more or less directly, with an external outlet, or into cavities provided with orifices that lead to them.

The organs by which the latter operations are effected, are called *secreting organs*, and the matters separated are spoken of as *secreted fluids*, or simply as *secretions*.

A distinction has been made between those secretions that are produced with an ulterior view as means to other functions in the economy, such as the saliva, gastric juice, &c., and those that are immediately rejected from the organism, as useless, as for example,



the urine, &c. The first are regarded more peculiarly as *secretions*; the latter, as *excretions*.

Of the reason why one organ should separate bile, another milk, and another sperm, no other account can be given than that which refers them to the special endowments of the *cells*, the real instruments in the process. That the particular modification of structure which the organ may present, has no essential connexion with the character of the secretion is evident, from the fact that almost every gland may be found under a variety of forms in different parts of the animal series; and for every gland there is a part of the animal scale below which it does not exist, and when it makes its first appearance it almost always presents a character nearly as simple, as that of the least complex glandular structures in the higher orders.

The *simplest form of secreting organ* is that of the simple *animal membrane*, well supplied with blood-vessels and covered with an epithelium; of such a membrane we have an example in the serous and synovial membranes. The next is that of the *follicle*, a depression, or inversion of the animal membrane, lined with epithelium cells, and abundantly supplied with blood-vessels from which are elaborated their peculiar secretions. (Figure 13, page 56, already referred to.) The *third and last* form of secreting organs is the *gland*, which is nothing but an aggregation of follicles, closely packed together, so as to present a large secreting surface in as small a bulk as possible. In some glands the sacs or follicles, are prolonged into *cæca*, or blind tubes, as in the kidney and testis; these are called *tubular glands*; or else they are very greatly multiplied, and clustered together (like currants on a stalk) upon efferent ducts common to several of them. (Fig. 17.)

In all secreting organs the important agents are the *cells* which are developed upon the lining membrane of the follicles and tubes, and which select and elaborate the materials from the blood and discharge their contents into the excretory duct. These cells are being constantly cast off and replaced by a new growth, having their origin in the basement membrane of the mucous membrane which lines the ducts or follicles.

The simplest condition of a secreting cell in the animal body is that of the adipose tissue, every cell of which has the power of selecting its materials from the blood. The contents of these, however, are not discharged, but remain stored as a reservoir in time of need. The *adipose tissue* has already been described.

There is a difference between the processes of *secretion* and *exhalation*; the former is a *vital* process, the latter a *physical*. Wherever a fluid requires to be elaborated, it is done by a process of secretion, and the agents are *cells*; but where no such process is necessary,

Fig. 17.



the fluid pre-existing in the blood, it soaks out by the physical process of exosmose.

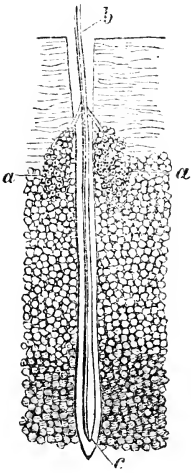
The *exhalations* do not require much notice after what has been said of their mode of separation. Under this head are included those from *serous* and *synovial membranes*, which are destined to lubricate them; the fluid of the *areolar tissue*, giving softness and suppleness to that tissue; the watery exhalations from the *skin* and *mucous membranes*, a mere physical evaporation; and the exhalation of the *aqueous* and *vitreous* humours of the eye, two of its transmitting and refracting media.

The *follicular secretions* are divided into two classes, the *mucous* and *cutaneous*. In the first division, besides the ordinary follicles which secrete the lubricating mucus, and which are seen generally existing in mucous membranes, there are included the numerous glandulæ of the intestinal canal. In the *stomach* are the simple and compound *gastric follicles*, opening into little pits or depressions in the mucous membrane; these follicles secrete the *gastric juice*. In the *duodenum* are the *glands of Brunner*, seated in the *sub-mucous* tissue; these consist of numerous minute lobules, with a common excretory duct. The nature of their secretion is unknown. In the *jejunum*, and more particularly in the *ilium*, are the agminated *glands of Peyer*, which consist of a cavity covered over with an extremely thin membrane, and having no excretory duct; their secretion probably escapes through the medium of cells developed in this membrane. These glands or follicles are supposed to secrete the putrescent elements of the *fæces*. Throughout the whole intestinal tract, especially in the small intestines, are found the follicles of Lieberkühn, which secrete the thick, tenacious mucus to lubricate these parts. In the *cæcum* and lower part of the rectum, are a number of simple and large follicles, producing slight elevations on the surface of the mucous membrane. These are always most abundant where most mucus is required. The glands of Duvergnny and Nabothi, in the vagina and cervix uteri are also lubricating mucous follicles: as are also the glands of Cowper, and the prostate in the male. The *tonsil glands* are considered by some anatomists and physiologists as composed of numerous mucous follicles having the same function, viz., to lubricate the parts on which they are placed.

The *cutaneous follicular secretions* include the *meibomian*, *ceruminous*, *sebaceous*, and *sudoriferous*. The *meibomian follicles* are seated in the substance of the tarsal cartilage, and secrete a gummy fluid to lubricate the edges of the lids. The *ceruminous*, are seated beneath the skin of the auditory meatus, and consist of a tube convoluted upon itself. They secrete a resinous substance, nearly solid, and intended to lubricate the external meatus. The *sebaceous* matter of the skin is secreted by innumerable minute, branched follicles opening by a narrow orifice. These sebaceous glands generally open into the follicles of the hairs. By these an adipose secretion

is poured out upon the skin destined to protect it from the action of the sun and air. They are sometimes the seat of a minute parasite called the *demodex folliculorum*.

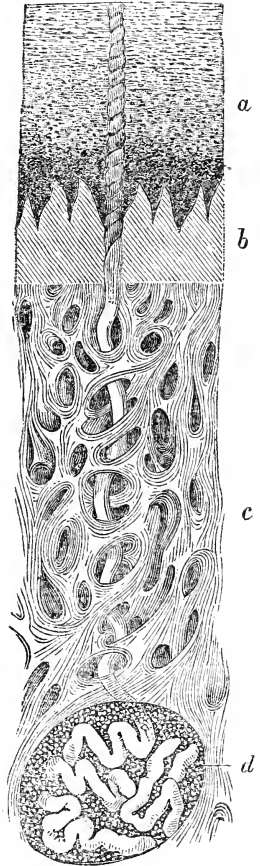
Fig. 18.\*



The *perspiration* is formed by small tubes of peculiar conformation, very much convoluted, and seated just beneath the cutis vera, and pouring out their secretion by minute pores upon the epidermis. The ducts pass through the epidermis and cutis vera in a spiral direction, and their openings upon the epidermis, which are seen along the elevated lines of the skin of the palm and sole, are called *pores*. (Fig. 19.) According to Mr. E. Wilson, the number of these sweat glands in the whole surface of the body is about *seven millions*, and the conjoined length of the perspiratory tube *28 miles*.

The secretion from these glands is continually taking place, but as it is usually evaporated as fast as it is formed it does not become *sensible*. If, however, from excessive secretion, or a moist condi-

Fig. 19.†



\* Fig. 18. *a a*, Sebaceous follicles. *b*, A hair with its follicle *c*, surrounded by fat cells.

† Fig. 19. *a*, Epidermis. *b*, Upper layer of cutis vera. *c*, Cutis vera. *d*, Sweat gland surrounded by fat cells, with its duct running spirally through the layers of the skin.

tion of the atmosphere, it is not carried off as fast as formed, it accumulates upon the surface, constituting the *sensible* perspiration. It has usually an acid reaction, which is due to the presence either of acetic or lactic acid. It contains also a small amount of animal matter, and some salts, principally *chlorides*.

The entire amount of fluid insensibly lost from the cutaneous and pulmonary surface is estimated at 18 grs. per minute; of these 11 pass off by the skin, the remainder by the lungs. The maximum loss from both sources during 24 hours is equal to about 5 lbs., the minimum  $1\frac{2}{3}$  lb.

The perspiratory secretion is *depuratory* and vicarious with that of the kidney, both separating the superfluous azotized matters. The amount of solid matter thrown off from the skin in 24 hours is about 100 grains. The amount of fluid thrown off is influenced greatly by external temperature, being greatest when it is elevated, the object of which increase is to keep down the temperature of the body by *evaporation*. It is also influenced by general conditions of the vascular and nervous system, though the manner is not yet well understood.

A peculiar glandule, resembling the sudoriferous, but larger, has lately been described as existing in the axillæ; these are called the *odoriferous* or *miliary*, and probably serve to secrete the characteristic odour of those parts. The odorous principle may be detected in blood which has been dried, by treating it with sulphuric acid: and it is said to differ so much in different animals as to afford a test by which their blood can be recognised. It has even been said that the blood of the female can by this means be distinguished from that of the male.

#### GLANDULAR SECRETIONS.

The *lachrymal secretion* is formed by the gland of that name, whose seat and structure are described in the *anatomical* division. It is one of the *granular* glands, and pours its secretion upon the surface of the conjunctiva to cleanse and lubricate. The lachrymal fluid resembles dilute serum deprived of a great part of its albumen. It is a constant secretion, and is absorbed by the open orifices of the nasal ducts, and carried into the nose as fast as it is poured out. The cause of this absorption is probably capillary attraction, assisted by the syphon-like action of the nasal duct. This secretion is greatly influenced by the emotions.

The *salivary secretion* is formed by the *Parotids*, *Submaxillaries*, *Sublinguals*, and *Pancreas*, the latter is sometimes called the *abdominal* salivary gland. These glands also come under the division of the granular glands, being composed of aggregated follicles, discharging into an excretory duct.

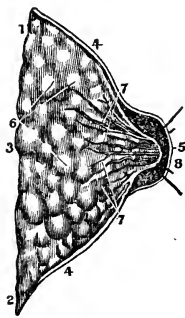
The salivary secretion is not necessarily constant, it takes place during the movements of mastication, and when any irritant is taken into the mouth. It is alkaline in its reaction, and contains among other ingredients, a peculiar animal principle, analogous to pepsine, called *ptyaline*, which seems to act as a ferment, since by it starch may be converted into sugar, and sugar into lactic acid. A considerable proportion of saline and earthy matter exists in the solid residue of the saliva; this is nearly the same as that the blood contains. The tartar of the teeth consists principally of one of these, the earthy phosphates, held together by a little animal matter. If the alkalinity of the saliva be destroyed, it loses its converting power on starch; and if acidulated, it has a solvent power for caseine, animal flesh, and other albuminous substances. The specific gravity varies from 1.006 to 1.009. The *quantity* secreted during 24 hours has been estimated at about 15 or 20 ounces. The *pancreatic secretion* contains a larger proportion of solid matter than the saliva.

The *Mammary Secretion* is peculiar to the *mammalia*, and is one of those which are destined for special uses in the economy. The *gland* is found in both sexes, and presents but little difference in them till the period of puberty. It consists of numerous lobules held together by areolar tissue. Each lobule consists of a series of ducts passing inwards from their termination in the nipple, and then ramifying like the roots of a tree, their ultimate subdivisions terminating in minute follicles. The mammillary tubes are ten or twelve in number; they are straight ducts terminating in the nipple, and having a slight dilatation just before their termination, which acts as a reservoir to receive the secreted milk. The secretion, as in the other glands, takes place in the ultimate follicles, by means of cells, which discharge themselves into the ducts. (Fig. 20.)

The mammary gland of the male is a miniature of that of the female, but it does not undergo any marked increase in size at any particular period, its evolution going on *pari passu* with that of the body. There are some instances on record (one by Dr. Dunglison,) of its secreting milk; in Dr. Dunglison's case, the secretion was induced by the individual applying the children entrusted to his care, to the breasts during the night.

The milk consists of water holding in solution sugar, various saline ingredients, and a peculiar albuminous substance called *caseine*, and having oleaginous particles suspended in it. By allowing the milk to stand, the oil-globules will come

Fig. 20.\*



\* A vertical section of the Mammary Gland, showing its thickness and the origins of the lactiferous ducts; 1, 2, 3, its pectoral surface; 4, section of the skin on the surface of the gland; 5, the thin skin covering the nipple; 6, the lobules and lobes composing the gland; 7, the lactiferous tubes coming from the lobules; 8, the same tubes collected in the nipple.

to the top, constituting the *cream*; this includes also a considerable amount of caseine, with the sugar and salts of the milk. By agitating the cream the envelopes of the oil-globules are ruptured, and it is separated into *butter* and *butter-milk*, the latter containing the *caseine*, *sugar*, &c. A small quantity of caseine, however, is generally entangled with the butter, which has a tendency to render it rancid, and should be removed by heat.

After the removal of the cream the milk still contains the greatest part of the caseine and sugar; if kept long enough the sugar is converted into *lactic acid*, which coagulates the caseine, precipitating it in small flakes. The same precipitation may be accomplished by other acids; the most effectual is that contained in the *rennet*, or dried calf's stomach, the active principle of which will coagulate 30,000 times its weight of milk. The sugar may be obtained by evaporating the whey.

The proportion of the solid ingredients of the milk is about 110 parts in 1000, varying according to constitution, the amount and character of ingesta, and the time which has elapsed since parturition.

The first milk is called the *Protogala*, or *Colostrum*, and has a purgative effect upon the child, owing to the presence in it of numerous yellow granulated corpuscles, called colostrum corpuscles. This property soon disappears, however, though occasionally it returns after the expiration of twelve months, seeming to indicate that the flow should be no longer encouraged.

Human milk contains more sugar and less caseine than that of the cow, a fact to be remembered in substituting the latter for the former. The milk of carnivorous animals, fed exclusively on animal diet, contains scarcely a trace of sugar, while the caseine and butter are abundant.

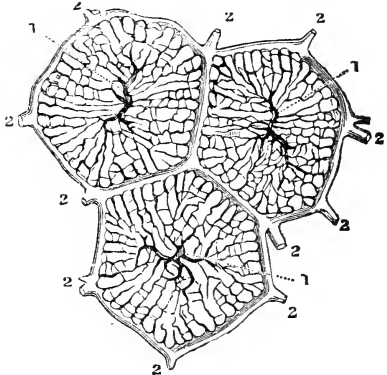
The quantity of milk that can be squeezed from either breast at one time is about two ounces. It is not always the largest breasts that secrete most milk, since their great size is often owing to the presence of adipose matter. The secretion is often materially affected by emotions, &c., so as to become poisonous to the child; and it is often rendered medicinal by substances administered to the mother.

The instances of vicarious secretion of milk are not numerous; and in no instance is there any proof that the elements of the fluid were pre-existent in the blood. The secretion sometimes occurs in undoubted virgins, widows, and women past the child-bearing period, as well as in males.

*Secretion of Bile.*—The *Liver* is perhaps more universally present throughout the animal scale than any other gland. It is the largest gland in the body, weighing from three to four pounds. The entire organ is made up of a vast number of minute *lobules*, of irregular form, of about the average size of a millet seed. Each of these

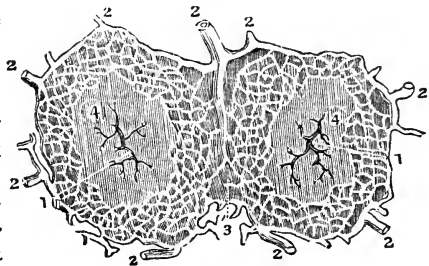
lobules is a miniature gland, containing all the component elements of which the gland is made up, viz.: branches of the hepatic artery and vein, branches of the portal vein, branches of the hepatic ducts and secreting cells. These lobules are connected together by means of areolar tissue and anastomoses of blood-vessels. The *hepatic artery* is distributed in a capillary form upon the walls of the hepatic ducts, and upon the trunks and branches of the portal and hepatic veins; it is therefore probably destined for the nutrition of the organ and not to supply materials for the biliary secretion, at least until it has become venous by traversing the capillary system. From the capillary network the blood passes into branches of the portal vein, and thence into the hepatic veins; for when fine injection was thrown by Mr. Kiernan into the hepatic artery, the portal veins became filled, but not the hepatic.

Fig. 21.\*



The *vena portæ* ramifies in a capillary form *between* the lobules, and hence is called the *interlobular vein*, sending capillary twigs inwards, which converge towards the centre of the lobule, to form the *hepatic* or *intra-lobular vein*. (Fig. 21.) These latter terminate in the larger trunks, which pass along the bases of the lobules, collecting from them their venous blood; these are called by Mr. Kiernan *sublobular veins*. The main trunk of the hepatic vein terminates in the ascending vena cava. The *hepatic ducts* also form a plexus, which surrounds

Fig. 22.†



\* Horizontal section of three superficial lobules, showing the two principal systems of blood-vessels; 1, 1, intra-lobular veins, proceeding from the hepatic veins; 2, 2, interlobular plexus, formed by branches of the portal veins.

† Horizontal section of two superficial lobules, showing the interlobular plexus of biliary ducts; 1, 1, intra-lobular veins; 2, 2, trunks of biliary ducts, proceeding from the plexus which traverses the lobules; 3, interlobular tissue; 4, parenchyma of the lobules.

the lobules, connecting them together, and sending branches towards the interior of each. Their mode of termination, and their relation to the *hepatic cells* forming the parenchyma of the gland, are as yet unexplained. These *cells* of the liver, which are the real agents in the secreting process, are of a flattened spheroidal form, lying in piles, which seem to be directed from the circumference to the centre of each lobule. Their diameter is from 1-1500th to 1-2000th of an inch; they have a distinct nucleus, and a well-marked biliary tinge, and contain a granular amorphous matter with a few small adipose granules. They are easily obtained in a separate condition by scraping a piece of fresh liver.

The secretion of bile is probably a constant operation, although it may vary in quantity at different times. It may be discharged at once into the intestine, or it may regurgitate into the gall-bladder, as it probably does when the intestine is empty and there is no stimulus there to provoke the flow. In the gall-bladder the bile undergoes a concentration by the absorption of its watery parts; it is also mixed with the mucus secreted from its walls.

The chemical composition of the bile is unsettled. It is of a yellowish green colour, viscid, and slightly bitter. It combines readily with water, mixes freely with oil or fat; and foams, when stirred, like soapy water. The proportion of solid matter is usually from 9 to 12 per cent; nearly the whole of this consists of substances peculiar to the bile.

Three distinct substances are found in the biliary matter:—*Cholesterine*, or bile fat, resembling spermaceti, and consisting principally of carbon and hydrogen. *Bilic acid*, a compound of soda with a peculiar organic body, now regarded in the light of a fatty acid, and described by some chemists as choleic acid, bilin, picromel, &c., and a colouring matter called *biliverdin*, a substance identical with the chlorophyl of plants. In addition to these the bile contains some earthy salts.

*Uses of the bile.*—A portion unquestionably passes off with the fæces; this, which includes the colouring matter, is that which would be injurious if retained in the blood, and is probably *excrementitious*. The *soapy portion* seems to act by rendering the fatty matters soluble, and thus enabling them to be absorbed by the lacteals. The importance of the bile, (probably the soapy portion of it,) has been shown by Schwann, who prevented it from passing into the intestine, and found that the animals wasted, and at last died in a state of emaciation. The bile may also perform another function, as before stated,—the transformation of sugar into fatty matter. It is not improbable that this change may take place in the liver; since in animals fed upon grape sugar, this substance has been found in the *portal vein* but not in the hepatic. The fatty matter of the bile, when reabsorbed with that of the newly ingested food, is probably



carried off in the respiratory process, to assist in the calorifying function. The bile, therefore, seems to be partly excrementitious, partly recrementitious.

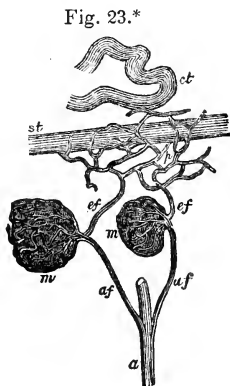
The *sources* of the bile may be found in the disintegration of the *fibrinous* and *nervous* tissues when the amount of food is just sufficient to supply the waste of the system, the liver removing such products as are rich in carbon and hydrogen; and in any excess in the non-azotised compounds derived from the food, beyond the amount that is requisite for the supply of the respiratory process, or that can be deposited as fat. In this elimination of hydro-carbon the liver is subsidiary to the lungs. In the fœtus it is the great decarbonizing agent.

In regard to the *kind of blood* from which the bile is secreted, analogy would point to the hepatic artery, although the experiments of Kiernan seem to fix it upon that of the vena portæ. Both have their supporters. Those who embrace the supposition of the secretion from the *hepatic artery*, assign to the vena portæ the office of mixing thoroughly with the blood heterogeneous substances absorbed from the stomach and intestines, before transmitting them to the heart. Those who contend for the secretion from the vena portæ assign to the hepatic artery the office of nourishing the liver, which from its small size, in comparison with the vena portæ, seems more justly to be its function.

*Secretion of urine.*—This secretion is purely *excrementitious*, being destined to removed certain effete substances from the blood, whose retention would be positively injurious. As it is the function of the liver to remove the superfluous carbon, so it is of the kidney to get rid of the excess of nitrogen in the blood.

The kidney is a *tubular* gland, being formed of uriniferous tubes, both convoluted and straight, the convoluted being found in the cortical portion, the straight in the medullary. The cortical portion is the most vascular, and it is probably the seat of the greater part of the secreting process, whilst the medullary is concerned in carrying the secreted matter; the two parts being in this respect analogous to the cortical and medullary portions of the brain.

In the cortical portion of the kidney are seen a number of small dark points, called corpora malpighiana; each of these is composed of a mass of minute blood-vessels very



\* Distribution of the renal vessels; from kidney of horse; *a*, branch of renal artery, *af*, afferent vessel; *m, m*, Malpighian tufts; *ef, ef*, efferent vessels; *p*, vascular plexus surrounding the tube; *st*, straight tube; *ct*, convoluted tube. Magnified about 30 diam.

much convoluted upon themselves, like a ball of twine, into which a small afferent branch of the renal artery is seen to enter, and an efferent venous twig to emerge, the points of immergence and emergence being very near to each other. Each of these Malpighian corpuscles is included in a flask-like expansion of one of the tubuli uriniferi which is dilated to receive it. It is at *this* point, and from the *arterial blood* of the corpuscle, that the *watery* parts of the urine are separated by soaking through the walls of the blood-vessels and tubes, the blood being detained in the corpuscles for this purpose. The *venous twig* after leaving the corpuscle of Malpighi, becomes again capillary, and interlaces with the uriniferous tubes at another point; and at *this* point, and from *venous* blood, as in the vena portæ, the *solid* matters of the urine are separated by the agency of *cells* developed in the walls of the tube. (Fig. 23.)

It would thus seem that the function of the Malpighian corpuscles is to get rid of the superfluous water in the blood, which, from their peculiar arrangement, they are well calculated to do. In this respect they assist the skin, which is very liable to great variations in the amount of fluid it exhales from the temperature of the air around.

The quantity of *solid* matter eliminated by the kidney has no reference to the amount of water to be got rid of; being dependent upon the amount of *waste* in the system, and upon the quantity of surplus azotised aliment which has to be discharged through this channel.

The average quantity of urine voided in twenty-four hours, by adults who do not drink more than the wants of nature require, is from 30 to 40 oz. Its average specific gravity is 1020. The amount voided is less in summer than in winter, on account of the large exhalations from the skin in the former season. The quantity of *solid matter* varies in health from 3·6 to 6·7 per cent. About one-third of the solid matter is made up of alkaline and earthy salts; the rest consists of organic compounds.

The urine in health usually presents an *acid* reaction; this depends, however, upon certain conditions furnished by the aliment, and may be altered by a change in the ingesta.

The most important constituent of the solid matters is *urea*, a transparent crystalline substance, soluble in water, and combining with acids without neutralising them. In chemical composition it is identical with cyanate of ammonia, viz.: 2 carb., 2 ox., 2 nit., 4 hyd. The amount of urea excreted may serve as a measure of the *waste* of the system, especially of the muscular system. The average amount of urea is about 30 parts in 1000 of urine. The amount excreted by children is much greater in proportion to their bulk than in old men. This corresponds precisely with the rapidity of interstitial change at different periods of life.

*Uric* or *lithic* acid is another important ingredient. It exists in

larger proportions in the urine of the lower vertebrata than in mammalia, in whom there exists only about one part in a thousand of urine. It is crystalizable, tasteless, inodorous, and nearly insoluble in water. It exists in healthy urine in combination with a base, either ammonia or soda, which latter, according to Liebig, is derived from the bibasic phosphate of soda, which by yielding up a part of its base gives the acid reaction to the urine that characterizes its healthy state. Its affinity for the base, however, is so feeble, that it is readily thrown down by any other acid in the urine. According to Keller, uric acid is not replaced by *Hippuric* in the urine on the administration of Benzoic acid. The amount of uric acid is not dependent on *waste* or diet; but often on disease, as gout, in which it is often deposited from the blood, in combination with soda, around the affected joints, forming *chalky concretions*. The *urates* are commonly *red*. The presence of *lactic acid* as a constituent of healthy urine is denied by Liebig.

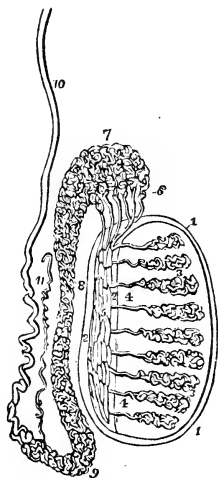
The urine contains also various saline matters, such as muriates, sulphates, and phosphates; the latter supposed to be derived from the waste of the nervous tissue, into whose composition phosphorus enters. The phosphates are commonly yellowish white in colour. The quantity of salts in the urine is never the same in the same individual in like spaces of time; the urine of men, however, generally contains a relatively larger portion of salts than that of women.

The total suspension of the urinary secretion is attended with rapidly fatal results, the patient dying with symptoms resembling those of narcotic poisoning.

Besides the essential constituents already mentioned, the urine often contains accidentally mixed substances, such as articles of food, of drink, or of medicine, which pass into it unchanged or changed, and can sometimes be detected in it in an inconceivably short time after administration.

The *spermatic secretion* is formed by the testes, another *tubular* gland consisting of lobules formed of convoluted seminiferous tubes. The number of lobules is about 450 in each testis, and that of tubules about 840. The different parts may be seen in Fig. 24. The diameter of the tubes is generally very uniform; they anastomose freely with each

Fig. 24.\*



\* A view of the minute structure of the testis; 1, 1, tunica albuginea; 2, 2, corpus high-morianum; 3, 3, tubuli seminiferi convoluted into lobules; 4, vasa recta; 5, rete testis; 6, vasa efferentia; 7, coni vasculosi constituting the globus major of the epididymis; 8, body of the epididymis; 9, its globus minor; 10, vas deferens; 1, vasculum aberrans or blind duct.

other without increasing in size. The testes originate in the lower part of the corpora woolfiana, in the embryo, while the kidneys spring from the upper and outer parts. They begin to descend into the scrotum about the middle of pregnancy; at the seventh month they reach the inner ring; in the eighth they enter the passage; and in the ninth they descend into the scrotum. Sometimes one or both remain in the abdomen, without, however, interfering with their function.

The sperm is a thick, tenacious, grayish fluid, having a peculiar odour called *spermatic*, probably dependent on the secretions mixed with it. It is difficult to analyze it in consequence of its admixture with the secretions of the prostate and Cowper's glands. It is alkaline in its reaction, and contains albumen and a peculiar principle called *spermatin*. The so-called spermatozoa are most probably cells of the ciliated epithelium of the mucous membrane lining the genito-urinary apparatus. They are supposed to correspond with the pollen tubes of plants, and are probably the agents by which the fecundating materials of the male are brought into contact with the elements supplied by the female. They seem to be essential to the reproductive process. The sperm also contains *seminal granules*, the mode of production of which corresponds with that of other glands. The salts that are found in the sperm are muriates and phosphates, especially the latter. The secretion takes place about the 14th or 15th year and continues till about 60 or 65, and during the whole of this time is much under the influence of the nervous system.

The *spleen*, *thymus* and *thyroid glands*, and *supra-renal capsules*, are called *glandiform ganglia*, sometimes *vascular glands*. They all act as diverticula to the circulation in their neighbourhood; the spleen to the portal circulation, the thymus to the lungs in fœtal life, the thyroid to the cerebral circulation, and the supra-renal capsules to the kidney. They all seem to share likewise in the preparation of the nutritive materials of the blood, assisting in this respect the lymphatic system, to which they seem to be appendages.

#### CALORIFICATION

Is that function by which the *heat* of organized beings is generated. The *source* of this heat has long been a disputed question among physiologists. From the fact that plants are capable of generating an amount of heat, sometimes far above that of the surrounding medium, an unequivocal indication is given that we are to look for its source in the organic functions and not in those of animal life. In examining the phenomena in plants which present any relation to this source, we at once perceive that an absorption of oxygen and extrication of carbonic acid is continually taking place, (constituting the respiration of plants,) and that these processes occur with great

activity at the time when the evolution of heat is most remarkable—that of germination and flowering.

In animals an exact conformity may be perceived between the amount of oxygen consumed and of carbonic acid given off, and the amount of heat liberated. Some physiologists have thought that this carbonic acid was formed in the lungs, and the resulting heat distributed to the system by the arterial vessels, they having a greater capacity for heat than the veins; but it has already been shown that the carbonic acid is formed in the tissues and not in the lungs; as the latter, therefore, cannot be the point at which the heat is generated, it must be evolved throughout the system. Exercise, or any increase in the nutritive operations of a part, is always attended with an elevation of temperature, as well as an increase in the extrication of carbonic acid.

The formation of carbonic acid by the union of the oxygen absorbed from the air with the carbon set free from the body, is the main source of the heat generated within the animal system. The amount of carbon consumed in 24 hours is not sufficient, however, to account for *all* the heat liberated; we must therefore look to other sources. That it is not *dependent* on nervous influence is evident from the fact that the process occurs in vegetables. Perhaps the formation of the various secretions,—fluids having a less capacity for heat than arterial blood,—may be accompanied with the elimination of some latent heat. It is also suggested that the union of oxygen with hydrogen, phosphorus and sulphur, and the conversion of the plastic fluids into solids may likewise explain the source of some of the heat that is unaccounted for.

That the *cutaneous respiration* is subservient to the maintenance of the heat is evident from the fact that if the hair of rabbits be shaved off, and the surface covered with varnish, the temperature instantly *falls*.

Diseases that involve an accelerated pulse and augmented respiration are generally accompanied with elevation of the temperature. The converse is also true. The ordinary temperature of the human body ranges from 98° to 100° Fahr., varying but a few degrees above or below when the temperature of the surrounding medium is elevated or depressed.

Man is able to resist high degrees of temperature, (provided the surrounding air be dry,) by the evaporation of the perspiratory secretion from the surface of his body. The less the age of the individual, the less is his ability to maintain an independent temperature; the human infant in this respect resembles a cold-blooded animal.

#### REPRODUCTION.

See **OBSTETRICS**, in which this function is treated of.

## ANIMAL FUNCTIONS,

## OR FUNCTIONS OF RELATION.

The *animal* functions are so called because they are peculiar to that class of organized beings. They render the individual conscious of external impressions, and capable of executing spontaneous movements, and are dependent for their exercise on the existence of a nervous system. They are thus classified :

- 1st. *Sensation.*
- 2d. *Muscular Motion.*
- 3d. *Mental Manifestation.*

It has been shown (pages 38, 39) that into the composition of the nervous structure two distinct kinds of matter enter, viz. : the *gray* or *vesicular*, and the *white*, or tubular ; that these two kinds differ not only in structure and colour, but also in *function*, the *gray*, or *vesicular*, being a generator of nervous influence, and the *white* the carrier of this influence to the various parts of the body. A union of these two kinds of matter constitutes a *ganglion*, or *nervous* centre.

Our fundamental idea of a nervous system consists of a *ganglion*, or *centre*, thus composed, and a set of trunks composed of the *white* or *tubular* matter, connecting the central organ with the different parts of the fabric. These trunks or branches are distributed to the *sensory surfaces* or *organs*, and to the *muscles* or *motor organs*. The *first* receive and convey impressions *from* the periphery *to* the centre, and are hence called *afferent*. The latter convey *motor* influence *from* the centre *to* the periphery, and are hence called *efferent*. The first are sometimes called *sensory*, from their connexion with *sensation* ; the latter are likewise sometimes designated *motory*, from their connexion with muscular contraction.

The *functional activity* of the nervous system is mainly dependent upon the due supply of oxygenated blood ; this is especially necessary at the points at which changes *originate*, not seeming so necessary for the mere conduction of impressions. In accordance with this, we find the *centres*, and the peripheral extremities of *afferent* nerves always duly supplied with *arterial blood* ; any interruption to its supply being attended with an immediate arrest of their

functions. On the other hand any *increase* in the supply of a part is attended with an exaltation of its function, as is seen in *active congestion* of the brain and spinal cord. It is now a generally received physiological truth, that the functional activity of the nervous system is mainly dependent, not only upon the due supply of arterial blood, but also upon the *combination of its oxygen with the elements of the nervous structure*.

For physiological consideration the nervous system may be divided into *three* great divisions, the *cerebro-spinal*; the *reflex*, or *true spinal*; and the *great sympathetic*.

The *cerebro-spinal* includes the cerebrum and cerebellum, with the *sentient* and *motor nerves*, that run to and proceed from them along the base of the brain, or along the spinal marrow to every part of the system. It presides over *sensation* and *voluntary motion*.

The *reflex*, or *true spinal*, includes the *gray matter* of the *medulla oblongata* and *spinalis* as its *centre*, and a peculiar set of fibres running to and proceeding from these centres, called *afferent*, or *excitor*, and *efferent*, or *motor*. It presides over *involuntary* or *excited movements*.

The *great sympathetic*, or *ganglionic*, consists of a series of ganglia on each side of the vertebral column, extending from the base of the cranium to the os coccygis, and communicating both with the spinal and encephalic nerves, sending its branches along the arteries, and particularly to the organs of involuntary functions. Its office is supposed to be to bring the functions of organic life into relation or sympathy with those of animal life.

The changes which take place in a nerve of any of the above divisions, when it is in action, are known to us only by the effects they produce on the sentient mind, or on muscular parts. There is no alteration in the physical appearance of the nerve or its fibres, which can be detected by our aided or unaided vision, and yet, from the instantaneous effect produced by stimuli, and its as sudden cessation on their withdrawal, we can refer the phenomena to nothing so readily as to a *molecular change*, rapidly propagated along the course of a nerve from the point of application of the stimulus. According to Bowman, a *state of polarity* is induced in the particles of the nerve by the action of the stimulus, which is capable of exciting an analogous change in other particles, whether muscular or nervous; whence results the peculiar effects of the nerve's influence. If this doctrine be tenable, the inference results that the nerves are not mere *passive* conductors, but that the whole extent of the fibre between the stimulated point and the peripheral extremity, or central termination, is the seat of change.

The organic changes produced in a nerve by either *mental* or *physical* stimuli, develop that remarkable power known as the *nervous force*, or *vis nervosa*. Of the nature of this power we know

nothing. That it is not *identical* with electricity or galvanism, as was once supposed, is now established. The following experiments prove this. If a ligature be placed upon a nerve its power of conducting nervous influence is lost, while it still continues to transmit electrical currents. Again, if a section of a nerve be removed, and its place be supplied by an electric conductor, electricity will still pass along the nerve, but no nervous force will be propagated through the conductor to the parts beyond. Lastly, the conducting power of nerve for electricity, according to Matteucci, is not more than one-fourth that of muscle; hence, if the nervous force were electric, it would leave the nerve, and follow the muscle in preference. It seems to be a peculiar power developed in the nervous structure under the influence of appropriate stimuli; just as *contractility* is developed in a muscle under similar influence.

The functions of particular nerves may be discovered by examining the anatomical distribution. If a nerve is discovered to lose itself entirely in the substance of *muscles* it may be inferred to be chiefly or entirely *motor*, or *efferent*. If, on the contrary, it can be traced to a membranous expansion, *cutaneous*, *mucous*, or otherwise, there is equal reason to believe it an *afferent*, or *sensory* nerve. If a nerve is *entirely* distributed upon a surface adapted to receive impressions of a *special* kind, it may be inferred that it is incapable of receiving or transmitting any others. Such a nerve is said to be one of *special sensibility*, to distinguish it from those that transmit impression of a general character, and which are called nerves of *general sensibility*.

In considering the functions of the various parts of the nervous system, it is best to begin with the *spinal marrow*, which, with its cranial prolongation, the *medulla oblongata*, may be regarded as the essential part of the *nervous system of vertebrata*.

#### OF THE MEDULLA SPINALIS.

The *spinal cord* is to be considered in a two-fold light. *First*. As a conveyer of nervous agency *to* and *from* the brain. *Second*. As an *originator* of nervous influence. All the cerebral nerves are subject to the influence of the brain, and all the *spinal* nerves are subject to the same influence through the medium of the spinal cord. As soon as the transmission of this influence is interrupted by division, or wounds inflicted upon the cord, impressions on sensitive nerves cease to be propagated to the sensorium, and the brain loses the power of *voluntarily* exciting the action of the *motor* nerves which are given off below the injured point. All the nerves *above* this point, however, still transmit impressions and are subject to the influence of the brain.

The *white fibrous* matter of the cord is to be regarded as the common trunk of all the nerves of the body. It must not be sup-



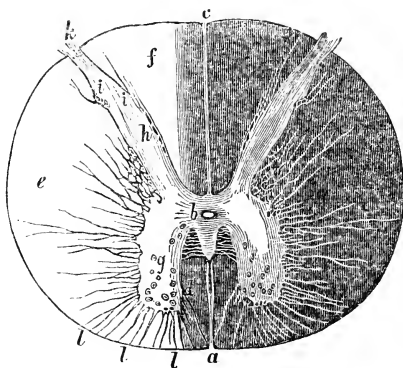
posed, however, that they are all fused into one *common trunk*, for each individual filament of every nerve runs a *separate and distinct* course from its starting point to its termination. It will hence be understood, that it is the *white* or *fibrous* matter of the cord that is connected with the cerebro-spinal division, and which is concerned in *sensation and voluntary motion*, or in other words, in the *transmission of nervous influence to and from the brain*.

The spinal cord is traversed by an anterior and a posterior fissure dividing it into *two lateral halves*, each of these also is marked by two furrows on each side, subdividing it into *three columns*. There are, therefore, upon each half of the cord, an *anterior, middle or lateral, and posterior* column. Each spinal nerve arises by two roots, an *anterior* and a *posterior*. The anterior root joins the spinal cord near the *anterior* furrow, and the posterior near the *posterior* furrow. (Fig. 25.)

The functions of these two roots are now established. The *posterior*, which is distinguished by having a ganglion upon it, is the *afferent* root. Part of its fibres run on to the brain, conveying impressions to this organ; part terminate in the gray matter of the spinal cord, in like manner conveying impressions to the latter. In a word, the posterior root is the *sensory root*.

The *anterior* is the *efferent* or *motor root*. Part of its fibres come from the brain conveying voluntary motion; part have their origin in the gray matter of the spinal cord, and are conveyors of *excited* motion from that centre. Those fibres of both roots which are unconnected with the brain, constitute the system to which reflex actions are due, and with the gray matter of the spinal cord, constitute *a distinct nervous circle*. Each spinal nerve, then, contains at least four sets of fibres,  
I. A *sensory* bundle, passing upwards *to* the brain.  
II. A *motor* set, conveying the influence of volition and emotion downwards *from* the brain.

Fig. 25\*.



\* Transverse section of human spinal cord, close to the third and fourth cervical nerves. *f.* Posterior columns. *ii.* Gelatinous substance of the posterior horn. *k.* Posterior root. *l.* Supposed anterior root. *a.* Anterior fissure. *c.* Posterior fissure. *g.* Anterior horn of gray matter. *e.* Antero-lateral column, (from *k* to *a*.)

- III. A set of *excitor*, or centripetal fibres, terminating in the true spinal cord, or ganglion, and conveying impressions to it.
- IV. A *motor*, or centrifugal set, arising from the same ganglionic centre (or true spinal marrow) and conveying the motor influence reflected *from* it to the muscles.

Of these, the *first* and *third* are united in the *posterior*, or *afferent root*; the *second* and *fourth*, in the *anterior* or *efferent roots*.

The functions of the I. and II. bundles have been treated of, when speaking of the spinal cord, as a conveyer of nervous influence *to* and *from* the brain. The III. and IV. are now to be considered, in connexion with the cord, as an *originator* of nervous influence. These latter, with the gray matter in the centre of the cord, constitute the *reflex system*.

The spinal cord has, in virtue of the gray matter in its composition, or the ganglionic cells collected in its interior, certain properties which characterize it as a central organ. It has a proper inherent motory power, which it communicates to its nerves independently of the brain, a fact which is proclaimed by the state of permanent contraction of those muscles, the sphincter for example, which depend most immediately on the spinal cord. If an animal be stunned by a blow upon the head, or even decapitated in some instances, it will still retain for some hours the power of moving the extremities, when the integument is pinched, but without the least consciousness, or anything like volition; the motions are automatic, and proceed directly from the spinal cord, in consequence of an excitement or stimulation of its substance effected through the fibres of the spinal nerves that terminate in its gray substance; the motions are pure *reflex* motions; in other words, motions which arise from stimuli conveyed to the spinal cord by centripetal or *afferent* nerves, which stimuli are reflected from the cord by centrifugal or *efferent* nerves.

These movements will also continue if the spinal cord be cut across, so as to make two segments, one for the upper and one for the lower extremity; each pair of members may be excited to movement by stimuli applied directly to themselves. The same phenomena are witnessed in the human subject when the spinal cord has suffered injury, or disease in the middle of the back, provided the lower segment remain sound, and its nervous connexions with the limbs are uninjured. These facts prove that sensation is *not* a necessary link in the chain of reflex actions, all that is required being an *afferent* fibre capable of receiving the impression, and conveying it to the centre; a *ganglionic centre*, composed of vesicular nervous substance into which the afferent fibre passes; and an *efferent* fibre, capable of transmitting the motor impulse from the ganglionic centre to the muscle which is to be thrown into contraction (Fig. 26).

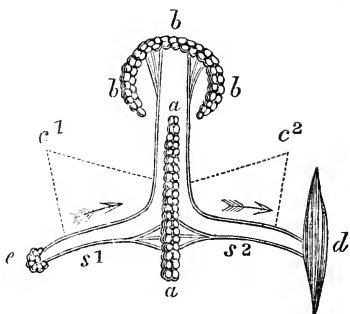
There is scarcely any evidence of a disposition to reflex movements of the limbs of the human body during health, or in the waking condition, these movements being restrained by the controlling influence of the brain. But when the spinal cord is in a state of unnatural excitability, as in tetanus and hydrophobia, or during the presence of strychnine in the system, or when the communication of cerebral influence to the limbs is cut off by disease of the spinal cord or brain itself, spasms may be excited in the extremities often by the slightest touch. It is to be understood in this explanation of the reflex system, that the spinal cord has the power of reflecting the action of sensitive nerves upon the motor nerves, without itself perceiving the impression, in other words, without possessing sensation, that being a function exclusively of the brain.

It is probable that all convulsive movements are produced through the agency of the spinal cord and medulla oblongata, either by irritation seated in the cord itself, (*centric irritation*;) or by causes seated at a distance, the irritation of which is transmitted to the spinal cord, (*eccentric irritation*.)

The *ganglionic system* of the lower orders of animals does not correspond with the *great sympathetic* or *ganglionic* of the higher, (the latter system existing only in those of most perfect development,) but with the *reflex* or *true spinal*. In the lower orders, the ganglia are scattered over various parts of the body, in the leech around the mouth; in the higher they are collected into one common centre, the *spinal cord*.

In regard to the *functions of the columns of the cord*, nothing definite is settled. In the opinion of some physiologists (Bellinger and Valentin), besides being concerned in sensation and motion, when the *posterior column* is irritated, at the point where the nerves of either extremity are given off, that extremity is *extended*; and that when the *anterior* is irritated, the extremity is *flexed*. According to others, (Todd and Bowman), if it could be proved that the anterior roots were exclusively connected with the antero-lateral columns, and the posterior roots

Fig 26.\*



\* Diagram of the origins and terminations of the different groups of nervous fibres: *aa*. Vesicular substance of spinal cord. *bb*. Vesicular substance of brain. *e*. Vesicular substance at commencement of afferent nerve, which consists of *c1* The sensory nerve passing to the brain, and *s1* The spinal division, or excitor nerve, which terminates in the vesicular substance of the spinal cord. On the other side is the efferent or motor nerve, consisting of two divisions. *c2* The cerebral portion conveying voluntary motion, and *s2* The spinal division conveying the reflex power.

with the posterior columns, then there would be ground for the belief that the functions of the columns corresponded with those of the roots; but nothing is more certain than that both roots are connected with the antero-lateral columns; and there is a doubt as to whether the posterior roots have any connexion at all with the posterior column. Hence they are disposed to believe that the antero-lateral columns are both *motor* and *sensitive*. They are also disposed to believe that the posterior columns have a function different from that usually assigned to them. They may be in part commissural between the various segments of the cord, and in part subservient to the function of the cerebellum in co-ordinating and regulating the movement necessary for perfect locomotion.

### FUNCTIONS OF THE MEDULLA OBLONGATA.

The brain and spinal cord act on each other through the medium of the medulla oblongata; hence the importance of a knowledge of the course of the different columns or bundles of fibres of these parts. It consists of *four* principal parts. 1st. The *Anterior Pyramids*, or

Fig. 27.\*

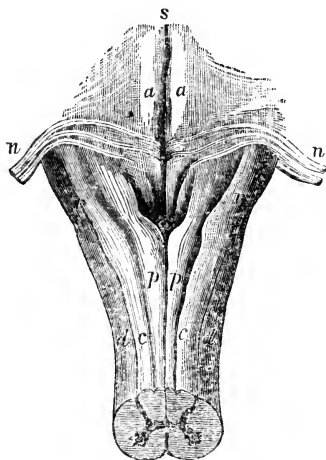
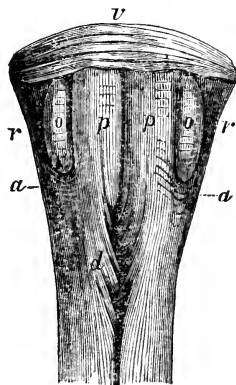


Fig. 28.†



*Corpora Pyramidalia*; 2d. The *Olivary Bodies*, or *Corpora Olivaria*; 3d. *Restiform Bodies*, or *Corpora Restiformia*; sometimes called *Processus a Cerebello ad Medullam Oblongatam*; 4th. The

\* Front view of medulla oblongata. *pp.* Pyramidal bodies, decussating at *d.* *oo.* Olivary bodies. *rr.* Restiform bodies. *aa.* Arciform fibres.

† Posterior view of medulla oblongata. *pp.* Posterior pyramids. *rr.* Restiform bodies, composed of *cc.* posterior columns, and *dd.* lateral part of antero-lateral columns. *aa.* Olivary columns, as seen on the floor of the fourth ventricle. *nn.* Fibres of seventh pair of nerves.

*Posterior Pyramids*, or *Corpora Pyramidalia Posteriora*. (Figs. 27 and 28.)

In considering the functions of these parts it is impossible to separate them completely, they are so closely connected with each other, and the functions of one part are so readily affected by any change in those of the others. In tracing *upwards* the four divisions of the *medulla oblongata*, the following are found to be their connexion with the brain.

1. The fibres of the anterior pyramids for the most part enter the crura cerebri, passing through the pons Varolii, and traversing the optic thalami, (which, it must be remembered, have scarcely any connexion with the optic nerves, or with the sense of sight;) after which they diverge and become mingled with gray matter, thus forming the *corpora striata*, and finally radiate to the convolutions of the cerebrum.

2. The fibres of the olivary body also pass into the pons Varolii, and there divide into two bands; one of which proceeds upwards and forwards to join the crura cerebri, thence to pass to the optic thalami; the other passes upwards and backwards into the corpora quadrigemina.

3. The fibres of the true restiform bodies pass entirely into the cerebellum.

4. The fibres of the posterior pyramids pass directly onwards through the crura cerebri into the thalami, whence they radiate to the convolutions.

The *anterior pyramids* may be said to connect the *motor* fibres of the cerebral hemispheres, with the antero-lateral columns of the spinal cord. Part of its fibres decussate, a large portion of those that proceed from the right hemisphere passing over into the *left* side of the cord; and those from the left hemisphere into the right side of the cord,—an arrangement which fully explains the frequent occurrence of paralytic affections on the opposite side from that affected in the brain.

The *olivary bodies* probably constitute the essential portion or *nucleus* of the medulla oblongata, that on which its power as an independent centre depends. This opinion seems supported by the fact, that these bodies and the central portion of the medulla oblongata contain that intermixture of *vesicular* and *fibrous* matter which constitutes the main character of a nervous centre. It is probably the centre of the *respiratory nerves*. The olivary bodies are connected above with the cerebral hemispheres and corpora quadrigemina, and below with the antero-lateral columns of the spinal cord.

The *restiform* bodies are probably associated in function with the hemispheres of the cerebellum, and the *posterior columns* of the spinal cord.

The *posterior pyramids* are supposed by some to have the func-

tion of connecting the different segments of the cord with each other. By Mr. Solly they are regarded as the ganglia of the sense of hearing.

The medulla oblongata has the general properties of the spinal cord. It has the same property of *reflection*, indeed in a higher degree than any other part of the nervous system; and the nerves which arise from it are more prone than any others to reflex action. It belongs also to the motor apparatus, and no other part has so great an influence on the production of motion, irritation of it exciting convulsions in the whole trunk. The most important motory influences of the medulla oblongata, however, are those that subserve *respiration* and *deglutition*, both of which, respiration more especially, depend upon it. All the rhythmical motions of respiration, such as laughing, yawning, sighing, &c., depend upon it. The faculty of the power of volition seems also to have its probable seat in the medulla oblongata, according to some physiologists, for many animals, after complete removal of the brain and cerebellum, still retain the power of performing voluntary motions. (Flourens.) It is doubtful how far the medulla oblongata participates in sensation, (as alleged by Desmoulins, Magendie, Flourens.) Any conclusion in this direction from experiments must be unsatisfactory, inasmuch as all the phenomena that have been noted are readily referred to reflex actions.

All the psychological excitements or faculties,—affections, passions, &c., are realised, or made manifest by means of the medulla oblongata; and in those diseases which mental emotion is apt to give rise to, many of the symptoms are referable to affections of the medulla oblongata.

The chief *excitor* nerve of the respiratory movements, is the *afferent* portion of the par vagum; the *afferent* portion of the fifth is, also a powerful excitor. The chief *motor* nerves are the *phrenic* and *intercostals*, which probably *originate* in the medulla oblongata, though they issue from the cord at a point lower down. Several other spinal nerves are concerned in the motor portion of the respiratory process, as are also the facial nerve, the motor portion of the par vagum, and the spinal accessory.

In the movements of *deglutition*, which are purely *reflex*, the chief *excitor* is the afferent portion of the *glosso-pharyngeal*, assisted by the branches of the *fifth*, distributed upon the fauces. The *motor* nerves are the pharyngeal branches of the par vagum, assisted by the facial, hypoglossal, *motor* portion of the fifth, and, perhaps, also, the motor portions of some of the cervical nerves. The medulla oblongata is also concerned, in its reflex action, in governing the aperture of the glottis, which it does through the agency of the *superior laryngeal branch* of the par vagum, the *afferent nerve*, and the *inferior or recurrent laryngeal*, the *efferent* or *motor nerve*.

The *medulla oblongata* is connected, in its upward prolongations,

with certain gangliform bodies, which have also their proper functions. These are the *corpora striata*, the *optic thalami*, and the *tubercula quadrigemina*. The *corpora striata*, and the *optic thalami*, whilst both extensively connected with the cerebral hemispheres, are, in the most marked way, connected inferiorly with separate and distinct portions of the *medulla oblongata*; the *corpora striata*, with the inferior planes of the *crura cerebri*, and their continuations, the anterior pyramids, and the *optic thalami* with the olivary columns, the central and probably fundamental portions of the *medulla oblongata*. Thus along the tract that passes from the *anterior pyramids* to the *corpora striata*, we have none but *motor* nerves: whilst along the tract that connects the olivary columns with the thalami, there are none but *sensory* nerves. The thalami then may be regarded as the ganglionic centres of *common sensation*, standing in the same relation to the sensory nerves, converging from the various parts of the body to the encephalon, as do the optic and other ganglia to their nerves of *special* sensation. On the other hand, the *corpora striata* are implanted on the *motor* tracts of the *crura cerebri*, which descend into the anterior pyramidal columns; and their connexion with the *motor* function is very generally admitted, from the constancy with which paralysis is observed to accompany lesions of these bodies.

According to the views above expressed, the *corpora striata* and *optic thalami* bear to each other a relation analogous to that of the anterior to the posterior horn of the spinal gray matter. The *corpora striata* and anterior horns are centres of motion; the *optic thalami* and posterior horns, centres of sensation.

The *tubercula quadrigemina* are the true optic ganglia, the encephalic recipients of the impressions necessary to vision, which, according to Bowman, are doubtless simultaneously felt by means of the *optic thalami*; they are also the centres of those movements of the iris which contribute largely not only to protect the retina, but likewise to increase the perfection of vision. Irritation of an optic tubercle on one side causes contraction of both irides.

This is quite in accordance with the fact, that if light be admitted to one eye so as to cause contraction of its pupil, the other pupil will contract at the same time. Whatever other functions the *tubercula quadragemina* may perform, they have a sufficiently obvious relation to the optic nerves, the eye, and the sense of vision. They may therefore be justly reckoned as special ganglia of vision.

At the base of the brain are found other ganglionic masses, which are in direct connexion with the nerves of sensation, and appear to have functions quite independent of those of the other components of the encephalon. Anteriorly are found the *olfactive ganglia*, in what are commonly termed the *bulbous expansions* of the olfactory nerve. That these are *real* ganglia is proved by their structure,

(containing gray or vesicular matter,) their relation to the olfactory nerves, their direct proportion of bulk to that of these nerves, and to the development of the olfactory apparatus. The *auditory ganglia* are not so clearly made out. In higher animals, and man, the auditory nerve can be traced into a small mass of vesicular matter which lies on each side of the fourth ventricle, which may be considered as having a character of its own, and that it is really the ganglionic centre of the auditory nerve. The ganglia of the *sense of touch* may be considered as existing in the ganglia on the posterior roots of the spinal nerves, and of the fifth pair. As this sense is diffused over the whole body, it would seem to need ganglia in connexion with those nerves which receive the tactile impressions. The *gustatory ganglion* is a collection of gray or vesicular matter, imbedded in the medulla oblongata, which is considered by Stilling to be the nucleus of the glosso-pharyngeal nerve, and to which a portion of the sensory root of the fifth pair may be traced.

#### FUNCTIONS OF THE CEREBELLUM.

On this point there has been, and is still, much discussion. Some regarding it as the organ of the sexual impulse; others, as being connected with the function of motion.

The development of the cerebellum in the scale of animals bears no relation to the energy of the sexual impulse. In the amphibia (as frogs and toads) this organ is extremely small, constituting a mere band lying over the fourth ventricle, and nevertheless the sexual instinct of these animals is proverbial, although they have no erectile organ. The same thing is true of the monkey and the kangaroo, both remarkably salacious, and yet with an inconsiderable development of the cerebellum. Pathological evidence is also against the phrenological doctrine; instances are on record of partial, and even total absence of the organ, without the destruction of the sexual passion. In the first case the individual was married, and the father of several children. In the other there was a tendency to masturbation.

The experiments of Flourens, Hertwig, Rolando, and others, show that after removal of the cerebellum the animals lost the power of executing the movements necessary for locomotion; stupor in these instances was never produced, nor the sensibility of any part of the body destroyed; the power of muscular movements *only* was lost; neither were convulsions ever produced. By the time the last portions of the organ were removed the animals had lost entirely the power of springing, flying, walking, standing, and preserving their equilibrium. All these mutilations were performed without the animal's evincing any sensibility in the cerebellum while it was being removed. There was no loss of volition or sensation, but merely of the faculty of combining the action of the muscles in groups. These



facts have led physiologists mostly to adopt the opinion that the cerebellum has for its function, the *regulation and harmonisation*, or *co-ordination of muscular* movements, especially those of a voluntary character.

This opinion is further substantiated by the observations of Leuret and Lassaigne, which show conclusively that the cerebellum is *larger* in geldings, which are commonly used for draught purposes, and in whom the number of muscles employed is consequently great, than it is either in the mare or stallion, the latter of which is kept especially for the purpose of propagation, and is much less applied to occupations which call forth their motor faculties. The cerebellum is connected with the medulla oblongata and spinal cord by the restiform bodies, and the posterior columns of the cord, and with the mesocephale by the fibres of the pons. Thus this organ is brought into union with each segment of the great nervous centre, upon which all the movements and sensation of the body depend.

#### FUNCTIONS OF THE CEREBRAL HEMISPHERES.

The fact of the cerebral hemispheres having a more perfect development in proportion as the animals in which we examine them are higher in the scale of vertebrata, from fishes up to man, and the coincidence of atrophy, and the absence of the convolutions on their surface with idiocy, are alone sufficient to indicate that the seat of the higher intellectual faculties must be sought for in this part of the encephalon. The primitive fibres which go to the constitution of the cerebral hemispheres have least of all to do with the simple motory and sensitive operations of the nervous substance. All inquirers agree in representing the hemispheres as altogether insensible; they may be cut, pricked, and either partially or entirely removed without any feeling of pain being excited. Wounds of this part of the encephalon, moreover, give rise to no convulsions; the only constant effect of a deep incision is blindness of the eye of the opposite side, and a state of stupidity. These investigations, while they render more precise the functions of the cerebrum, have also tended to *limit* them.

It has also been shown that this organ is *not essential to life*, that it must be considered as an organ *superadded* for particular purposes; that it has no representative in the lowest classes of animals, and that when it first makes its appearance in fishes it evidently performs a subordinate part in the general actions of the nervous system. Hence, whatever be its function, it should be remembered that it does not deprive other parts of their independent powers, although it may keep them in check, and considerably modify their manifestation.

The experiments instituted by the same physiologists above mentioned, go to prove that the cerebrum is the organ of *intelligence*.

Animals from whom the hemispheres were removed, had constantly the appearance of deep sleep, and when irritated resembled in their motions an animal just awaking. M. Flourens likens them to an animal condemned to perpetual sleep, but deprived even of the faculty of dreaming. A hen, in which Hertwig had cut away the hemispheres nearly to the base of the brain, was found to be deprived of sight, hearing, taste, and smell; it sat constantly in one spot, and was as if dead, until strongly roused, when it moved a few steps; it neither fed itself, nor drank, nor attempted to avoid danger. It is evident from these experiments, and from the effects of pressure on the cerebral hemispheres in man, *that they are the seat of the mental functions*; that in them resides the power of directing the mind to particular sensorial impressions,—the faculty of attention.

The portions of the cerebral hemispheres that possess these elevated functions are the *convolutions*. The complexity of the convolutions in the animal scale is in the direct ratio of the advance of intelligence. In infancy they are imperfectly developed, and their increase in size goes on simultaneously with the advance of mental power. If their growth be arrested, the mental powers are of the feeblest kind. In idiots the brain is not only small, but the convolutions are exceedingly limited. The *object* of these convolutions is to afford as extensive a surface of the gray or vesicular matter, in as small a space as possible. By this arrangement also, a more ready access is permitted to the blood-vessels on the one side, and a more free communication on the other with the vast number of fibres by which its influence is to be propagated.

It is evident, that if the surface of the gray did not exceed that of the white matter, folds or convolutions would not be necessary, but a simple expanse of the former would suffice to cover the surface of the latter. The existence of convolutions on the surface of the hemispheres affords evidence of a large relative amount of the dynamic or vesicular nervous matter, and their number or complexity is a measure of the extent to which the vesicular surface is increased. Of two brains, equal in bulk, the one that has most convolutions has most vesicular matter, and is, physiologically, the more potential. It has been calculated that the entire surface of the human cerebrum, when the convolutions are unfolded, is equal to about 670 square inches.

The *weight* of the *entire* encephalon in the adult male usually ranges between 46 and 53 ounces; in the female, from 41 to 47 ounces. The maximum is about 64 ounces or *four pounds*; the minimum about 31 ounces, or rather less than *two pounds*. In the idiot it is often much below this, as for instance 20 ounces. The cerebral hemispheres alone weigh about *four times* as much as the rest of the cerebro-spinal mass.

The brain is abundantly supplied with blood by the vertebrals and

carotids, which anastomose very freely with each other, to obviate the effects of pressure upon either of them. Their course is also a tortuous one, that the impulse of the blood upon so delicate an organ may be avoided.

A certain amount of regulated pressure upon the walls of the vessels of the brain is essential to the proper exercise of its functions. It is known that the amount of blood circulating through the brain varies at different times in accordance with its increased or diminished functional activity, and that the cranial case is not an unyielding one, as its contents would then be invariable. A special provision is made to meet this varying amount of fluid, and to keep up the same degree of pressure upon the organ, in the existence of a fluid beneath the arachnoid wherever the pia mater exists. The amount of this fluid averages about 2 ounces, but in cases of atrophy of the brain, as much as 12 ounces may be obtained from the cranio-spinal cavity; whilst in all instances in which the bulk of the brain has undergone an increase, either from the production of additional nervous tissue, or from undue turgescence of the vessels, there is either a diminution, or a total absence of this fluid. It has been shown by Magendie that the withdrawal of this fluid in living animals always causes great disturbance of the cerebral functions, probably by allowing undue distension of the blood-vessels. It is, however, speedily renewed, and its reproduction restores the nervous centres to their normal condition.

#### FUNCTIONS OF THE SYMPATHETIC.

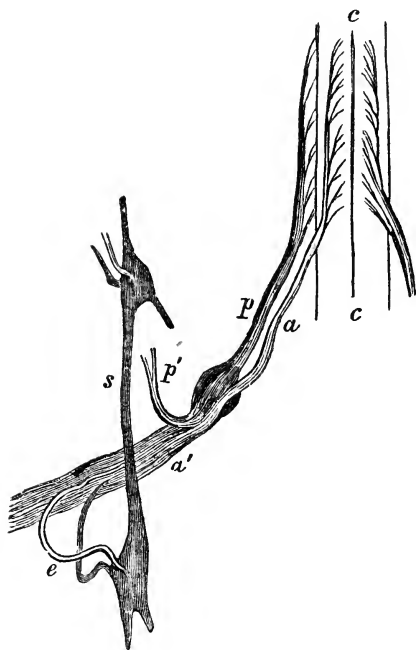
This nerve has been variously called the *splanchnic*, *ganglionic*, *vegetative*, and *organic*. It consists of an uninterrupted chain of ganglia, extending on each side of the vertebral column, from the first cervical vertebra down to the coccyx, and moreover extending upwards beside the cranial vertebræ, and occupying spaces between the bones of the cranium and those of the face. The chains of the opposite sides communicate with each other at various points in the plexuses of nerves that originate from them, and through the *ganglion impar*, a single ganglion in front of the coccyx. A *cephalic* communication is as yet uncertain. Ribes described a *ganglion impar* situated upon the *anterior communicating artery* of the circle of Willis, and other anatomists regard the pituitary body in the sella turcica as a ganglion of like description, a common point of union for the right and left chains at their cranial extremities.

The peculiarities of the sympathetic fibres were spoken of when describing the development of the nervous system, (page 39.)

The sympathetic system contains two sets of nervous fibres,—the ordinary white tubular fibres, which it derives from the cerebro-spinal system; and the *gray* or *gelatinous* fibres, which belong exclusively to itself.

Each of these systems thus mingles with the other, the cerebro-spinal transmitting both motor and sensitive fibres into the sympathetic; whilst the sympathetic is represented in the cerebro-spinal system by certain fibres and collections of vesicular matter of its own. (Fig. 29.)

Fig. 29.\*



Adopting this view of the compound nature of the sympathetic, it seems to be impossible to regard it either as independent of the cerebro-spinal centres, or wholly depending upon them. It is probably independent of them as regards its gelatinous fibres, but dependent upon them as regards its tubular fibres. It is to be looked upon as a portion of the nervous system, peculiar in its composition, having, as regards some of its constituent fibres, a special

relation to the blood-vessels, especially the arteries, but being by its other fibres connected with the cerebro-spinal centres. It is also distributed both to sentient surfaces and to muscles, as to the heart and intestinal canal, movements in which can be excited by stimulation of the ganglia connected with them. The well-known occurrence of pain in parts supplied by it, proves the existence of sensitive fibres.

The sympathetic thus appears to exercise a threefold office: first, that of a sensitive nerve to the parts to which it is distributed; secondly, that of a motor nerve for certain muscular parts; and thirdly, that of a nerve to the blood-vessels. By the last arrangement it may influence nutrition and secretion by its effect upon the contractility of the coats of the vessels. The effect of the emotions

la. \* Fig. 29. Roots of a dorsal spinal nerve, and its union with the sympathetic. c. c. Anterior fissure of the spinal cord. a. p. Anterior and posterior roots. s. Sympathetic. e. Its junction with the anterior branch of the spinal nerve, by a white and a gray

operating through this channel upon the blood-vessels is seen in the act of blushing, and also in the pallor that often accompany them.

Dr. Carpenter thinks that as the sympathetic system is not developed in proportion to the predominant activity of the functions of organic life, but in proportion to the development of the higher division of the nervous system, its office is not to preside over the former, but to bring them into relation with the latter; so that the actions of the organs of vegetative life are not dependent upon it, but influenced by it, in accordance with the operations of the system of animal life.

#### SENSATION.

By this term is meant *the perception of an impression*. It is with the brain alone that the mind possesses the relation necessary for the production of sensation. Hence the brain is often called the *sensorium*. Sensations are of two kinds, *external* and *internal*. By the first are meant those that arise from impressions made upon the external surface of the body, as the sense of sight, touch, or hearing. The *internal* are such as occur within the body, and arise from some alteration in the function of the part, for the time being. Hunger and thirst are internal sensations.

With regard to all sensations, it must be remembered that the change of which the mind is informed, is *not* the change which occurs at the peripheral extremity of the nerves, but the change communicated to the sensorium; in other words, sensation does not occur at the point impressed, but in the brain. Hence it happens that sensations often occur from impressions upon a nerve somewhere in its course. This is of frequent occurrence in the senses of sight and hearing, flashes of light being seen, and ringing sounds being heard, when no external stimuli could have produced such impressions. In such cases they not unfrequently arise from impressions made on these nerves in their course from special ganglia to their peripheral termination. This variety of sensations is termed *subjective*, to distinguish them from *objective*, in which the stimuli are derived from without. The most common cause of these subjective sensations is congestion or inflammation in the course of the nerve.

Whenever an impression is made upon a nerve in its course, the mind instinctively refers it, not to the point impressed, but to the ordinary termination of the nerve upon the periphery of the body, even although these terminations should not exist, or should be incapable of receiving impressions. Thus, after amputations, the patients are often troubled with sensations which they refer to the removed extremities; and in like manner, after the Taliacotian operation, all sensations produced by touching the nose are referred to

the forehead, from whence the flap was taken, until the new vascular and nervous communications are established.

An active capillary circulation in a part is essential to its sensibility; any cause which retards this, deadens the sensibility of the part, as is well seen in the benumbing influence of cold. Increased vascular action, again, produces a corresponding increase in sensibility; this is seen in the active congestion preceding inflammation.

Sensations are divided into *general* and *special*. *General sensation* is distributed over all the body; by it we feel those impressions made upon our bodies by surrounding objects, which produce the various modifications of *pain* and *pleasure*, the sense of contact and resistance, and variations of temperature. *Special sensation* is that which arises from impressions of a peculiar character, upon nerves which are adapted to receive them alone.

The intensity of all sensations is very much blunted by frequent repetition, excepting in the case of those to which the attention is particularly directed; these, so far from losing their acuteness, become much more cognizable by the mind. Hence arises the educability of the special senses.

Although there are some stimuli which can produce sensory impressions on *all* the nerves of sensation, it will be found that those, to which any one organ is peculiarly fitted to respond, produce little or no effect upon the rest. Thus the ear cannot distinguish luminous rays, nor the eye the undulations of sound; and the same is true of the other senses. Hence it may be inferred, *that no nerve of special sensation can, by any possibility, take on the function of another. But that each requires its own peculiar stimulus to call it into action, light for the eye, and sound for the ear, &c.*

The nerves of *special* sensation have in themselves no *general* sensibility; they may be pricked or torn without the individual suffering any pain; they only experience or give rise to their own peculiar sensations. All the *general* sensibility that the organs of the senses possess is derived from nerves of *general* sensibility distributed to them. The *special senses* are five in number, viz.: *touch, taste, smell, hearing, seeing*. To these some add a *sixth*, the *muscular sense*, or that by which the will can produce, check or regulate the amount of contraction in the voluntary muscles; and also appreciate, by certain sensations originating in the muscles, the precise degree of contraction in each.

The *organs* of the special senses consist of two parts, a *physical* and a *vital* part. The physical part receives and modifies the impression; the vital transmits the impression to the brain. The different transparent media of the eye contribute its physical portion; the *nerve* is the vital portion.

## SENSE OF TOUCH.

Of all the senses, Touch is the most extensively diffused throughout the animal kingdom; it is the simplest and most rudimentary of all the special senses, and may be considered as an exalted form of *common sensation*, from which it arises by imperceptible gradations till it reaches its highest development in some particular parts. It is also the earliest called into operation, and the least complicated in its impressions and mechanism.

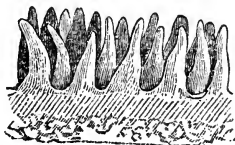
The sense of touch is most highly developed in those parts that are most abundantly supplied with sensory nerves. In the lips, the tip of the tongue, and the palmar aspect of the last joints of the fingers, the nerves are both very numerous and superficially distributed, and whilst the epidermic layer is thinner, there is at the same time a greater degree of isolation of the papillæ of the skin between lines and furrows of the epidermis. The number of these lines or furrows is commensurate with the development of the sense. Even in man the acuteness of the sense of touch varies much in different regions of the body, as can be proved by observing the varying distances at which the two points of a pair of compasses can be separately recognised on different parts of the surface; on the points of the fingers they can both be recognised at a distance of  $\frac{1}{3}$  of a line, while they require to be separated 30 lines in order that the two points may be recognised over the spine.

The nerves of touch are the same as those of general sensation, viz.: the posterior roots of the spinal nerves, and some fibres of the fifth and eighth cerebral nerves. They are distributed to the tactile papillæ of the skin, small elevations enclosing loops of blood-vessels and branches of the sensory nerves, (Fig. 30,) situated on the exterior surface of the cutis vera. The papillæ are covered by the epidermis, which protects them from too violent impressions of external bodies upon them.

In the sense of touch the body to be examined must be brought into contact with the sensory surface. The only exception to this is in regard to the sense of temperature, for which there would seem to be a distinct set of nerves.

The only idea communicated to our minds by the sense of touch, is that of *resistance*. By the various degrees of resistance which the sensory surface encounters, we obtain a knowledge of the hardness or softness of a body. When the sensory surface, and the substance touched are moved upon each other, we obtain a notion of extension or space. At the same time, by the impressions made

Fig. 30.\*



\* Papillæ of the palm, the cuticle being detached.

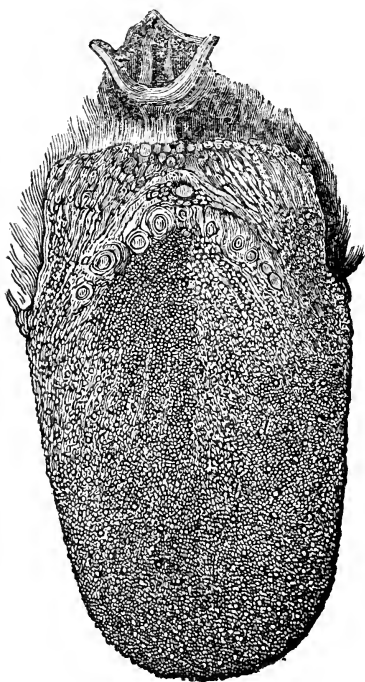
upon the tactile surface, we discover the roughness or smoothness of the substance. The knowledge of *form* and *weight* is derived by the additional assistance of the *muscular sense*.

The sense of touch is exceedingly educable, as is seen in the case of the blind, who can be taught to read, and even distinguish colours by its agency.

Impressions made upon the organ of touch continue perceptible for some time after the stimulus has been removed; for instance, the stinging of a smart blow does not soon subside, and the simple contact of an article of clothing often leaves the impression of its presence after it has been removed. The *subjective sensations* pertaining to the nerves of this sense are among the best known. The tingling of a limb that is "*asleep*," which commonly depends on pressure

on its trunk, may also result from changes in the centre; the same is true of formication, heat, chilliness, itching, and also of pain.

Fig. 31.\*



#### SENSE OF TASTE.

In the sense of taste, as well as in touch, the substance to be examined must be brought into contact with the organ of the sense, which organ is the mucous membrane of the tongue and fauces. The mucous membrane of the tongue is largely supplied with papillæ of various forms, which are abundantly supplied with nerves and blood-vessels. The papillæ are of three varieties: 1st. The *calyciform*, or *circumvallate*, situated at the base of the tongue in a V shaped line, *a* (Fig. 31); the *fungiform*, on the sides and apex, *b*; and the *conical*, or *filiform*, the most numerous, and most abundant, in the

central part, *d*. The latter are supposed to be concerned rather in the sense of touch than of taste. When these papillæ are called into

\* Upper surface of tongue. *a*. One of the circumvallate papillæ; *b*. one of the fungiform; *d*. conical papillæ.



action by the contact of substances having a strong savour, they become turgid and erect, so as to produce a decided roughness on the surface of the organ.

There is no special nerve of taste, the sense seems to be divided between the glosso-pharyngeal and the fifth.—The impressions made upon the front of the tongue are conveyed by the fifth; those upon the back of the organ by the glosso-pharyngeal. The first ministers also to general sensibility; the latter conveys the impressions that produce nausea. It is also the afferent nerve in the reflex act of swallowing. The ninth pair is also distributed to the tongue, but it is a *motor* nerve, and not at all concerned in the special sense.

A necessary condition for the exercise of this sense, is solubility of the substance to be tasted; if it be insoluble it merely excites the feeling of contact. The sapid substance should also be moved over the surface of the tongue; by this means the taste is very much heightened. In this respect there is a strong analogy between touch and taste. Taste may also be produced by mechanical irritation or chemical excitation of its nerves. A smart blow of the finger, or galvanism, will often excite a taste, sometimes acid, at others alkaline. A large part of the impression made by sapid substances is received through the sense of smell, as may easily be proved by attempting to taste any substance while holding the nose. In inflammation of the Schneiderian membrane too, we lose the power of appreciating the flavour of bodies through the impairment of the sense of smell.

Taste is an educable sense, as is seen in the case of the spirit tasters, but it is not considered an intellectual one. Its *subjective* phenomena are not so strongly marked as in some of the other senses, and yet we are constantly experiencing pleasant or unpleasant tastes without any apparent cause. Magendie states that dogs, into whose veins he had injected milk, licked their lips as though they tasted it.

The sense of taste is designed to guide us in our search for food; it is therefore placed at the entrance of the digestive apparatus. Impressions of taste remain longer than those of other senses; but the after taste itself is not always the same as the original.

Cold air deadens the sense of taste, precisely as it is known to do in the sense of touch.

#### SENSE OF SMELL OR OLFACTION.

This sense is designed to acquaint us with the odorous qualities of particles suspended or dissolved in the atmosphere. It is seated in the mucous membrane of the nose, and at the commencement of the respiratory passages, that it may protect them against the entrance of deleterious matters. Its principal use, however, is to second the impressions of taste in conveying intelligence of the properties of food.

The organ of the sense of smell has no capacity of movement in

relation to its ordinary stimuli ; the odorous particles are brought into contact with it in the act of inspiration. These particles are so small as to elude detection by the most delicate experiments. The whole mucous membrane of the nose is not endowed with the sense of smell ; it seems to be limited to that portion expanded over the *superior and part of the middle spongy bones*. This region is therefore called the *olfactory region*. It is to this portion only that the *olfactory nerve* is distributed. The other portions of the mucous membrane are supplied with branches of the *fifth pair*, from which they obtain their general sensibility. These branches are derived from the ophthalmic and superior maxillary divisions. When the fifth nerve is diseased, irritating substances may be introduced into the nose without discomfort to the patient. Section of the fifth pair also arrests the secretion from the mucous membrane, and in that way diminishes the acuteness of smell. This nerve is the *afferent or excitor* nerve in the reflex act of sneezing.

The organ of smell is seated high up in the nose, not only to protect it from mechanical injury, but that it may be screened from the contact of air either *too cold* or *too dry*. The convoluted arrangement of the turbinated bones, with their expansion of mucous membrane, effects this. These parts break the force of the current of air, warm it, and impart that degree of moisture which is best calculated to aid the solution of the odorous particles on the sentient surface to which they are to be applied.

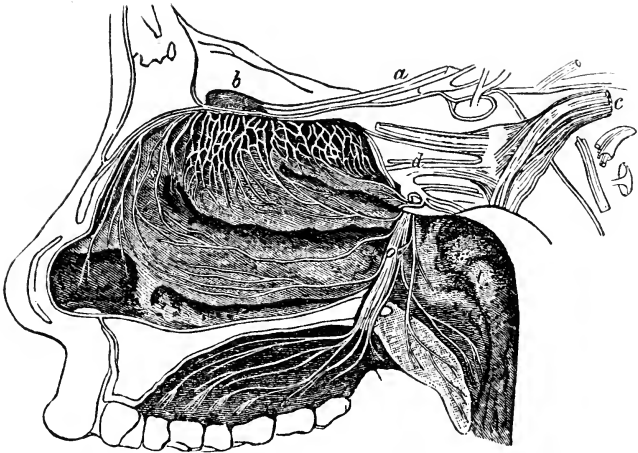
The olfactory nerve passes down from the olfactory bulb or ganglion through the cribriform plate of the ethmoid bone, and is distributed in minute threads having a plexiform arrangement, (Fig. 32.) Their ultimate distribution is probably in *loops*.

The *conditions* requisite for the exercise of the sense of smell are, in addition to the integrity of the nervous apparatus, a healthy condition of the mucous membrane. If it be dry, or in a raw irritable state, with a watery discharge, the sense is lost or impaired. This is familiarly seen in a *cold in the head*. The substance to be smelt must also be *soluble* ; insoluble substances cannot be perceived by this sense. When we wish to examine any substance closely, it is drawn up into the nose with some force, in order that the odorous particles may reach the olfactory region.

The sense of smell, although not an intellectual sense, is susceptible of cultivation ; by it individuals are often capable of recognising others, and even, as in one instance, to discover their own clothes among many others.

*Subjective phenomena* sometimes occur in this sense, arising, as in the others, from irritation by an internal cause. Disease of the olfactory bulb, or of the anterior lobe of the brain, has been known to produce them. Muller relates the case of a man, who ever after a fall from his horse, believed that he smelt a bad odour. Whether

Fig. 32.\*



substances introduced into the circulation would excite the olfactory nerve to the perception of the odour, has not been ascertained experimentally.

The cavities that communicate with the nasal passages have no connexion with the sense of smell.

#### HEARING OR AUDITION.

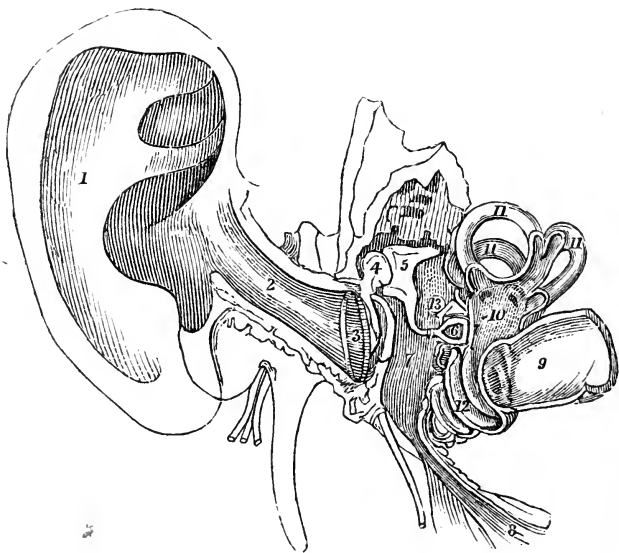
By the sense of hearing the mind takes cognizance of the condition of the auditory nerve produced by those oscillations of elastic matter which give rise to the phenomena of sound. The communication of these oscillations to the ear may take place through the air, or through the intervention of some solid conductor, brought into immediate connexion with the organ of hearing. The following condensed account of the organ is from the eighteenth chapter of Todd and Bowman's *Physiological Anatomy*. The essential part of the organ of hearing is a sac, containing fluid, upon which the nerve of hearing is freely distributed; this sac being in connexion with the cranial parietes. This is represented in the human subject by that small cavity excavated in the petrous portion of the temporal bone called the *vestibule*. This, and *three semicircular canals*, with a spirally disposed canal, divided by a partition, constituting the *cochlea*, form the *labyrinth*. External to this, and situate between the squamous and petrous portions of the temporal bone, is a cavity,

\* *a.* Olfactory process. *b.* Olfactory bulb. *c.* Fifth nerve within the cranium. *d.* Its superior maxillary division, anastomosing with the olfactory filaments, and with *s.* branches of the nasal division of the ophthalmic nerve. *e.* Posterior palatine twigs from Meckel's ganglion, supplying the soft and hard palate.

The cut represents the outer wall of the nasal fossa, with the three spongy bones and meatus.

the *tympanum*, which in front further communicates very freely with the cavity of the throat through an open canal, the *Eustachian tube*, whereby air has a free access into the tympanum. This cavity is closed on the outside by the *membrana tympani*, which extends over its external orifice as a drum. A small chain of bones extends from this membrane to another in the inner wall of the tympanum, (the membrane of the foramen ovale.) These are the *ossicles* of the ear. These small bones are articulated by movable joints, and are moved by small muscles, which are thus enabled to regulate the tension of the *membrana tympani*, as well as of the membrane of the vestibule. Externally is an apparatus for collecting sounds and conducting them to the tympanum, called the *external ear*, comprising the free expanded part, the *auricle* and the *auditory canal*, or *meatus externus*. (Fig. 33.)

Fig. 33.\*



\* The *auditory nerve* is the *portio mollis* of the seventh pair, which is distributed to the vestibule, cochlea, and semicircular canals. Its mode of termination is unsettled. It will be seen from this description of the auditory apparatus that it is divided into three parts.

\* 1. Pavilion. 2. Meatus externus. 3. Membrana tympani. 4, 5, 6. Chain of bones. 7. Cavity of tympanum. 8. Eustachian tube. 9. Meatus internus. 10. Vestibule. 11. Semicircular canals. 12. Cochlea. 13. Stapedius muscle.

1st. *External ear* ; 2d. The *middle ear*, or *tympanum* ; 3d. The *internal ear*.

Sounds may be propagated in three ways, by *reciprocation* ; by *resonance* ; and by *conduction*. Vibrations of *reciprocation* are excited in a sounding body when it is capable of yielding a musical tone of definite pitch, and another body of *the same pitch* is made to sound near it. Thus, if two strings of equal tension be placed side by side, and one be thrown into vibrations, the other, although untouched, will be thrown into corresponding vibrations. The same is true of membranes as of strings. If a membrane and a string both capable of yielding the same note, be placed side by side, and one be thrown into vibrations, the other will reciprocate. But no membrane or string will reciprocate any tone that is lower than its own *fundamental note*, by which is meant, the *lowest note* which it will yield when the whole of it is in vibration together.

Vibrations of *resonance* occur when a sounding body, as a tuning-fork, is placed in connexion with any other, of which one or more parts may be thrown into reciprocal vibrations, even although the tone of the whole be different, or it be not capable of producing a definite tone at all. If a tuning-fork, whilst vibrating, be placed in contact with a sounding-board, the board will divide itself into a number of parts, each of which will reciprocate the original sound so as greatly to increase its intensity.

*Vibrations of conduction* are the only ones by which sounds can be said to be propagated. If the ear be placed at one extremity of a long board, and the other be lightly struck, the sound will be *conducted* to the ear along the whole length of the board. All media are capable of conducting sound, a vacuum being the only space through which it will not pass. Solids are better conductors than fluids, and fluids than gases. The greatest diminution in the intensity of sound is usually perceived, when a change takes place in the medium from which it is propagated, especially from the aeriform to the liquid.

The *object* of the *external ear* is to receive sonorous vibrations, concentrate and conduct them inwards. The various elevations and depressions of the external ear, adapt it peculiarly to catch the sonorous waves arising from opposite quarters. The *auditory canal*—*meatus externus*—receives the sonorous pulses immediately, and conducts them to the *membrana tympani*. The sound is at the same time strengthened by reflection from the walls of the meatus, and the resonance of the mass which it incloses ; the walls of the passage, moreover, are solid conductors of sound.

The *use* of the *membrana tympani* is to receive the sonorous undulations in such a manner as to be thrown into *reciprocal vibration*, which is to be communicated to the chain of bones. It cannot, however, reciprocate any sounds that are lower than its own funda-

mental note, hence, if it be unduly tense from any cause, the individual will be deaf to low sounds. In its natural condition it is rather *lax* than tense; by this means it can reciprocate a greater variety of sounds. The integrity of this membrane does not seem to be essential to hearing, since it may be perforated, or destroyed, without the loss of the sense.

The *chain of bones* is intended to *conduct* the sonorous undulations across the tympanum to the internal ear. The *tensor tympani muscle* which is inserted into the handle of the *malleus* has a protective agency over the organ of hearing, analogous to that of the *iris*. When this muscle contracts it draws in the handle of the malleus and renders the *membrana tympani* tense, and thus takes away from it the power of reciprocating low sounds. It is also capable of being excited to reflex action by *loud* sounds, and thus putting the membrane into such a state of tension as not to reciprocate them. It may, therefore, be fairly compared to the iris, which contracts ever the more powerfully the stronger the light that impinges upon it.

The *tympanum* isolates the chain of bones and allows free vibration to the membrane at either end of it. Moreover the air which it contains reverberates, and the walls and neighbouring spaces and cells reflect sonorous pulses, which thus fall strengthened upon the walls of the labyrinth, and particularly upon the membrane of *fenestra ovalis* and *fenestra rotunda*. The principal use of the Eustachian tube seems to be, to maintain the equilibrium between the air of the tympanum and the external air, so as to prevent undue tension of the *membrana tympani*. It also serves to conduct away the secretions of the middle ear, which it discharges into the cavity of the throat by means of *ciliæ* vibrating upon its surface.

In regard to the uses of the different parts of the labyrinth nothing certain is known. The *semicircular canals* are supposed by their direction to give information as to the *direction* of sounds. The *cochlea*, in like manner, is thought to enable us to judge of the pitch of notes, an idea which seems to derive confirmation from the corresponding development of this portion in animals, and the variety in the *pitch* of the sounds, which it is important they should hear distinctly. The *vestibule*, from its uniform presence, may be considered as the essential part of the organ of hearing.

The chain of bones, it was said, connects the external and internal ears. The base of the stapes is attached to the membrane filling up the *fenestra ovalis*. Immediately beneath this is a circular opening, called the *foramen rotundum*, which also is filled up with a membrane, and is capable of receiving reciprocal vibrations from the air of the middle ear, and transmitting them to the internal ear.

The *vestibule* and *semicircular canals* have lying within them, a *membranous labyrinth*, having the same general shape as the cavi-

ties in which it lies, only smaller. Between it and the walls of the bony labyrinth lies the fluid called the *perilymph*, and within it is contained the *endolymph*, and some small calcareous particles called *otolithes* or ear-stones. The use of the membranous labyrinth is probably to afford a more extended surface for the expansion of the auditory nerve. The *otolithes*, by being thrown into vibration, probably increase the impression upon the nerve.

The sonorous waves reach the labyrinth from the *membrana tympani* in three distinct ways. 1st. A portion of the vibrations reflected from the walls of the *tympanum* reaches the external wall of the vestibule immediately, this being at the same time the internal wall of the *tympanum*. 2d. Other vibrations are thrown directly upon the *fenestra rotunda*, and in this way reach the cochlea. 3d. A third set of vibrations travel along the chain of bones immediately from the *membrana tympani* to the labyrinth. This is the most powerful of any. The fluid of the labyrinth may also be thrown into vibration, by undulations transmitted through the bones of the head.

A single impulse communicated in any of the above ways is sufficient to excite the momentary sensation of *sound*, but a number of them in rapid succession is essential to the production of a *musical tone*. The *acuteness* or *depth* of the tone depends upon the rapidity with which the impulses succeed each other.

The acuteness of hearing varies very much in different individuals, and its power may be very much increased by practice. A part of this increase is due to the greater attention which its fainter indications receive; a part also to the increased use of the organ. A want of *musical ear* is an encephalic defect, and not a deficiency of the organ.

The power of appreciating the *direction* of sounds is for the most part acquired by habit. In some instances we are assisted by the relative intensity of the sensations communicated to the two ears respectively. The idea of *distance* is another acquired perception depending principally upon the *loudness* or *faintness* of the sound.

The sensation of sound often lasts longer than the exciting cause of it. It is upon this circumstance that the continuity of a musical tone depends; a fresh impulse succeeding before the impression of the first has disappeared.

The *subjective phenomena* of hearing generally result from some affection of the brain, or that part of it in which the auditory nerve is implanted. Ringing sounds, or buzzing in the ears, are the most common, and are indicative of either redundancy or deficiency of blood in the brain. They may also be caused by some disturbance of the local nutrition of the brain.

## SENSE OF VISION.

By the sense of sight, we become acquainted with the existence of *light*; and by the medium of that agent, we take cognizance of the form, size, colour, position, &c. of bodies that transmit or reflect it. A knowledge of the laws of light and optics, is essential to an understanding of the functions of the different parts of the organ of vision; for these the student is referred to the works on natural philosophy.

In the globe of the eye we recognise, as the most essential parts, the expansion of the optic nerve, called the *retina*; and in front of this the *transparent refracting media*, which transmit the light so as to bring it to a focus upon the nervous expansion. The optic nerve, at its entrance into the eye, splits up into numerous fibrils, which spread themselves out, and inosculate freely with each other, so as to form a net-like plexus. This plexus comes into relation with numerous vessels and a layer of ganglionic cells, like those in the cortical part of the brain. This layer of cells constitutes the internal layer of the true retina.

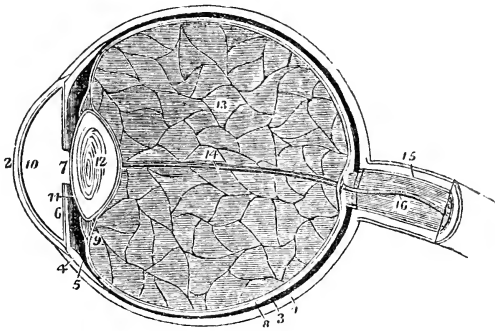
In order to protect the retina, the slightest change in whose form would be attended with injury to its function, the whole is enveloped in a dense tissue called the *sclerotic*, which is opaque, with the exception of its front, where it becomes modified to allow the light to enter, and is called the *cornea*. Between the sclerotica and the retina is a layer of dark pigment contained in a delicate membrane called the *choroid*, the use of which is to absorb the rays of light after they have made their impression upon the retina. In the albino it is entirely wanting, and in others it becomes gradually lighter in colour as they advance in life, so as to increase the stimulus applied to the retina, by reflecting the rays again from one part of its surface to another. In front of the retina are the *transparent media*. These are the *vitreous humour*, the *crystalline lens*, and the *aqueous humour*. The *vitreous humour* lies immediately within the cup formed by the retina, and seems destined to give it the necessary support inside, which the sclerotic gives outside. In the anterior part of the vitreous humour is imbedded the *crystalline lens*, which comes nearly up to the cornea in front, leaving a small cavity, however, which contains the *aqueous humour*. Across this cavity, and dividing it into an *anterior* and *posterior chamber*, hangs a vertical curtain-like process of the choroid, called the *iris*. This is perforated in its centre by a circular aperture called the pupil, which is capable of being enlarged or diminished; a condition permitted by the fluidity of the aqueous humour.\* The contraction of the pupil under the stimulus of light, seems to be effected by a *sphincter muscle* surrounding the orifice of the pupil, and put in action by the third pair

\* Todd and Bowman.



of nerves. This seems to be a pure reflex action, in which the optic nerve is the *afferent*, and the third pair the *efferent*. The stimulus is the presence of light. When the optic nerve is divided, the *fifth pair* may in some degree convey the requisite stimulus. The *dilatation* of the pupil probably results from the elasticity of the tissue of the iris after the muscular contraction has ceased. The iris prevents the ingress of too much light, and also shuts off the rays of light from falling on the circumference of the lens. The *transparent media* so refract and modify the rays of light, as to overcome both *spherical and chromatic aberration*, and bring them to a perfect focus upon the retina.

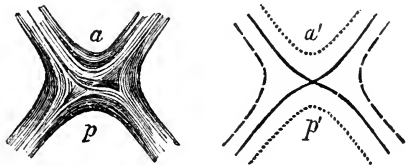
Fig. 34.\*



The *second pair of nerves* is devoted to the sense of sight, and is hence called *optic*. The greater part of their roots may be traced

to the tubercula quadrigemina, which are regarded as the optic ganglia; from these they run forwards along the base of the brain, and unite in front of the tuber cinereum and mammillary bodies, forming an intimate junction called the *chiasm*. From this point they diverge, and enter the orbits through the optic foramina. Part of the fibres of each nerve pass to the opposite eye, part are commissural, and the remainder pass to the eye of the same side. (Fig. 35.)

Fig. 35.†



\* Longitudinal section of the globe of the eye. 1. Sclerotic. 2. Cornea. 3. Choroid connected anteriorly with (4) ciliary ligament; and (5) ciliary processes. 6. Iris. 7. Pupil. 8. Retina. 9. Canal of Petit. 10. Anterior chamber, containing aqueous humour. 11. Posterior chamber. 12. Crystalline lens. 13. Vitreous humour. 14. Neurilemma of the optic nerve. 16. Central artery of retina.

† Course of fibres in the chiasm. *a*. Anterior fibres, commissural between the two retinae. *p*. Posterior fibres, commissural between the thalami. *a'*. *p'*. Diagram of the preceding.

The eye has six muscles, four straight, *the recti*; and two oblique, the *obliqui*. The first are supplied by the third pair of nerves, except the rectus externus, which has the sixth. Of the latter, the superior oblique receives the fourth pair; the inferior, a branch of the third. When the *recti* act together, they fix the eyeball; when singly, they turned it towards their respective sides. The *oblique* antagonise the *recti*, and in addition, when acting together, draw the globe inwards, and converge the axes of the eye. The superior oblique turns the eye downwards and outwards, and the inferior oblique upwards and inwards. There is, however, considerable uncertainty as to their functions.

The adaptation of the eye to distances, by which a perfectly distinct image is perceived, whether the object be far or near, is a phenomenon as yet not explained. By some it is thought to be entirely educational; by others it is supposed to depend upon a varying length of the focal distances, produced either by altering the shape of the globe of the eye, so as to diminish or increase its convexity, or by altering the position of the lens by muscular agency. It is interesting to remark, that the adjusting power of the eye is lost or greatly impaired by the extraction of the lens, or by paralysing the ciliary and iridial muscles by belladonna. According to Dr. Clay Wallace, the ciliary muscle advances the lens by compressing the veins, and thus causing an erection or lengthening of the ciliary processes. The contraction of the iris, which takes place when the eyes converge, is supposed to depend on the third pair, which is distributed to it, and the internal recti.

The forms of imperfect vision, known as *myopia* and *presbyopia*, are to be attributed entirely to defects in the optical adaptation of the eye. In *myopia*, or *near-sightedness*, the refractive power of the eye is too great, and the rays of light are brought to a focus before reaching the retina. This defect is to be corrected by a double concave lens which shall *disperse* the rays, and thus overcome the too great convergence. In *presbyopia*, or *far-sightedness*, there is the opposite defect, there is not sufficient refracting power, and the rays reach a focus behind the retina. This defect is to be obviated by convex lenses, which increase the refracting power of the eye. Myopia, which commonly occurs in young persons, is not always corrected by age. The presbyopic eye is always present after the operation for cataract.

It is known that the rays of light from the opposite points of a luminous object, by reason of the changes they undergo through the successive refractions they experience, cross one another, and thus the image on the retina appears inverted. The question then arises, how do we see objects *erect*, with an *inverted* image on the retina? Volkmann has shown, that Sir D. Brewster's law of visible direction, which affirmed that every object is seen in the direction of a

perpendicular to that point of the retina on which the image is formed, and that as all these perpendiculars meet in the centre of the eye, the line of direction is identical with the prolonged radius of the sphere, is not optically correct. Some of these lines cross each other at a point behind, and some before the lens, and they thus fall on the retina at such different angles, that no general law can be laid down respecting them. The notion of erectness, which we form by the combined use of our eyes and hands, is really the result of *education and experience*.

*Single vision with two eyes*, is explained by the fact that the rays of light proceeding from a luminous object fall upon parts of the retina which are *accustomed to act together*. It is not necessary that these points should be equi-distant from the optic nerve, as is evident in strabismus. Double vision almost always follows the operation for its cure, till the parts become accustomed to act together.

The vanishing of images that fall on particular parts of the retina, as shown in Marriotte's experiments, is due to the fact that the rays fall directly upon the centre of the optic nerve, at the point where the middle artery of the retina passes in; and as this has no special sensibility, no impression, of course, is conveyed to the brain.

By the association of visual and tactual sensations, we obtain knowledge of various properties of bodies, such as smoothness and roughness, form, and to a certain extent, of distance. In the latter both eyes seem to be required. The distinctness of outline also assists us in the estimate of distances, haziness of outline being generally associated with distance. If we know the *real* size of an object, we often judge of its distance by its *apparent* size.

Impressions made upon the retina continue for some time after the removal of the stimulus. It is this which causes the appearance of *a circle* of light when an ignited point is rapidly moved in a circle. It also accounts for the optical delusion in the toy called thaumatrope.

The phenomena of *accidental colours* is thus explained. When the eye is steadily fixed for a length of time upon one particular colour, as for instance, upon a red wafer, the retina becomes fatigued and loses its impressibility to that colour; if now the eye be turned to a white ground, a spot having a different colour will be seen; this will be made up of all the colours of the solar spectrum, *minus the red*, and the resulting one colour is called the *complementary* or *accidental colour*. In this case it will be bluish-green. The laws of harmonious colouring in painting, are founded upon the combination of complementary colours.

The subjective phenomena of vision are familiar to all. Examples are seen in the flashes of light before the eyes in congestion of the

brain; and that also result from blows that jar the optic nerve or ganglia.

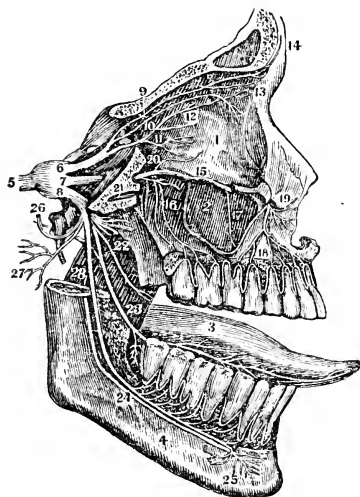
The mal-appreciation of colours, like the deficient musical ear, is rather an encephalic defect, than in any way connected with the visual organ itself.

#### THE ENCEPHALIC NERVES.

The only encephalic nerves whose functions have not been alluded to, are the *fifth*; *portio dura* of the *seventh*; and the *eighth pairs*. The *fifth* and *eighth pairs* combine the functions of *sensitive* and *motor* nerves. The *portio dura* is entirely *motor*.

The *fifth pair* presents a remarkable resemblance to the spinal nerves in its mode of origin. It arises by two roots, a larger and a smaller; the larger is involved in a ganglion, and the two are quite distinct until after the formation of the ganglion. The trunk of the nerve separates into three branches, the *ophthalmic*, the *superior maxillary*, and the *inferior maxillary*. The first two consist exclusively of fibres derived from the posterior, or larger root, and ganglion; the third is composed of fibres from both roots: it is the only portion that is strictly compound, (Fig. 36.)

Fig. 36.\*



The ophthalmic and superior maxillary being composed of fibres from the posterior root, are exclusively *sensitive*. The inferior maxillary is both *motor* and *sensitive*. The ophthalmic and superior maxillary are distributed entirely to sentient surfaces; division of them, therefore, destroys the sensibility of those parts, without impairing the muscular action. The inferior maxillary sends some branches and motor filaments to the mus-

cles of mastication; the others go to the integuments of the lower part of the face, and the mucous membrane of the mouth and tongue, which they supply with general sensibility. Division of these last destroys the general sensibility in the parts to which they are distri-

\* A view of the distribution of the fifth pair. 6. First branch of the fifth pair or ophthalmic. 7. Second branch or superior maxillary. 8. Third branch or inferior branch. For other references, see Anatomy.

buted, and also puts a stop to the movements of mastication. Painful affections of the face (neuralgia) have their seat in the sensitive branches of this nerve.

The *portio dura* of the seventh pair is the *general motor nerve* to the face, (Fig. 37.) The muscles supplied by it are chiefly those upon which the aspect of the countenance and the balance of the features depend. It is sometimes called the *nerve of expression*. The acts of closing the eyelids and frowning depend on this nerve.

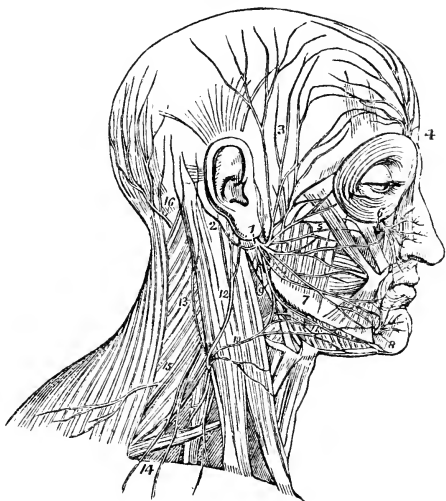
Subsequently to its entrance into the canal from which it emerges, it receives sensory filaments from the fifth, and some cervical nerves, which cause irritation of its several branches to produce pain. Section of the nerve, at its emerging from the stylo-mastoid foramen, is followed by paralysis of the muscles of the face and eyelids.

It was formerly thought to be the seat of *neuralgia*, and was upon several occasions cut. The only result was *paralysis of that side of the face, total loss of control over the features, of the power of frowning, and of closing the eyelids*. The *portio dura* is also the channel of the reflex movements concerned in respiration, but it is not at all concerned in mastication.

The *eighth pair of nerves* is made up of three others, the *glossopharyngeal*, the *par vagum* or *pneumogastric*, and the *spinal accessory*, (Fig. 38.) The conclusions that have been arrived at by physiologists in relation to these nerves, can alone be stated here.

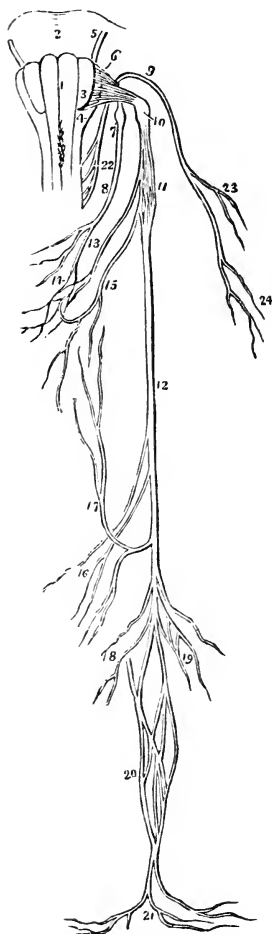
The *glossopharyngeal* is the *sensitive nerve* of the mucous membrane of the fauces and of the root of the tongue, and in the latter situation it ministers to taste and touch, as well as to common sensibility; and being the sensitive nerve of the fauces, it is probably concerned in the feeling of nausea so readily excited by stimulating the mucous membrane of this region. Such are its peripheral or-

Fig. 37.\*



\* Distribution of the facial nerve. 1. Facial nerve escaping from stylo-mastoid foramen. For references, see Anatomy.

Fig. 38.\*



ganization, and central connexions, that stimulation of any part of the mucous membrane in which it ramifies, excites instantly to contraction all the faucial muscles supplied by the vagus and the facial nerves, and the permanent irritation of its peripheral ramifications, as in cases of sore throat, will affect other muscles supplied by the facial nerves also. It is, therefore, an *excitor* of the movements necessary to pharyngeal deglutition.

The *par vagum*.—The following conclusions may be adopted respecting the functions of this nerve and its branches.

1. That the vagus nerve contains filaments both of *sensation* and *motion*.

2. That its pharyngeal branches are *motor*.

3. That its superior laryngeal branch is the *sensitive* nerve of the larynx, containing a few motor filaments to the cricothyroid muscle.

4. That the inferior laryngeal is the principal *motor* nerve of the larynx.

5. That the cardiac branches exert a slight influence on the movements of the heart.

6. That its pulmonary branches contain both *motor* and *sensitive* filaments, and exercise an important influence upon the respiratory acts, for they cannot be destroyed without retarding materially the respiration, impeding the passage of the blood through the lungs, and causing œdema of these organs.

7. That the œsophageal branches are the channel through which the muscles of that tube are excited, through the

medulla oblongata, to contract.

8. That the gastric branches influence the movements of the stomach, and probably in some degree the secretions and the sensibility of its mucous membrane; but that their integrity is by no

\* Origin and distribution of eighth pair of nerves. 6. Origin of the glosso-pharyngeal nerve. 8. Trunk of the nerve. 9. Spinal accessory, 10. Ganglion of the pneumogastric. 22. Origin of the spinal accessory.

means essential to the continuance of the secretion, or to complete chymification, (Todd and Bowman.)

The *spinal accessory* is so called in consequence of its extensive connexion with the upper part of the spinal cord. Of its two branches, the *internal* is probably *sensitive*. The *external* is distributed to the *sterno-cleido-mastoideus* and *trapezius* muscles, some of its filaments inosculating with the cervical plexus, and is *motor* in its functions. The movements excited by irritating it, are of a direct, and not of a reflex character.

### MUSCULAR MOTION.

The muscular system forms part of the apparatus of animal life, inasmuch as it is the instrument by which nervous energy operates upon external objects. The contractility which it manifests on the application of a stimulus, is an endowment derived from its own structure, and not from the nervous system. The presence of this contractility is connected with the healthy nutrition of the tissue, and with its due supply of arterial blood : the separation of any muscular part from its nervous connexions has none but an indirect influence on its properties.

The development of muscles, their physical and vital properties, their mechanical adaptation as moving agents, having been already described, (pages 36, 37,) but little remains to be added.

There is one form of *contractility* which produces a *constant* tendency to contraction in the muscular fibre, but which differs from simple elasticity from the fact that it exists after death and before decomposition takes place. This is called *tonicity*, and it manifests itself in the separation or retraction that takes place between the divided ends of a living muscle, as in amputation. It also shows itself in the permanent flexure of the joints when the extensors are paralysed, as in lead palsy. In the healthy state the tonicity of the several groups of muscles is counterpoised, but the balance is destroyed when the tonicity of one set is lost or impaired.

The tonicity is greater in the non-striated than in the striated ; it is this property that keeps the walls of the arteries contracted upon their contents. It is increased by cold, and diminished by heat. The *rigor mortis*, as already described, is probably to be regarded as a manifestation of this property.

The *energy* of muscular contractions is seen in the various feats of strength performed by jugglers, &c. It is very much increased by continued exercise. Much, however, depends upon the mechanically advantageous application of the power ; persons of ordinary strength may in this way perform feats that would seem incredible.

An idea of the *rapidity* of muscular contractions may be had by estimating the number of letters that can be pronounced in a given time. Some persons can pronounce 1500 in a minute ; each of

these requires a separate contraction of muscular fibres, followed by a relaxation of equal length. Each contraction must therefore have occurred in one-tenth of a second.

The production of *voice*, or vocal sounds, depends upon the application of muscular power to the vocal instrument, and is therefore properly considered under this head.

#### OF THE VOICE AND SPEECH.

The voice is produced when the air is expelled from the lungs; every one knows it is impossible to articulate sounds with the mouth and nose closed. It must be remembered that vocal sounds, and speech are two very different things; the former may be produced in great perfection, where there is no capability for the latter. The voice is formed in the larynx; the modifications of it by which speech is formed, are effected in the cavity of the mouth. The natural voice, or *cry*, exists in nearly all animals. Man alone, it is believed, has the power of producing articulate sounds or *language*.

The larynx consists of four cartilages. The *cricoid*, the *thyroid*, and two *arytenoid*. The *cricoid* is the lowest of these; it surmounts the trachea, and is shaped like a seal-ring, having its deepest portion behind. The thyroid is situated above the cricoid, with which it is articulated by its lower cornua, in such a manner that its lower front margin may be made to approach or recede from the upper margin of the cricoid. The higher the tone, the more nearly do they approximate. The *arytenoid* cartilages are situated upon the posterior and superior portion of the cricoid, with which they are articulated also in a movable manner. From the tips of the arytenoid cartilages, to the inner front of the thyroid, are stretched the two pairs of vocal ligaments, composed of yellow elastic tissue, and named the *superior and inferior vocal ligaments*. The whole interior surface of the larynx is lined by mucous membrane, which is reflected over the vocal cords, dipping down into the spaces between them to form the *ventricles of the larynx*, or, as they are sometimes called, ventricles of Morgagni, or of Galen (Fig. 39). Upon the varying degree of tension of the vocal ligaments depends the variety of tones of which the voice is susceptible. For the production of vocal tones the ligaments of the opposite sides are also required to be brought into approaching parallelism with each other, by the approximation of the points of the arytenoid cartilages, whilst in the intervals they are separated from each other, and the *rima glottidis*, or fissure between them, assumes the form of the letter V (Fig. 40).

The muscles that are concerned in governing the pitch of the notes, by regulating the tension of the cords, and those that govern the aperture of the glottis are the following. (The table is derived from Carpenter's Human Physiology.)



Fig. 39.\*

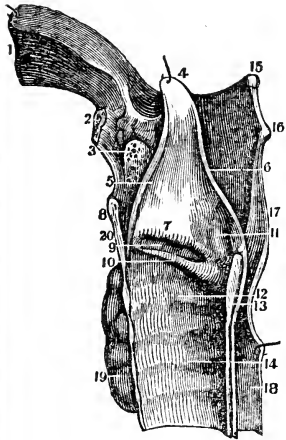
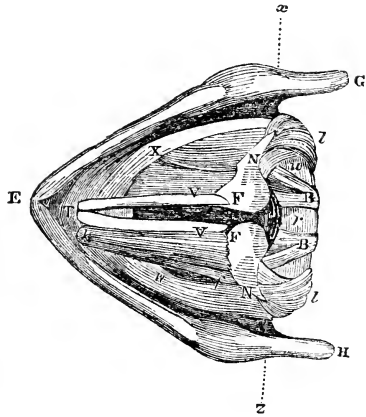


Fig. 40.†



GOVERN THE PITCH OF THE VOICE.

- |              |   |                           |   |   |
|--------------|---|---------------------------|---|---|
| Antagonists. | } | <i>Crico-thyroidei,</i>   | } | Depress the front of the thyroid cartilage on the cricoid, and stretch the vocal ligaments; assisted by the arytenoideus and crico-arytenoidei postici. |
|              |   | <i>Sterno-thyroidei,</i>  |   |   |
| }            | } | <i>Thyro-arytenoidei,</i> | } | Elevate the front of the thyroid cartilage, and draw it towards the arytenoid, relaxing the vocal ligaments.  |
|              |   | <i>Thyro-hyoidei,</i>     |   |   |

GOVERN THE APERTURE OF THE GLOTTIS.

- |                                     |   |                           |
|-------------------------------------|---|---------------------------|
| <i>Crico-arytenoidei postici,</i>   | } | <i>Close the glottis.</i> |
| <i>Arytenoideus,</i>                |   |                           |
| <i>Crico-arytenoidei laterales,</i> |   | <i>Open the glottis.</i>  |

The muscles that relax or stretch the vocal ligaments are concerned in voice alone. Those that govern the aperture of the glottis are also concerned in respiration, regulating the amount of air received. They are also the seat of the spasmodic affections of the larynx which so often occur in children.

The vocal apparatus has been compared to various instruments, such as *stringed instruments, flutes, and reed instruments*. It is not justly compared to a stringed instrument, inasmuch as the cords are too short to produce all the varied notes of which the human voice is capable, more especially the lower notes. Besides which they are covered with mucous membrane, which would act effectually as a damper upon them.

\* Vertical section of the larynx to show its internal surface. 7. Superior vocal ligaments. 8. Section of thyroid cartilage. 9. Ventricle of Galen. 10. Lower vocal ligament. 11. Arytenoid cartilages. 12. Inside of cricoid cartilage.  
 † Larynx from above. G. E. H. Thyroid cartilage. N. F. Arytenoid cartilages. T. V. T. V. Vocal ligaments. N. X. Crico-arytenoideus lateralis. V. k. f. Right thyro-arytenoideus. N. l. N. l. Crico-arytenoidei postici. B. B. Crico-arytenoid ligaments.

Neither can they be compared to a flute pipe, in which the sound is produced by the vibration of the column of air contained in the tube, and the pitch of the note determined by the length of the column, slightly modified by its diameter. There is nothing in the form or dimensions of the column of air between the larynx and mouth which can be conceived to render it capable of such vibrations as are required to produce the tones of the human voice.

The third class of instruments are the *reeds*, and to these the vocal organ bears more analogy than to any of the others. In the reed instrument, a thin plate or lamina vibrates freely in a frame that allows the air to pass readily round it. In the accordion the variations in the tone are produced by different lengths in the reeds. In the vocal apparatus there are laminæ formed by stretching the mucous membrane over the vocal ligaments, and by increasing or diminishing the tension of these, various notes can be produced. In this respect it resembles a reed instrument. In regard to the production of falsetto notes nothing certain is known. Muller supposes that in them merely the border of the glottis vibrates.

The *intensity* of the voice, or, as it is commonly called, the *volume* of the voice, results in part from the force with which the air is driven from the lungs, and from the size of the thoracic cavity; and in part from the facility with which the vocal cords of other parts of the larynx are able to vibrate. These modifications explain the difference which exists between the male and female voices. The vocal cords in the male are longer than in the female in the proportion of 3 : 2, and their voices are commonly an octave lower.

The power of the will in determining the exact degree of tension necessary to produce a given note, is extremely remarkable. The natural compass of the voice in most persons is two octaves or 24 semitones. Now a singer can produce ten distinct intervals between each semitone, or 240 intervals. There must, therefore, be 240 different states of tension of the vocal cords all produceable at pleasure when a distinct conception exists as to the tone required. And all these different notes can be produced without a greater variation in the length of the vocal cords than one-fifth of an inch.

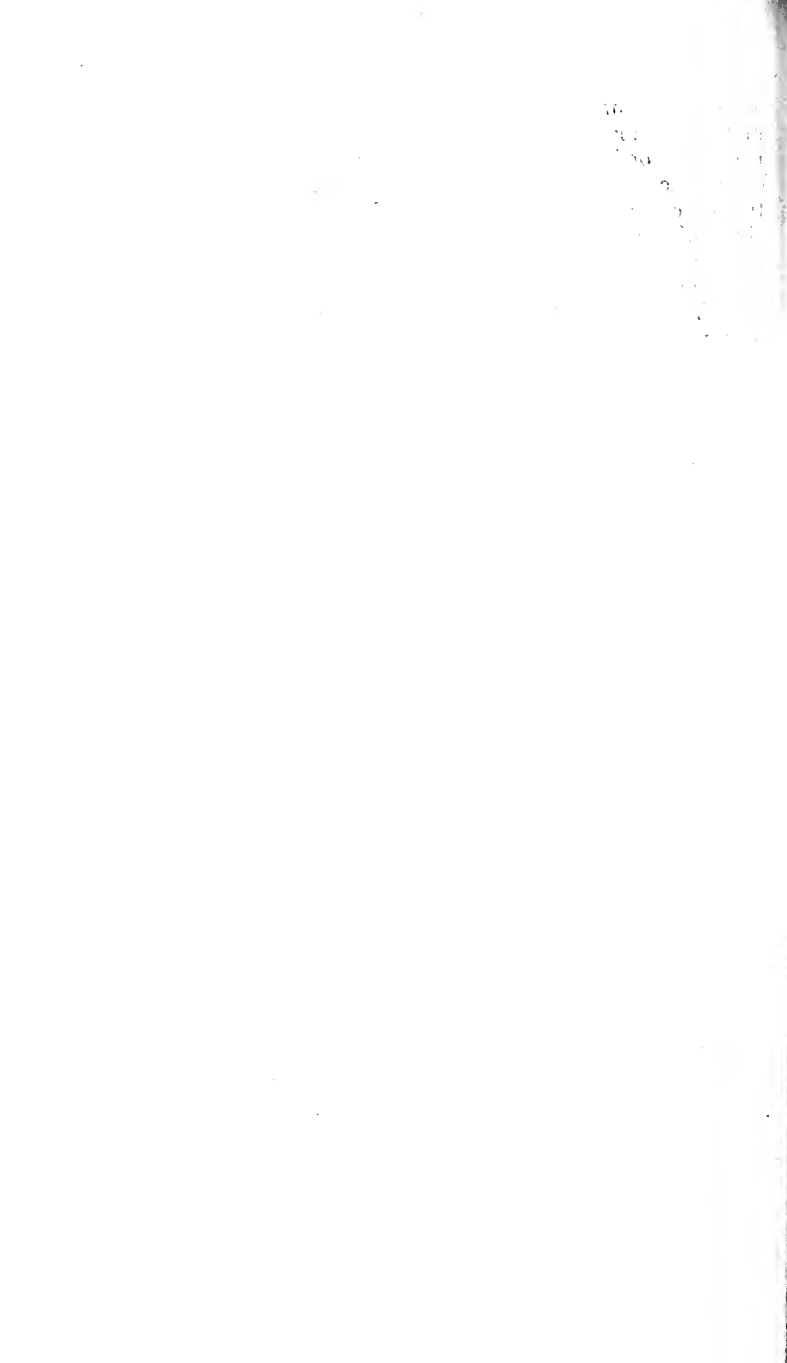
The peculiar *timbre*, or *quality* of the voice which each person possesses, and its imperfections, depend on the smoothness or roughness of the cartilages of the larynx, or on the different aptitudes for vibration which the parts of the organ possess.

In the production of voice the *inferior ligaments* are the important agents. If we remove the superior ligaments, voice continues, though more feeble; but if we divide the inferior ligaments, voice is destroyed. Even the ventricles of the larynx may be cut into and yet voice continue. The use of the ventricles is to allow free vibration of the vocal laminæ.

All the articulated tones or sounds which form the basis of speech

are produced under the conjoint influence of the larynx, fauces, and mouth. In the majority of instances, the whole, or the greater number of the organs included in the mouth co-operate in producing each articulate sound. The vowels alone are primarily formed between the vocal chords, and are continuous sounds, modified by the shape of the aperture through which they pass out. The sound of consonants is formed by some kind of interruption to the voice, so that they cannot be properly expressed unless joined with a vowel. It is the latter which commonly offer the greatest difficulty to the stammerer, especially those which are called *explosive*.

THE END.







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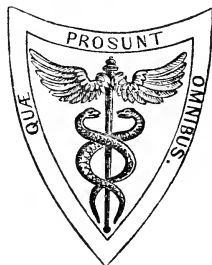


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WITH FIFTY ILLUSTRATIONS.  
BEING A PORTION OF  
AN ANALYTICAL COMPEND  
OF THE  
VARIOUS BRANCHES OF MEDICINE.

BY  
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DEMONSTRATOR OF ANATOMY IN THE UNIVERSITY OF PENNSYLVANIA, LECTURER  
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PHILADELPHIA:  
LEA AND BLANCHARD.  
1848.

Entered, according to Act of Congress, in the year 1848,  
BY LEA & BLANCHARD,  
In the Clerk's Office of the District Court for the Eastern District of  
Pennsylvania.

C. SHERMAN, PRINTER,  
19 St. James Street.

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# SURGERY.

## INFLAMMATION.

THE *immediate* or *proximate causes* of inflammation have been variously ascribed to viscosity of the blood, to enlarged blood-globules obstructing the capillaries, to a spasm of the extreme vessels, to an increased action, to a debility, to a paralysis, to an injury of the nerves, to an attraction of the red globules, to a rapid union of the inflamed parts with oxygen, to abnormal nutrition. The theory which is best substantiated by facts is the following:—The blood circulates with greater rapidity and abundance in the capillaries of an inflamed part; this is followed by exudation of lymph in the interstices; subsequently the blood stagnates in the focus of the inflammation, by the adhesion of the red globules to each other, and to the sides of the capillaries; finally, the tissues are broken down and disorganized, pus is formed, the blood ceases to circulate, and the parts mortify.

The *symptoms* are redness, swelling, heat, pain, throbbing, increased sensibility, disorder of function, arrest and change of secretion.

*Redness*.—This is due to an afflux of blood to the part; the vessels become distended, and the capillaries convey red blood; the proportion of the red globules is also increased by the exudation of the serum. The *degree* varies in different tissues, and according to the intensity of the action; compare, for instance, an inflamed tendon with an inflamed mucous membrane. The *tint* varies also between a bright scarlet and a deep purple. *Permanency* is characteristic of inflammatory redness. The redness of blushing is not indicative of inflammation, because it is momentary, and not conjoined with other symptoms.

*Swelling*.—This is occasioned by the increased quantity of blood, and an effusion of serum, pus, &c. The swelling of inflammation must be conjoined with other symptoms also, for in œdema there is swelling, but not inflammation. It must be *gradual* in its development: the sudden swelling produced by a hernia or dislocation is not that of inflammation. It must also be recent, not like the tedious growth of a genuine tumour. Swelling may be injurious, as in the brain or orbit of the eye; or it may be useful, as in a fracture, &c.

It is most remarkable in loose textures; also in the breast, testicles, and lymphatic glands.

*Heat.*—This depends upon a more rapid oxidation of the tissues, which are also supplied with an increased quantity of blood. Heat of inflammation may be partly actual, as ascertained by the touch or the thermometer, and partly the result of a perverted nervous function, estimated only by the patient. It must be permanent, and conjoined with other symptoms to be characteristic, for in hectic there is burning of the hands and feet, yet no inflammation is there.

*Pain*—is caused partly by the pressure upon the nerves of the inflamed spot, and the distension of the arteries which are supplied by small nerves; and partly by disordered function. Mechanical pressure increases it, for instance, by the hand in peritonitis, or inspiration in pleurisy. Pain varies with the natural sensibility of the part affected, hence inflammation of the skin is more painful than that of cellular tissue. It is proportionate to the yielding nature of the structure affected; thus inflammation produces more pain in bones and ligaments, than in mucous membrane.

Pain is not always indicative of inflammation—for example, in spasm and neuralgia. In spasm the pain comes on suddenly, and is relieved by pressure; in neuralgia it is intermittent. Not so with inflammation—in the latter the pain gradually increases from the first; if it suddenly disappears suspicion is excited lest gangrene has supervened. Pain may be sympathetic, and referred to a part at a distance: in coxalgia, the pain is at the knee; in liver disease, in the shoulder; in disease of the kidney, at the orifice of the urethra. This is a point of practical importance in the application of remedies.

*Increased sensibility.*—This may be illustrated by intolerance of light when the eye is inflamed; the tenderness of the skin in erysipelas; the rejection of food by the stomach, and the constant urination if the bladder is the seat of inflammation.

*Disorder of function.*—The stomach cannot digest, nor the kidney secrete. If the brain or spinal cord be the seat, we may expect convulsions, or paralysis.

The *causes of inflammation* may be divided into *predisposing* and *exciting*.

*Predisposing causes.*—Include sanguine temperament, excitability; plethora, excess in food, drink, or exercise; debility, miasmata, bad air, food, and clothing; previous disease, &c. These may be considered as constitutional or idiopathic.

*Exciting causes.*—May be *direct*, such as the chemical effects of acids, salts, &c.; or mechanical effects of wounds, pressure, &c. *Indirect*, or vital, such as heat and cold, cantharides and turpentine. *Specific*, as in the instance of vaccine virus.

The *duration* and *character* of inflammation are modified by the nature, situation, and condition of the part affected, and the tempera-



ment and diathesis of the patient. Age, sex, habit, atmosphere, and season, all exercise an important influence in its progress and type.

## RESULTS OF INFLAMMATION.

1. *Resolution*.—This is the most favourable result. It is the restoration of the part, as regards both structure and function, to its original and normal state. Effusion takes place, the vessels are relieved, the red globules move on, absorption takes place, and the usual symptoms subside. *Delitescence* is the *sudden* disappearance of inflammation; and when it is attended by the establishment of a new one, the term *metastasis* is used.

2. *Excessive deposit*.—Either of serum or fibrin, which has exuded through the coats of the vessels. When *serum* is effused into cellular tissue it constitutes *œdema*, which is characterized by *pitting* on pressure; when effused and collected in serous membranes, it constitutes *dropsy*. The effusion of fibrin requires a higher degree of inflammation, upon the subsidence of which new structures are formed by the organization of the fibrin, and parts are repaired; hence the term *plastic* is applied to it. Thus wounds unite, bones knit, and arteries consolidate.

3. *Hæmorrhage*.—Occasioned by the destruction of the coats of the vessels. If it occur in the interior it is termed *extravasation*. It is usually injurious, by producing pressure and exciting irritation, as for instance, in the humours of the eye, or membranes of the brain.

4. *Suppuration*.—The formation of a fluid called pus. It is called *laudable* when it is yellow, creamy, and opaque; insoluble in water, but readily mixing with it. It has no odour, but a slightly sweetish taste. It is not corrosive, but bland and protective to tender granulations until covered by cuticle. When confined, it produces disintegration of the textures in contact, by pressure. It is the result of a vital action. It consists of a fluid and globules. The fluid is the liquor sanguinis of blood effused; this separates into serum and fibrin; the fibrin becomes granular by the formation of exudation corpuscles, and these degenerate into pus-globules. When pus is thin and acrid it is termed *ichor*, consisting mostly of serum. In scrofulous persons it is flaky. When it contains blood it is called *sanies*. When it is of a leaden colour, thick, coagulated, and very offensive, it is *sordes*. Sometimes it is mixed with a subtle virus, as the venereal or vaccine; it is then said to be *specific*. When mixed in the mucous or serous discharges, it is termed sero-purulent or muco-purulent.

When suppuration is profuse and long continued, in a debilitated frame, it produces a fever called *hectic*, which is a constitutional irritation different from the inflammatory type. It is remittent, and attended with paleness of surface, except upon the cheeks. The appetite is good, but yet there is great emaciation. The tongue is

clean, at first moist, but afterwards dry and glazed or apthous. The bowels are constipated, or else attended with a diarrhœa, termed colliquative. The palms and soles burn, and there is great thirst. Respiration is rapid and short. The pulse is frequent and small. At noon there is increased fever preceded by a chill; at night there is perspiration, most profuse towards morning. The eyes are bright, though sunk in hollow orbits; and though there may be sleeplessness, lassitude, and debility, yet the mind is clear and the spirits are good.

5. *Ulceration*.—Hunter supposed that it was entirely the result of absorption. It is more properly a vital softening of a texture changed by inflammation and suppuration; becoming disintegrated and fluid, it passes away with the pus. The more violent the inflammation, the more rapid is the destruction; the term phagedenic is applied to those ulcerations in which the part is apparently eaten or consumed with unusual rapidity. Congestion is a predisposing cause of ulceration. The skin, mucous membranes, and cellular tissue, yield more rapidly in ulceration than the vascular, nervous, and fibrous tissues. Those of intemperate habit, and of scrofulous or syphilitic taint, are most liable to its ravages. The parts most likely to be affected are those whose circulation is weak and languid, such as the lower extremities, and parts newly formed, such as cicatrices, callus, and tumours.

6. *Mortification*.—This term includes the dying and death of a part from injury or disease. *Gangrene* denotes the process of dying, and is recognised by the following signs. Redness is changed into a livid hue; circulation is arrested, so is effusion, and there is less tension. Pain and heat abate, often suddenly. Putrescence commences, and there is an offensive smell. Phlyctenæ, or vesicles filled with putrid serum, appear over the skin. *Sphacelus* is the completion of the gangrene. The part is cold and insensible; shrunken, soft, and flaccid; crepitates distinctly, owing to its containing gas, the result of putrescence; vital action has ceased, and the colour becomes black if the parts are exposed to the air. A *slough* is a small sphacelation. Nature makes an effort to throw off an injurious mass. The living part in contact with the dead inflames; and, in consequence, the abrupt livid line is bordered by a diffuse, red, and painful swelling—the *line of demarcation*; this vesicates, the vesicle bursts, puriform matter is discharged, and an inflamed and ulcerating surface is disclosed—the *line of separation*. The furrow deepens; skin and cellular tissue yielding first, the tendon and arteries resisting for some time. No hemorrhage occurs during gradual division of the parts; the arteries are sealed by the effusion of fibrin during the inflammation. But when the mortification is rapid, as in acute hospital gangrene, arteries are found playing

in the dark and putrid mass alive, whilst all is dead around them. At length they yield, and death is hurried on by hæmorrhage.

The *constitutional symptoms* are of a typhoid form. The pulse is frequent and small, irregular or intermittent. The countenance is anxious, the face livid, the nose pinched, and the lips contracted.

Anxiety is soon changed into stupidity of expression, as if the patient were under the influence of opium or alcohol; sighing, hiccup, and involuntary movements of the hands and fingers are now observed, such as picking and fumbling with the bedclothes. Appetite fails; the tongue is coated with a brown fur, except at the tip and edges. The lips and mouth are dry and incrustated; swallowing is difficult. The mind is stupid, wavering, and subject to illusions; the articulation is thick and broken. Still more marked are the deathlike coldness, the clammy sweat, the small, indistinct, and flickering pulse, and the cadaverous expression. In this state a patient will sometimes lie for hours, and die without a struggle.

Mortification may be *acute* or *chronic*. The acute comprehends the humid, inflammatory, and traumatic. The chronic—the dry and idiopathic.

The *cause* of mortification is a *want of vital power*, and may be the result of high inflammation, mechanical injury, pressure, heat, obstruction to the return of venous blood, deprivation of nervous agency, interruption to arterial supply, as by aneurism or tourniquet, cold, general debility, bed-sores, improper food, spurred rye.

#### TREATMENT OF INFLAMMATION.

The first object is always to remove the cause, and afterwards to prevent or diminish the inflammatory action. The chief means are termed antiphlogistic, and consist of

*General Bloodletting*.—This is only required when the inflammation is severe, as in erysipelas, and compound fractures, when important organs are involved, such as the lungs, bladder, kidney, eye, and peritoneum. If resorted to unnecessarily, it produces congestions, effusions, and atrophy. *Syncope*, or fainting, is produced when bleeding is pursued to a great extent. It is occasioned by the removal of the natural stimulus of the heart—the blood, and by the sedative influence transmitted from the brain, when deprived of its share of arterial blood. The benefit to be derived from bleeding is not merely the loss of superabundant blood, but also the sedative influence, whereby the emptied capillaries can resume their natural tone. A rapid full stream from a large orifice will soon produce syncope, if the patient be sitting or standing; whereas the system may be almost drained of blood by a slow stream from a small aperture, before faintness ensues, if the recumbent position is maintained. Bleeding is not to be regulated by its *amount*, but by its *effects*. As a general rule, the blood should flow until there is some

paleness of the lips, sighing, nausea, fluttering of the pulse, or relief of pain. The ability to bear bleeding will vary according to age, sex, temperament, and disease. A man in health will faint usually from the loss of fifteen ounces; the same person, with a severe inflammation, particularly of the head, will bear double that amount. *Reaction* takes place after bleeding, the pulse rises, and pain increases, often to such an extent, as to require a second amount to be taken. A smaller quantity will now produce the same effects as a large one in the first instance. The operation is usually performed at the bend of the arm, in the neck, or in the anterior temporal artery.

*Local Bleeding.*—This is preferable when the inflammatory action is not high; when the powers of the system are low, when the inflammatory action on the part has been fully established, and there would be no benefit from a general bleeding, and when extreme age forbids it.

*Cupping.*—By this means blood is obtained more rapidly than by leeches, and we have the advantage of general bleeding combined with local abstraction.

*Leeching.*—Leeches can be applied where cups cannot. In order to apply them, the part should be first washed, and if they will not stick, a little cream or blood should be smeared on it. Their appetite is increased by being dry. If slow to bite, immersion in warm porter will be useful. Their bites are sometimes troublesome from hæmorrhage. This is arrested by the mur. tinct. ferri, or a fine point of nitrate of silver. American leeches will draw a 3 or 3iss. of blood; foreign leeches take an 3 or 3iss. Salt will occasion them to drop off.

*Purgatives.*—They deplete, by causing an increase of mucous exhalation from the bowels. They also act as derivant, prevent assimilation of nutrition, and promote absorption; they are particularly useful in diseases of the head, but are contra-indicated in bad fractures, and inflammatory affections of the bowels.

*Emetics, diaphoretics, and diuretics* are useful at the outset, emptying the stomach, and promoting perspiration, particularly the tart. ant. et potassæ.

*Mercury.*—Not only as a purge, but gradually introduced into the system, it seems to exert a tonic effect on both the extreme blood-vessels and the lymphatics; that is, in the exhalents and absorbents, thus preventing or limiting impending effusion, and at the same time expediting the removal of that which had already been exuded.

*Opium.*—Particularly useful when combined with calomel, and given after bleeding. Before bleeding it arrests secretion, and stimulates,—afterwards, it soothes the nervous system, relieves pain, and prevents reaction.

A strict *diet* must be maintained, and the drink should be refri-

gerant ; at the same time both body and mind should be at rest, and there should be a good supply of fresh air.

*Local Remedies.*—Complete rest of the inflamed part. Elevated position, so as to favour the return of blood. Cold applications, ice-water, solution of sugar of lead, and muriate of ammonia—especially in the early stages ; for in high inflammations warmth and moisture are very grateful to some persons—relaxing tension, and assuaging pain. Nitrate of silver has great antiphlogistic powers, as well as caustic properties, especially when applied to the skin and mucous membranes. Iodine also exerts a somewhat similar influence.

*Counter-irritation.*—By means of dry cupping, blisters, setons, issues, caustic, and actual cautery.

## ABSCESS.

An abscess is a collection of pus in a part or cavity, and may be either acute or chronic.

*Acute Abscess.*—Is frequently called *phlegmon*, when occurring in the subcutaneous cellular tissue. Commencing with all the symptoms of inflammation,—fever, pain, redness, and swelling. The centre is firm, with œdema surrounding it. The formation of pus is indicated by rigors, an abatement of the fever, and a feeling of weight, tension, and throbbing. The centre softens, which is termed *pointing*, and *fluctuation* can be felt. There is a natural tendency to the discharge of pus, which is more apt to be towards the skin. It is less apt to open into serous than into mucous membranes. The matter having been discharged, the pyogenic membrane lining the cavity becomes covered with numerous small, red, vascular eminences, called *granulations*. They are formed by the organization of lymph.

The cavity contracts and fills up with granulations. A white pellicle extends from the circumference, gradually covers the whole surface, and becomes organized into a new cutis and cuticle, called a *cicatrix*. At first the cicatrix is thin, red, and less vascular ; it afterwards contracts and becomes paler.

The causes of abscess are mostly idiopathic ; it occurs frequently after fevers ; it may, however, be caused by blows, foreign bodies, &c.

*Treatment.*—The indications are, in the first stage to produce resolution, and prevent the formation of matter. After it has formed, the indications are to cause its evacuation, and induce granulation and cicatrization. There should be cold applications, and leeches applied to the part, purging, and low diet. When matter is formed, the applications should be warm fomentations and poultices. Poultices may be made of bread, Indian meal, or ground flaxseed softened with water ; they should be large and light, and renewed

frequently: they relax the skin, promote perspiration, soothe the pain, encourage the formation of pus, and hasten its progress to the surface. Lint soaked in warm water may answer for a substitute.

Abscesses need not be *opened* if they point, and are pyramidal, and do not enlarge in circumference, but allowed to burst themselves. But they should be opened when they are beneath tendons, fascia, or the thick cuticle; when caused by the infiltration of urine; when in loose cellular tissue, with a tendency to burrow; when near a joint, or under the deep fascia of the neck,—where it is desirable to obviate the scar made by the abscess opening spontaneously. The best instrument for the purpose is a straight-pointed, double-edged bistoury, by which the opening can be enlarged to any extent. The matter should not be forcibly squeezed out, but allowed to exude gradually into a poultice. By introducing a tent the edges are prevented from uniting.

Abscesses are sometimes absorbed, especially those in glandular structures and venereal cases. This can be promoted by leeches, mercurial ointment, and remedies adapted to increase the general health.

*Chronic abscess.*—Is the result of a low degree of inflammation, and is often unsuspected. It is lined by a cyst, and the pus is serous or curdy. Sometimes the matter is concrete. Is most apt to occur in weak and scrofulous habits, and is usually free from pain, redness, swelling, &c. It may, however, become exceedingly large, and from distension, inflame, ulcerate, and discharge.

*Treatment.*—Improve the general health, and promote absorption by means of mercurial plasters, blisters, and iodine frictions. If it cannot be absorbed, it must be opened with care; a small, superficial abscess should be opened freely at once, the cavity injected with a stimulating solution, and pressure applied by means of compress and bandage. If the matter is not freely evacuated, great injury results from the effect of air on the contained pus; putrefying, the product—hydrosulphate of ammonia is absorbed, and the patient becomes typhoid. When the abscess is large, the opening should be small and valvular, so as to prevent the introduction of air; or, the opening may be healed after a portion of the matter has escaped, and another made ten days afterwards; or, the part may be kept constantly immersed in water.

#### ULCERS.

Ulcers are breaches of continuity of surface, the destruction being caused by disease or unrepaired injury. The following classification will be found to include the great majority of ulcers.

*Simple or Healthy Ulcer.*—In this we have an exemplification of granulation and cicatrization. The surface is covered with a thick, creamy, yellow pus, not too profuse, and inodorous. The granula-

tions are small, pointed, florid, sensitive, and vascular. When they reach the level of the skin, cicatrization commences. The edge swells a little, and then is covered with a white pellicle of lymph, which is converted into cuticle.

*Treatment.*—The plan of the treatment is simply protective. Pus is the natural protection to these granulations; if, however, it collects, it becomes a source of injury, increasing ulceration. The air acts as a stimulus, and may cause too great inflammation. Hence the propriety of dressing. It should be lint dipped in tepid water or some simple cerate; water dressings are now preferred. The dressing should only be removed for the sake of cleanliness and removing the fluid pus; but care should be taken not to wash the surface too freely, else the progress of cicatrization is delayed by the removal of lymph which may be mistaken for pus.

*Weak Ulcer.*—If the granulations are too luxuriant, becoming pale and flabby and long, they should be treated by an astringent wash, such as a solution of sulphate of zinc or copper; or they may require an escharotic, such as solid sulphate of copper or nitrate of silver; or a scab may be formed by exposure to the air, or spreading fine lint upon the surface; at the same time a generous diet will be beneficial.

**SCROFULOUS ULCERS.**—These occur in debilitated constitutions, and usually in clusters; most frequently upon the neck and joints. They originate in the cellular tissue, beneath the skin. At first, there is hardening, without pain, then swelling, followed by imperfect and slow suppuration; the skin becomes blue and thin, and the aperture for the discharge has ragged edges, revealing a dirty gray surface, with no granulations; the integument is soon undermined, and the ulcers communicate. The pain is slight, and the discharge is thin and serous. The system sympathises and the result may be hectic.

*Treatment.*—Constitutional remedies should be steadily persevered in. Active measures must be taken to get rid of the soft infiltrated tissue surrounding, by escharotics; caustic potash must first be freely applied, and then a poultice; upon its removal a slough will be found to have separated, and the surface to be firm and vascular, covered with healthy granulations. The sore may then be treated as a healthy one, unless a relapse occur, when the application should be repeated. The constitution must be sustained, and the cicatrix supported by a bandage; otherwise it may ulcerate, especially if it is blue, soft, spongy, and elevated.

**INDOLENT ULCER.**—This is the most common of all ulcers, and occurs most frequently in the lower extremity and in old persons. It is owing frequently to a healthy sore having been neglected or badly treated. Its surface is smooth, glassy, concave, and pale. The discharge is thin and serous. Its margin is elevated, round, white, and callous, resembling a cartilaginous ring surrounding a mucous

membrane. The surrounding integument is swollen, hard, and of a dusky red colour.

It has little sensibility, and the patient is apt to let it go unnoticed, unless by accident, exposure, or over-exertion, it inflames and becomes painful.

*Treatment.*—At first a poultice will be serviceable by cleansing the sore and diminishing the inflammation and pain which usually precedes the application for relief, which a purge and rest will assist in producing. The surface should be lightly touched with nitrate of silver or nitric acid, in order that healthy granulations should sprout; or, pressure may be employed to produce the same effect by means of strips of adhesive plaster and bandages. Small doses of opium are also useful in maintaining the capillary circulation.

**IRRITABLE ULCER.**—This has been defined as possessing an excess of organizing action, with a deficiency of organizable material. It is superficial, having an unequal surface of a dark hue, and often covered with tenacious fibrin. It occurs most frequently near the ankle. The edges are thin, serrated, and everted. The discharge is thin, acrid, and bloody. It is very sensitive, attended with great pain, and produces often peevishness of disposition.

*Treatment.*—Rest, elevation, and relaxation of the part. Nitrate of silver produces a sedative and antiphlogistic effect. This should be followed by a light poultice, or warm-water dressing, or, if there is great pain, fomentations of the infusion of opium, conium, or belladonna.

*Phagedenic Ulcer.*—This is of an irregular form, with ragged, abrupt edges, and uneven brown surface, looking as if gnawed by the teeth of an animal. It is attended with burning pain, and great constitutional disturbance.

It frequently assumes a sloughing form, as in hospital gangrene, and cancrum oris, where the discharge is extremely fetid.

*Treatment.*—Should be both constitutional and local. Fresh air and good diet are all-important; the secretions must be corrected and a Dover's powder given at night. Locally, there should be applied active escharotics, such as nitric acid, nitrate of mercury, &c., followed by warm poultices; these may be superseded by warm solutions of the chloride of lime or soda. Mercury must never be given, especially in cases of a venereal taint.

**VARICOSE ULCER.**—This is dependent upon a varicose condition of the veins, and usually occurs in the leg, just above the ankle. They are oval and superficial, and attended with deep-seated, aching pain. They are indolent, and usually moist upon the surface.

*Treatment.*—The cure must depend upon removing the disease of the veins. Great relief will be found in the constant use of cold water, rest, regular bandaging, or laced stockings.

*Certain ulcers are not to be healed, for example, when an ulcer*



has been stationary for years, when the patient is old, gouty, or a high liver; it may be looked upon as a safety valve, and any tendency to unite as indicative of impaired health. The sudden cessation of a drain of pus might be followed by hemorrhage, apoplexy, or inflammation of some important organ.

#### ERYSIPELAS.

Erysipelas is an inflammation of the skin and subcutaneous cellular tissue, having a tendency to spread.

The *cutaneous* form is characterized by redness, elevation, and burning pain; compression produces pale dimples, which soon disappear, and the cuticle vesicates. It usually terminates in a week or two, but may return to some other part.

The *phlegmonous* or *cellulo-cutaneous* form is more severe. The swelling is greater, the colour darker, and the pain more severe. Thin, ichorous pus is formed, which infiltrates the cellular tissue, and thus ulcerations and sloughs follow. The constitution sympathizes; at first the fever is high, then there are signs of hectic, and at last prostration and collapse.

When it affects the head or throat, producing coma or dyspnoea, and when it occurs in feeble, old, or intemperate persons, there is great danger.

The *causes* may be fatigue, foul air, intemperance, epidemic influence, contagion, and injuries.

*Treatment.*—This must be adapted to the *age* and *constitution* of the patient; the young and plethoric will require most active anti-phlogistic treatment constitutionally, whilst the old and broken down will need stimulants and tonics. In most instances, bleeding will be useful, followed by saline purgatives and diaphoretics. In highly inflammatory cases, an emetic administered early will also prove serviceable.

Bark will be necessary in the latter stages, if there is debility; opium will allay the restlessness at night.

The *local measures* most useful are leeches, punctures, cold lotions, if the pulse is good; and mercurial ointment, or nitrate of silver applied to the surface. Extension of the disease may be prevented by strips of blistering plaster, encircling the part.

Deep incisions are to be made in case there is pus collected under the skin.

Chronic, or habitual erysipelas, is best treated by alteratives and aperients.

#### FURUNCULUS, OR BOIL.

Boils occur most frequently in the young, and in those of plethoric habit, and in those parts where the skin is the thickest. They are

usually gregarious, and depend upon derangement of the primæ viæ, and frequently succeed eruptive diseases.

The swelling is of a conical shape, having a hard, red, and painful base, and a yellow apex. If left to itself it bursts and discharges pus, and a core, or slough of cellular tissue. When completely emptied the heat and pain subside.

*Treatment.*—Poultices and warm fomentations should be applied early; as soon as pus has formed a free incision must be made; and the granulating wound dressed in the ordinary way.

#### ANTHRAX, OR CARBUNCLE.

This is a serious disease; it is a solitary inflammation of the cellular tissue and skin, presenting a flat spongy swelling of a livid hue, and attended with dull burning pain. It varies in size, and its progress is slow.

The constitutional symptoms are asthenic throughout, and the attendant fever is apt to become typhoid; prostration and delirium often terminate the case. It most frequently attacks high livers of an advanced age.

*Treatment.*—A free and early incision will evacuate sanious pus and fetid sloughs; this is to be followed by applications of caustic potash, in order that the dying parts may be thoroughly removed. Poultices and warm fomentations will clean the surface, and give rise to healthy granulations. Tonics and stimuli, such as bark, brandy, ammonia, are early required, particularly if the carbuncle is large, and system debilitated.

#### PERNIO, OR CHILBLAINS.

This is an affection of the skin, produced by sudden alternations of cold and heat, most commonly affecting the toes, heels, ears, or fingers. It is attended with itching, swelling, pain, and slight redness at first; it may afterwards become of a livid hue, with vesications and ulcerated fissures, which are difficult to heal.

*Treatment.*—There is a great variety of applications in domestic use for this disease, and some of them of the most opposite character. The most serviceable remedy under all circumstances, but particularly when there is ulceration, is the nitrate of silver. Temporary and soothing relief is produced by cold applications.

#### FROST BITE.

Severe exposure, combined with exhaustion and fatigue, irresistably induces sleepiness, which, if yielded to, is followed by coma and death. When a part of the body is frost-bitten it becomes contracted, pale and insensible. It may take place without the consciousness of the patient; without care it terminates in gangrene.

*Treatment.*—Produce moderate reaction, which will restore cir-

ulation and sensibility, taking care that it be *not excessive*, which would lead to dangerous inflammation. First rub the part with snow, and then with cold water in a room without fire. For the comatose condition of the body produced by cold, also use friction with snow, in a cold room, afterwards substituting fur or flannel; gradually giving warm and stimulating drink, such as wine and water.

#### BURNS AND SCALDS.

There are three principal divisions of these injuries, which may be produced by hot fluids, vapour, flame, or solids.

1st. Those which produce mere redness and slight inflammation, terminating in resolution, and perhaps desquamation.

2d. Those causing vesications of the cuticle, which often dry up and heal; but if the cutis has been injured and inflamed, suppuration and ulceration result.

3d. Those causing the death of the part, in which there is not much pain, and which are followed by sloughs.

Extensive burns, even if superficial, are very dangerous; and those upon the trunk are more fatal than those of the extremities. The symptoms are paleness and shivering, with a feeble, quick pulse; often prostration, coma, and death. The greatest danger is during the first four or five days, from collapse; subsequently from an affection of head, chest, or abdomen, or from prostration.

*Treatment.*—Bathing the part in cold water will mitigate the heat, pain, and inflammation; afterwards it must be protected from the air by cotton, or some bland unctuous substance, care being taken to discharge the vesicles without removing the cuticle. Calm the nervous excitement with opium, and prevent sinking with wine and ammonia. Be careful of over stimulation, and promote the separation of sloughs by rest, poultices, and fomentations. Regulate the diet, and encourage granulations by water dressings, saturated with salts of copper, zinc, or silver, or with chloride of lime. Contraction of cicatrices is to be prevented by mechanical means, and the function of joints is to be retained by passive motion.

#### WOUNDS.

Wounds are classified into incised, contused, lacerated, punctured, poisoned, and gunshot.

*INCISED.*—These are produced by sharp-edged instruments, and bleed freely. They heal in various ways; *by adhesion, or union by the first intention*, in which there is no suppuration. Fibrin is thrown out, and coagulating, becomes organized, and constitutes a new living structure; incorporated with the cut surfaces, it restores the solution of continuity in the solid parts.

Wounds heal by *growth*, whereby reparation is made, without inflammation and suppuration, as in ordinary nutrition.

Wounds heal by the *modelling process*, which is somewhat similar to the last, the gap gradually filling up with lymph, and restoring the deficiency.

Wounds heal by *granulation*, constituting union by the *second intention*, a process formerly described in treating of abscess.

*Treatment*.—This consists in arresting hemorrhage, removing foreign bodies, bringing the edges together, and promoting adhesion.

*Hemorrhage* is arrested by cold applications, elevated position, and compression, or, if an artery has been cut, by a ligature, or by torsion.

*Ligatures* are usually made of silk or thread, and should be round or twisted, in order to divide the internal and middle coats of the artery. Animal ligatures are sometimes used on account of their speedy decomposition, and separation from the artery; ligatures of lead have also been used.

*Compression* can be effected by the tourniquet, bandages, and pledgets of lint; in lieu of a tourniquet a Spanish windlass may be used, which is made by tying a handkerchief around a limb, and twisting it tightly with a stick.

*Styptics* are also used where the vessels are small, and the *actual cautery* when the hemorrhage cannot be arrested by other means. Foreign bodies, such as pieces of glass, clots of blood, &c., &c., are to be removed from the wound, and the lips brought together by means of adhesive plaster applied to surfaces cleanly shaved, and free from moisture.

*Sutures*, or stitches, are to be used only when the edges cannot be approximated by other means. An *interrupted suture* is made by passing a needle, armed with a single ligature, through both lips of the wound, which are then to be drawn together without any great straining, and secured by a double knot. These stitches are to be made at intervals of about an inch, but should not be made in any tendinous structure, or highly inflamed part.

A *twisted suture* is made by transfixing the margins of the wound with a needle or pin, and passing around it a wax ligature in the form of the figure 8, by which means the edges are brought in contact; the point of the pin, or needle, is to be protected with wax, and allowed to remain for several days.

The *continued*, or *glover suture*, is nothing more than the ordinary mode of sewing cloth or leather.

**CONTUSED AND LACERATED.**—These resemble each other; are attended with little hemorrhage, because the arteries are little torn, and do not bleed so much as when cut. They are dangerous, because they are liable to inflammation and sloughing, and are often complicated with foreign bodies; and they are more apt to produce constitutional disturbance and tetanus.

*Treatment*.—Adhesion is impossible; suppuration must take place, and the dead parts be thrown off; the reparation takes place by

granulation. At first it will be necessary to arrest hemorrhage, remove foreign bodies, bring the parts in apposition by strips of adhesive plaster, and apply water-dressings, or a light poultice, according to the condition of the patient. Cold and other antiphlogistic means, such as bleeding and purging, must be used cautiously when there has been a great shock upon the system, otherwise the vitality of the parts will be depressed, and the risk of gangrene increased; but after fever and suppuration are established, the usual means of combating inflammation may be employed. When the sloughs are numerous, and the discharge profuse, typhoid symptoms will appear, especially if the patient be much reduced by depletion and rigid diet.

**PUNCTURED AND PENETRATING.**—These are inflicted by sharp-pointed instruments, and are extremely dangerous, on account of the injury done to important parts, by opening vessels and cavities, and from the diffusion of purulent secretions, and the liability of tetanus.

*Treatment.*—After ascertaining that the wound contains no foreign matter, apposition is effected, and maintained by position, rest, and dressings, and the system placed under antiphlogistic regimen; adhesion is to be expected, or reparation by granulation. There may be severe secondary symptoms arising from secondary hemorrhage, or confined purulent secretions; it may be necessary to apply a ligature upon the artery above the ulcerated wound; or, to open and dilate it for the exit of pus, or a foreign body before undiscovered.

**POISONED.**—These include bites and stings of animals, and the effects of dissecting wounds.

The stings of ordinary insects are not sufficiently severe to require surgical aid, unless in great number, and in peculiar situations. Children sometimes suffer with fever and headache, when stung in a number of places; and the suffocation produced by a sting in the pharynx is alarming.

*Treatment.*—For the common sting of a wasp or bee, remove the sting of the animal with forceps, should it remain, and apply some stimulating application, such as turpentine, cologne water, or hartshorn. Hartshorn will probably give most relief, especially combined with cold applications. If there is faintness or depression, administer wine and opium. If the sting is in the fauces, use leeches internally and externally, stimulating gargles, and, if necessary, open the trachea.

*Spiders*, especially the tarantula, *scorpions*, and *serpents*, inflict a most severe injury. The bite of the *viper*, *cobra de capello*, and *rattlesnake*, is attended with great pain, swelling, constitutional disturbance, and death. In such wounds great caution must be used to extract the poison from the wound, and to prevent its passing into the circulation. Surrounding the limb with a ligature, bathing the

wound with warm water, and sucking it, are all of use ; but the application of cupping glasses, and scarifications, is the most certain method.

The prostration of the system is to be treated with brandy and ammonia, and the pain to be relieved by opium. Various remedies are given internally, such as sweet oil and ammonia, but arsenic has a most decided preference ; the celebrated Tanjore pills each contain a grain ; the proper dose is fʒj to fʒij of Fowler's solution.

**HYDROPHOBIA.**—Hydrophobia is a disease brought on by inoculation with the saliva of a rabid animal, and characterized by intermitting spasms of the muscles of respiration, together with a peculiar irritability of the body and disturbance of the mind.

The first symptoms in the dog are shyness, want of appetite, drooping of his tail and ears, a suspicious, haggard look, red and watery eyes, constant snapping at and swallowing straws, and licking cold surfaces, such as stone and iron ; afterwards respiration becomes difficult, viscid saliva flows rapidly, and there is inflammation of the fauces, and high fever. He is not always furious, nor does he always bite, unless irritated ; his gait is staggering, and he dies in convulsions, usually after the fifth day.

The symptoms in man vary with constitution and habit, and usually appear between five and ten weeks subsequent to the bite.

The wound heals as usual ; after a time there is pain and itching in the cicatrix, which gradually increases, and ulceration follows. There is headache, restlessness, fever, and excitement of the nervous system. The mind is particularly clear and active ; the memory strong, the imagination vivid, the countenance animated, and the eyes sparkling. This is succeeded by despondency, and the dread of fluids, great agitation, spasms, difficulty of breathing. Every attempt to relieve the burning thirst is followed by convulsive contractions of the neck and throat ; sleepless despair, change of voice, croupy inspiration, and involuntary biting are the next symptoms. As the disease advances, the brain becomes more affected and death is preceded by delirium.

*Treatment.*—The recent wound should be treated by cupping-glasses and nitrate of silver. In not more than one case out of twenty does hydrophobia follow the bite of a rabid animal. The bite is much less dangerous when through the clothes. After the disease is established, nothing can be done with the prospect of cure ; although every remedy and mode of treatment has been recommended. Palliatives and medicines which calm the nervous system and relieve pain may give some temporary relief.

**DISSECTING WOUNDS.**—These are followed by unpleasant results more frequently in those of a scrofulous temperament, or in those whose systems are exhausted by study or dissipation.

The consequences may be a simple pustule, inflammation of the lymphatics, and typhoid fever, with diffuse abscesses.

The *pustule* has not much elevation, is surrounded by redness, and attended with burning and itching. When opened, it discharges a little thin pus, and is soon refilled, the excavation gradually increasing. This may not be followed by constitutional symptoms, unless the health is very bad.

The inflammation of the lymphatics is more apt to follow a small scratch or wound from examining recent subjects, especially those dying with peritonitis or any disease of serous membranes. The pain and swelling extend up the arm to the axilla, and there is fever and depression of spirits. The course of the inflammation can be traced along the lymphatics to the axillary glands, which often suppurate.

Extensive abscesses and typhoid fever take place when the poison is very violent, and the system much prostrated.

*Treatment.*—The pustule will be managed best by a lye poultice, and then removing the coverings and touching the surface with lunar caustic. A simple incision or puncture for an ordinary pustule will not prevent the renewal of the matter.

When the lymphatics are inflamed, the original wound is not always the most tender spot, nor is there the appearance of a pustule. Leeches, cold applications, poultices of Indian meal and rye, nitrate of silver, and tincture of iodine are useful local applications. Bleeding may be necessary when the inflammation and fever are very high. Free incisions prevent the formation of abscesses, by evacuating the serum and depleting the part. Spreading abscess of the cellular tissue is attended with typhoid fever, and very dangerous. The system must be supported by stimulants and tonics, such as brandy and bark; opium will allay pain and restlessness, and the local dressing will resemble that for abscess in general.

Fresh air, clean clothes, healthy skin, good diet, and regular habits will be found to be the best prophylactics.

#### GUNSHOT WOUNDS.

These include all injuries by fire-arms, and partake of the nature of lacerated and contused wounds. There is usually but little hemorrhage, unless a large vessel is injured. The nature and extent of the injury will vary with the distance, force, and character of the shot or slug producing it, and the part affected; fracture, contusions, and perforations, may require amputation. The aperture made by the entrance of the bullet often appears smaller than the bullet, and resembles an incised wound with inverted edges; the aperture of its exit is larger, and has ragged and everted edges. The pain of a flesh wound is often so slight that it does not attract attention; but when a bone is broken or a nerve torn, the pain is severe. The

shock upon the system is greater than in other wounds, and is partly corporeal and partly mental. Syncope and depression of spirits are very common attendants.

The idea of injury resulting from the *wind of a ball* is erroneous. Injuries may result from spent balls, which, having a rotary motion, may roll over the surface without producing an open wound.

The course of bullets is uncertain; any obstacle, such as a button, a watch, or a bone, may occasion a most devious track. A ball may strike the forehead, and emerge at the occiput, or, striking the sternum, lodge in the scrotum. A bullet may be divided into two parts by striking a sharp edge of bone; or it may bury itself, and remain concealed for years, being enclosed in a cyst.

When there is but one aperture, it is probable that the ball has lodged; though it may have escaped upon the removal of the clothing, if a portion of the clothing should have been carried before it into the wound; or, the ball may make a complete circuit, and escape by the aperture of entrance; in this instance the track would be discovered by redness and swelling. When two orifices are in a straight line, it is not always to be inferred that the ball has escaped, for two balls may have entered opposite each other; the character of the orifices will determine this point. A plurality of openings does not always imply a plurality of balls; the same bullet may perforate and escape, and perforate again.

The wound partially sloughs and may produce abscess, erysipelas, hemorrhage, disease of the bones, hectic, or tetanus.

*Treatment.*—The general indications are to overcome the shock, remove foreign matters, adjust the parts, and place them in a comfortable and relaxed position.

A simple wound, made by a ball passing through some fleshy part, should at first be sponged clean, and after hemorrhage has ceased, dressed with dry lint, secured by strips of plaster. A little wine and laudanum may be given if the patient is disposed to faint, or suffers much with anxiety and fear. In a few days there is inflammation and suppuration. The primary dressings are to be removed with warm water, and a poultice or the water dressing substituted. Care must be taken that the sloughs are readily thrown off, and that no sinuses are formed. The constitutional treatment should be moderately antiphlogistic; consisting of purging, low diet, leeches, and perhaps bleeding; an opiate at bedtime will allay pain and twitching.

The presence of bullets and other foreign bodies can be detected by a probe, and they are to be removed by a forceps, the wound having been dilated, if necessary. If they are superficially lodged, they are to be cut down upon, extracted by a counter opening; if they are deep-seated and impacted, wait for the suppurative stage. When lodged in bone, they are to be removed by a chisel or tre-



phine, lest they produce caries or necrosis, although in many instances they have become encased and occasioned no inconvenience.

The question of amputation will be settled by considering the liability of gangrene, the usefulness of the limb if retained, the age, habits, and strength of the patient, and the means at hand for carrying out the treatment. The latter consideration will justify more numerous amputations in military and naval than in civil surgery. The following circumstances make amputation necessary.

When a limb is completely knocked off by a cannon-ball. If the bone is shattered and the joint endangered it should be amputated above the joint.

When the femur is fractured; and the femoral artery or vein, or the sciatic nerve is lacerated.

When large joints are injured; but that of the elbow may often be excised.

When the main artery is wounded, and gangrene has commenced and is spreading.

#### TETANUS.

Is a disease of the true spinal system and is manifested by spasm and rigidity of voluntary muscles.

When the muscles of the neck and face are affected, it is termed *Trismus*, or locked jaw; when the muscles of the front, *Emprosthotonos*; when the muscles of the back, *Opisthotonos*; bending to either side is termed *Pleurothotonos*.

Tetanus may be either an *acute* or *chronic* disease; the former is the most frequent in occurrence, and most formidable to treat; the latter, apt to be partial, milder, and more subject to treatment.

*Traumatic* tetanus follows a wound or injury, and is usually acute; *idiopathic* tetanus is of spontaneous origin, and usually chronic.

Acute traumatic tetanus is more frequent in hot climates, and in military practice, and may follow a slight bruise or puncture, especially if some nerve has been injured. Intestinal irritation and atmospheric changes predispose to the disease.

The symptoms may appear in a few hours, or in as many days; at first there is stiffness and soreness about the neck and face, the contraction of the muscles causing a ghastly smile; swallowing and mastication are difficult, the forehead is wrinkled, eyeballs are distorted, nostrils dilated, and the grinning countenance is expressive of horror. Respiration is rapid, the tongue protrudes, and saliva dribbles; the sphincters are usually contracted, perspiration is profuse and of a peculiar odour; the pulse at first may be strong and full, but soon becomes weak and indistinct. The mind is clear until just before death, which generally takes place in a few days.

*Treatment.*—The indications are to remove all sources of irrita-

tion, and diminish the spasm. The wound is to be cleansed from all foreign bodies, pus to be discharged by a free incision, if necessary, and warm anodyne poultices and fomentations are to be applied. Excision of the wound, or division of the nerve leading to it, has been practised with great benefit. Bleeding should be employed with great care, and purgatives combined with mercury are always of advantage. Opium is almost indispensable, and may be used externally and internally. Camphor, musk, assafœtida, and tobacco are also of use as antispasmodics.

Chronic tetanus is seldom fatal, and frequently idiopathic; it lasts several weeks, and should be treated by the shower-bath, tonics, and electricity.

## DISEASES OF BONES.

### C A R I E S.

Caries is an unhealthy inflammation of the bone, attended with softening, and leading to suppuration and ulceration. The bone has its cells filled with serous, and often with scrofulous fluids, and when dried has a spongy and worm-eaten appearance, and resembles a lump of sugar after being dipped in hot water. The disease most frequently attacks the thick bones, and the extremities of long bones; and it may result from local injury, or simply from constitutional causes, such as scrofula, or effects of mercury. It is attended with pain and swelling, and after ulceration there is a fœtid discharge containing portions of bone.

*Treatment.*—The constitutional treatment consists of fresh air, tonics, and alteratives; and the local treatment in removing those portions incapable of repair, and endeavouring to establish healthy granulations. Sometimes it may be necessary to remove loose portions of bone which are disintegrated, and to apply escharotics to the surface.

### C A R I E S OF THE SPINE.

This occurs most frequently in children, and in persons of a scrofulous temperament. At first there is a sensation of numbness in the lower extremities, languor, and a stumbling gait. The patient usually sits with his legs drawn up under the chair, has a constriction of the chest, and derangement of the digestive organs; in a short time paralysis ensues, and there may be a pointing of matter at some portion of the spinal column, most frequently about the dorsal vertebræ. The bodies of the vertebræ are softened and compressed, and thus a curvature takes place, most generally in a posterior direction. Many die from fever and irritation, and recovery is usually attended with deformity.

*Treatment.*—Absolute rest upon a mattress, attention to the

general health, counter-irritations over the tender point, by means of blisters and issues, and in the early stages, leeching. The diet should be light and nutritious, and a laxative administered occasionally.

#### NECROSIS.

This signifies the death of the bone, which is often enclosed in a case of new bone. When a superficial layer is affected it exfoliates; the dead portions thrown off are termed *sequestra*. It occurs at all ages, and most frequently in the compact bones; the immediate cause, is inflammation of the periosteum. It is attended with swelling, and a discharge of matter through openings in the case of new bone, which are termed *cloacæ*. The pain is deep-seated, long-continued, and very severe.

*Treatment.*—This is principally local, although constitutional remedies may be given to allay pain. The great object is to facilitate the escape of pus and the sequestra; it is often necessary to enlarge the cloacæ by a saw or trephine, and to dilate the sinuses with lint. Amputation may be necessary in case the joints are involved.

#### EXOSTOSIS.

This is a tumour formed by an excessive and irregular growth of bone. The shape varies, being sometimes broad, and sometimes spiculated. The structure is healthy, and it may cause no inconvenience, unless it interferes with an artery, muscle, or joint.

*Treatment.*—The object is to produce absorption, by means of mercury, iodine, blisters, and leeches; but since these usually fail, it is necessary to resort to an operation. This may be performed by a saw or trephine. Scraping off the periosteum is also recommended.

#### FRAGILITAS OSSIUM.

This is a brittleness of bones, occurring frequently in youth, but oftener in old age. The proportion of earthy matter is relatively but not actually increased. The cancellated structure is filled by an oily substance, and surrounded by a thin, brittle lamella. This degeneration follows long confinement, intemperate habits, and rheumatic and cancerous affections. A hasty step, turning in bed, or tripping on a carpet, may produce fracture.

*Treatment.*—In old persons all that can be done is to guard against any accident, and to enjoin a nutritious diet and salubrious atmosphere. In children, care should be taken to overcome a scrofulous constitution by tonics and good diet, and to treat the fracture as usual.

## MOLLITIES OSSIUM.

This is a deficiency of the earthy matter of bones, and hence they are soft and pliable. This disease occurs in adults, and its course is rapid; the general health is impaired; flesh, spirits, and strength, diminish daily. The bones are light, soft and greasy, and often consist of an external shell, filled with a soft, greasy matter. The cause is obscure; phosphatic deposits are found in the secretions.

*Treatment.*—This is merely palliative, for the disease is incurable.

## RICKETS.

This is an original defect of the skeleton, peculiar to youth and scrofulous temperaments. The bone is changed in its structure, becoming soft and pliable, as in mollities ossium. The cancellated structure predominates, the cells being filled with a reddish oily fluid. The flat bones are often thickened, and the long bones atrophied in the shaft. This disease gradually increases with age, and hence great deformity, and curvatures of limbs must necessarily occur. In adult life, the general health may be regained, and the patient, though a confirmed and unseemly dwarf, weak and puny in his boyhood, may prove a healthy, muscular, and active man.

*Treatment.*—Improvement of the general system by diet, exercise, proper clothing, and tonics. Mechanical apparatus, properly constructed, may be of service in preventing permanent deformity. Those articles of diet which are readily converted into lactic acid, such as sugar, starch, gum, milk, &c., should be avoided, and animal food of easy digestion preferred.

## SPINA VENTOSA.

This is a swelling, usually of considerable extent, involving the whole circumference of the bone, and has a regular surface. In most instances, it is a bony shell, containing one or several cavities, filled with an ichorous fluid, clotted blood, and portions of carious bone. It is preceded by severe pain, and external injuries and constitutional causes may give rise to it. It is difficult to cure, especially in adults.

*Treatment.*—When the tumour is small, the cure is to be effected by means of puncture, satisfactory evacuation, external support, and internal stimulation of the cavity. If the tumour is large, and the general health affected, amputation will be necessary.

## OSTEO-SARCOMA.

This is a tumour, composed partly of bone and partly of flesh, and is usually considered of a malignant nature. A *dissection* of the tumour presents a dense, pearl-coloured membrane, covering the

surface, and adhering closely to the bone; above this membrane the muscles are thin and spread out, so as to cover an extensive surface, having lost their colour. Upon opening the tumour, it will be found to contain cells divided by spicula of bone, and materials resembling flesh, jelly, and fat. It is attended with deep-seated pain, and at last bursts, assuming a cancer-like ulceration.

*Treatment.*—At first, leeches, cold applications, and anodynes, may give temporary relief, but no permanent benefit can be expected without its removal; and even after amputation, it frequently attacks the stump.

#### COXALGIA.

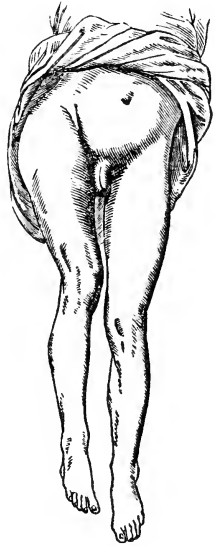
This is a disease of the hip-joint, common to scrofulous children.

*Symptoms.*—At first there is slight pain, referred to the knee; lameness, and stumbling in walking; tenderness in the groin, and pain is produced by pressing the head of the bone suddenly against the acetabulum; apparent lengthening of the limb. This apparent increase of length is owing to a depression of the pelvis of the diseased side, the weight of the body being supported on the opposite limb.

If the disease is not arrested, destruction of the head of the bone and acetabulum results, and the femur is drawn up, constituting a spontaneous luxation. Often an abscess forms, and opens externally. The toes may be turned inward or outward.

*Treatment.*—Perfect rest upon a mattress, as in caries of the spine, the limb being confined in a curved splint. Cups and leeches, over the joint, will be useful at first; subsequently, more benefit will be derived from blisters, setons, and issues. Counter-irritation, by purging with jalap and cream of tartar, tonics, and iodine, are the constitutional remedies. It may require months or years to effect a cure.

Fig. 1.



#### FRACTURES.

Fracture is a solution of continuity of a bone, produced by external violence, or muscular contraction. Fractures are divided into oblique, transverse, and longitudinal, according to the direction. *Simple* fracture is a mere separation of the bone into two parts; *com-*

*pound*, implies an open wound, communicating with the fracture; *comminuted*, when the bone is broken into numerous fragments; and *complicated*, when attended with luxation, laceration of large vessels, &c.

The *signs* of fractures are deformity, preternatural mobility, crepitation, pain, swelling, and helplessness of the part. Old age, and certain diseases of the bones, predispose to fractures; in cold weather, they are more numerous, on account of the increased muscular exertion necessary in walking, where there is ice. Indirect violence may occasion fracture, when a force is applied to the two extremities of a bone, which gives way between them. Deformity may be produced by an angular derangement, or a derangement in the direction of the axis, the diameter, or the circumference of the bone. Bent bones are occasioned by a few of the osseous fibres giving away upon the convexity of the curve. The process of reparation is more rapid in the young, and also takes place sooner in a small than in a large bone. Danger results, according to the site of the injury, the nature of the fracture, and the state of the system. The mode of reparation is attended by the following changes: extravasation of blood; after this is absorbed, the liquor sanguinis is effused, and assumes the position which the blood occupied; this consolidates; the serous portion is absorbed; the fibrin remains, and becomes organized. This period of plastic exudation lasts for eight or ten days, and then becomes cartilaginous. This mass contracts, increases in density, and gradually becomes bone. The ossification advances from the periphery. The fractured extremities are now surrounded by a bony case, termed the *provisional callus*; after which continuity is truly restored by the formation of what is called *definitive callus*, which takes place between the fractured extremities; and, finally, the provisional callus is absorbed.

*Treatment*.—This consists of two parts; first, *reduction*, which is to be effected gradually by extension and counter-extension, overcoming muscular contraction, and coaptating the extremities; secondly, *retention*, which is effected by keeping the limb in such a posture as will relax those muscles which would be likely to cause a displacement, and by applying such mechanical means as will prevent motion; these means consist of splints, which are variously constructed of wood, pasteboard, or metal, and applied by means of bandages or rollers; they should be light, and always of such a length as to command the neighbouring joint; the inner surface should be padded or lined, in order to prevent chafing. After being dressed, the part should be laid upon a pillow, and not disturbed, unless there should be inordinate swelling of the limb, when the bandage should be loosened. Bandages soaked in gum or starch, have recently been used, in place of splints. Under certain circumstances, this dressing is admirable, but an indiscriminate employ-

ment tends manifestly to injury : on account of the swelling of the limb, it produces pressure, which may occasion ulceration or sloughing. It is called the immovable apparatus. •

The diet should be watched, and antiphlogistic means resorted to, if necessary. At the end of three to six weeks, the provisional callus is complete, and the substitutes for this splint of nature can be discontinued ; the use of the part must be resumed gradually, especially in the lower limbs.

#### FRACTURE OF THE NOSE.

The nasal bones are usually fractured by a fall, a violent blow, or kick of a horse, or some direct application of force. This fracture is often attended by injury of the brain, and followed by caries and exfoliation.

*Treatment.*—This consists of antiphlogistic means, such as leeches, cold applications, and rigid diet, to remove swelling and inflammation, and the adjustment of the fragments ; which can be accomplished by a catheter, probe, or dressing forceps. The nose should not be plugged with lint, unless to check profuse hemorrhage.

#### FRACTURE OF THE MALAR AND SUPERIOR MAXILLARY BONES.

These can only occur by the most direct violence, or gunshot injuries, and are usually attended with crushing and wounding of the soft parts ; severe inflammation and nervous symptoms may come on, and the brain may also be affected. There will be great pain and difficulty in chewing.

*Treatment.*—If there is no displacement, there is nothing to be done but to subdue inflammation, and keep the parts quiet. If the alveolar processes are loosened, they must be pressed into their places, and the mouth kept shut, and the patient nourished by fluids.

#### FRACTURE OF LOWER JAW.

This may occur in the middle of the base of the jaw, in the ramus or processes ; and in children it may take place at the symphysis. The most frequent seat of fracture is between the chin and the insertion of the masseter muscle ; the longer fragment and the chin are depressed. In double fractures, the chin alone is depressed. There is pain, swelling, inability to move the jaw, irregularity of the dental arch, crepitus, and frequently hemorrhage and deafness.

The diagnosis of fracture of the ramus and condyle is often obscured by swelling ; the neck of the condyle is drawn forwards by the external pterygoid muscle, and crepitation will be perceived by the patient.

*Treatment.*—The teeth serve as a guide in the adjustment of the fragments, and the upper jaw acts as a splint in the retention. A

compress and a pasteboard splint, retained by a suitable bandage, will retain the parts in apposition; and the patient is to be fed by gruels and soups, through the interstices of the teeth. The union is rapid, and there is usually but little deformity.

#### FRACTURE OF THE SPINE.

This is attended with serious injury to the spinal cord, from compression, laceration, bruising, concussion, or from subsequent inflammation and softening. When it occurs above the fourth cervical vertebra, death is almost certain, on account of the origin of the phrenic nerve which supplies the diaphragm.

When the lumbar region has suffered, the symptoms are paralysis of the lower limbs, involuntary discharge of fæces, retention of urine, and frequently priapism.

When the injury is in the upper dorsal or lower cervical region, there is, in addition to these symptoms, paralysis of the arms, difficulty of breathing, sluggishness of the bowels, and distention of the abdomen. In all fractures of the spine, the kidneys suffer, and bed-sores are apt to follow.

*Treatment.* — Absolute rest upon a mattress, low diet, and anti-phlogistic means, to prevent the formation of pus, and thickening of the membranes. The discharges of the bowels must be regulated, and the bladder relieved by the catheter; counter-irritation and frictions will be useful in the latter stages of the case. The use of the trephine in this injury has not met with success, and will probably do more harm than good.

#### FRACTURE OF THE PELVIS.

Fracture of the bones of the pelvis can only be produced by the greatest violence. There is but little displacement, although great danger results from injury to the parts within.

*Treatment.* — All that can be done is to place the patient at rest in an easy position, keep a catheter in the bladder, and make incisions, if urine or pus is extravasated in the perineum. The application of a broad bandage around the hips, will assist in preventing motion.

When the crest of the ilium or the anterior superior spinous process is knocked off, the fragment is displaced inwards, and can be readjusted by the fingers. Fracture of the sacrum is longitudinal usually, and there is no displacement. The coccyx may be fractured by a kick, and is displaced inwardly: readjustment may be effected by the finger in the rectum. The acetabulum may be split, and injury of the neck of the femur may be simulated, though there is no shortening of the limb, and crepitus is felt by the finger in the rectum, when the pelvis is moved.



## FRACTURE OF THE RIBS.

The ribs are very liable to fracture, which usually is in the middle, when occurring from direct force, or force applied at each end. Displacement is seldom great, and is difficult to detect in fat persons. There is pain, swelling, and difficulty in breathing; crepitus is felt, when the hand is placed over the part during respiration or coughing; emphysema appears when the pleura is injured.

*Treatment.*—If there is an angular projection of the extremities, a compress is to be applied over it; if there is a depression, a compress is to be placed at each extremity; the chest is to be surrounded by a roller, in order to prevent respiration by the intercostal muscles, and thus to keep the parts at rest. Inflammation and cough are likely to ensue, and must be treated by antiphlogistic means and anodynes.

Compound fracture of the ribs is treated of, under the head of Wounds of the Chest.

## FRACTURE OF THE STERNUM.

Fracture of this bone is rare, on account of violence being necessary to produce it; injury usually is done to the thoracic viscera. The deformity is generally a depression, and the symptoms are great difficulty of respiration, pain, palpitation of the heart, and perhaps spitting of blood, and cough. Caries, or a pulmonary affection, often results from a fracture of the sternum or ribs in scrofulous habits.

*Treatment.*—The local treatment consists of a compress and a roller, applied upon the same principles as in fracture of the rib. The general treatment must be adapted to the inflammatory conditions of the organs of the chest. Collections of pus and blood behind the sternum can be evacuated with a trephine, but the operation is often attended with unfavourable results.

## FRACTURE OF THE SCAPULA.

The *acromion* process is sometimes fractured; the shoulder loses somewhat of its roundness, the head of the humerus falls slightly, and there is a slight depression at the point of fracture. It is distinguished from dislocation by mobility of the joint, and crepitation can be felt by rotating the head of the humerus.

*Treatment.*—It may unite by bone, but generally it unites by ligament. It is to be kept in its place, by elevating and firmly fixing the os humeri; this is effected by placing a cushion between the side and the elbow, and retaining it by a roller, the elbow being carried a little backwards. If the pad be placed in the axilla, and the elbow be brought close to the side, the fragments will be separated; but little inflammation follows, and bandages may be removed in

three weeks. In many individuals, the tip of the acromion process is slightly movable, being merely united by ligament.

The *neck of the scapula* is rarely fractured, and it is liable to be mistaken for a dislocation; the shoulder falls; there is a hollow below the acromion, from a sinking of the deltoid muscle; and the head of the humerus can be felt in the axilla. It can be recognised by the facility with which the parts are replaced, the falling of the head of the bone into the axilla, when the extension is removed, and by crepitation.

*Treatment.*—The first point is to carry the head of the humerus outwards, and the second to raise the glenoid cavity and arm. The former is effected by a thick cushion confined in the axilla by a bandage, and the latter by placing the arm in a short sling. Ten or twelve weeks are necessary to procure union, and a still longer time to recover the strength of the arm.

The *coracoid* may be fractured by direct violence; the process is drawn downwards, by the action of the coraco-brachialis, pectoralis minor and biceps muscles. There are pain, swelling, and crepitation in the part, and loss of power in the limb.

*Treatment.*—This consists in making the fingers of the injured limb touch the shoulder of the opposite side, the position being secured by bandaging.

The *body* of the scapula may be fractured either vertically or transversely, and there is but little displacement, unless it is near the lower angle of the scapula. When the angle is fractured, it may be drawn forward and upward.

*Treatment.*—This consists of a tight roller around the chest; the arm being placed in a sling.

#### FRACTURE OF THE CLAVICLE.

This fracture is frequent, and is usually produced by violence upon the shoulder, arm, and hand. It is generally oblique, and near the middle of the bone; the part is painful and swollen, and every attempt at motion produces pain; the shoulder is sunken, and drawn towards the sternum, and the acromial fragment is drawn downward by the weight of the arm, and forward and inward by the action of the subclavius muscle. The patient usually supports the arm with his other hand, to relieve the pressure upon the axillary plexus of nerves. The indications are plain, viz.: to elevate the shoulder; to keep it outward from the chest; and to draw it slightly backward.

*Treatment.*—The mode of dressing this fracture is extremely various. *Dessault's apparatus* consists of a compress placed over the fracture, a wedge-shaped pad placed in the axilla, and retained by a roller which surrounds the chest. The elbow is to be brought to the side, and the arm and chest surrounded by circular turns of a

second roller, whereby the shoulder is elevated and drawn outwards. A third and last roller commences at the armpit of the sound side, and being carried obliquely over the compress, descends the posterior portion of the arm, passes under the elbow, and obliquely upwards across the chest to the armpit, whence it started; then over the back to the shoulder of the affected side, across the compress, down in front of the arm, under the elbow, and across the back to the sound armpit again. This bandage serves to retain the arm and shoulder in its elevated position.

*Fox's apparatus* consists of a wedge-shaped pad, secured by strings to a circular collar which surrounds the shoulder of the sound side, and a sling made of linen, which contains the forearm; it elevates the shoulder, and, by bringing the elbow to the side, draws the shoulder outwards.

Some use merely a pad and two handkerchiefs, which, if properly applied, can be made to fulfil all the indications.

Some deformity almost always results.

#### FRACTURE OF THE HUMERUS.

The *anatomical neck* is the seat of fracture in young persons, and sometimes in old. There is little or no flattening of the shoulder, owing to the head of the bone remaining in its place; the end of the shaft is directed obliquely upwards and forwards, and projects on the coracoid process; the arm is shortened, and crepitus is distinct after slight extension and coaptation of the fragments.

*Treatment.*—This requires a pad in the axilla, a splint on the fore and back part of the arm, a roller, and a sling for the hand, the elbow hanging free.

*The Surgical Neck.*—The upper fragment remains in its place, but its low extremity inclines slightly outwards; the upper end of the lower fragment is drawn upwards and inwards under the pectoral muscle, and the shoulder is round, the arm shortened, the elbow abducted, and there is crepitation upon adjustment.

*Treatment.*—A pad is placed in the axilla; two splints secured by a roller; the hand supported by a sling, and the elbow free.

*Fracture at the Neck* may be accompanied with *dislocation*. This is recognised by the tumour in the axilla, formed by the head of the bone, which does not move when the shaft is rotated.

*Treatment.*—An effort should be made to restore the head of the bone, and then to coaptate the extremities: this is often impossible; then the extremity of the lower fragment should be brought to play in the glenoid ca-

Fig. 2.



vity. A pad will be necessary in the axilla, and the same dressing as the last. A new joint is formed, and the motions of the arm are only partial.

The *shaft* may be fractured at any point, and is easily recognised by crepitation; and when the fracture is just below the surgical neck, the lower extremity of the upper fragment is drawn inwards by the muscles inserted into the bicipital ridges, and the upper extremity of the lower fragment is drawn outwards by the deltoid muscle.

*Treatment.*—The reduction is easy, and the extremities may be retained in contact by four small splints placed around the arm, and secured by a roller, which, as in all other instances of its use in the upper extremity, must commence at the hand. The forearm should be suspended in a sling.

The *condyles* are fractured in various ways. Either condyle may be fractured, most frequently the internal; or, there may be a fracture between the two condyles, and another separating them from the shaft. These injuries are distinguished from dislocation at the elbow by mobility and crepitation.

*Treatment.*—By a roller and two angular splints, (Physick's,) reaching to the hand from the middle of the arm. The angle of the splints must be changed to prevent anchylosis. Some deformity and stiffness often remain.

#### FRACTURE OF THE RADIUS AND ULNA.

When both bones of the forearm are fractured at once, or when either bone is fractured near the middle, there is but little difficulty in the diagnosis, being easily recognised by the ordinary signs of fractures, such as pain, crepitus, swelling, and uselessness of the limb.

*Treatment.*—The great object is to preserve the interosseous space; for, if the fragments unite at an angle, supination and pronation will be prevented. The fracture is readily reduced by slight extension, and then the muscles should be pressed into the interosseous space, in order to separate the two bones.

Two splints, well padded on the inside, reaching from the elbow to the fingers, should be applied, and retained by a roller. The arm must be kept in a position between supination and pronation, and supported by a sling; after a week or two pasteboard splints, or a starch bandage may be substituted.

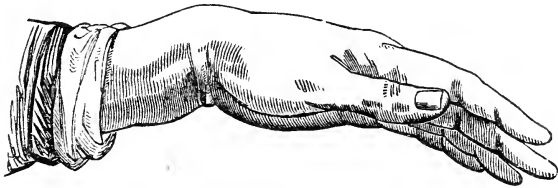
The *RADIUS* is more frequently fractured than the ulna, on account of its articulating with the carpus, and thus receiving the weight of the body in falls, &c. When fractured near the middle there is but little deformity, the ulna acting as a splint.

The *neck* of the radius is but rarely fractured, and the accident is difficult to recognise, especially when the muscles covering it are

very large. It is to be discovered by fixing the head of the bone, and rotating the hand and forearm.

The *lower extremity* of the radius is often fractured, and frequently mistaken for a dislocation of the wrist. (Fig. 3.)

Fig. 3.



Fractures of the radius are to be treated upon the same principles, and by the same means as in other fractures of the forearm, unless the fracture should be through the articular surface of the carpal extremity of the radius. This latter fracture gives a peculiar deformity to the wrist, dependent upon a partial luxation of the carpus. In this instance, besides the ordinary splints, two small compresses are to be applied, one upon a prominence on the dorsal surface caused by the fragment, the other upon the projecting extremity of the radius on the palmar side. Of course these compresses will not be opposite to each other. Passive motion should be established in a week, for

Fig. 4.



Fig. 5.



fear of ankylosis, and the loss of the pulley-like motion of the extensor tendons on the back of the radius.

The *ULNA* is most frequently fractured below the middle of the shaft. The lower fragment approximates the radius by the action of the pronator quadratus, and the other usual symptoms of fracture are evident.

The *olecranon* process is often fractured by sudden violence, or muscular action. The fragment is drawn up upon the back of the arm by the triceps muscle, and the deformity is increased by flexion. The union is usually ligamentous. (Fig. 4.)

The *coronoid* process is rarely fractured, and usually by inordinate muscular action of the brachialis anticus muscle, whose tendon is inserted in front of the base of this process. Dislocation backwards by the action of the triceps may result. The union will be ligamentous. (Fig. 5.)

*Treatment.*—Fractures of the shaft are to be treated by two splints and compresses, as are those of the radius. Fracture of the olecranon is to be treated by extending the elbow, placing a small splint in front of the joint, and securing it by a roller. The coronoid is to be treated by flexing the elbow, applying a roller to relax the muscles and prevent their action, and keeping the forearm in a sling.

#### FRACTURE OF THE CARPUS, METACARPUS, AND PHALANGES.

The bones of the carpus are seldom fractured. The injury is usually a compound one, and produced by direct force.

The metacarpal bones are subject to simple fracture, which is easily recognised by pain, swelling, crepitus, &c. The treatment consists of coaptation of the fragments, and retaining them by means of two splints and interosseous pads, or compresses.

The *phalanges* are liable to compound and simple fracture. Simple fractures to be treated by two or four small splints, and a narrow bandage; when several fingers are broken, a curved splint will be useful.

#### FRACTURE OF THE FEMUR.

The *neck* may be fractured within the capsule. This occurs most frequently in old persons, and in females, on account of bony texture being more brittle in advanced life, and on account of the anatomical character of the neck of the femur in women. The accident may be produced by a slight fall, muscular contraction, blows, &c. The head of the bone remains in the acetabulum; the lower fragment is drawn upwards by the muscles of the hip, and the foot is everted, owing to the action of the rotator muscles. The limb is shortened, the trochanter is one or two inches higher, and flatter than its fellow; there is pain, crepitus, and want of voluntary

motion. The arc which the trochanter, upon rotation, will describe, will be of a much smaller circle than that described by the rotation of its fellow.

Union is possible, but improbable; on account of the difficulty of coaptating the fragments, the want of provisional callus, the fractured extremities being bathed in an increased quantity of synovia, and the feeble nutrition of the head of the bone through the round ligament. Yet, in a young person of good constitution, where the periosteum is not completely severed, there may be bony union. Ordinarily there results a false joint, thickening of the capsule, partial absorption of the fragments, and the patient is lame for life, and requires a stick or crutch. Feeble old women may die from the shock of the injury or from the irritation of pain and confinement.

*Treatment.*—Extension and splints are unnecessary—the limb should be supported by pillows, and motion restrained. Care should be taken with reference to bedsores, sloughs, &c.

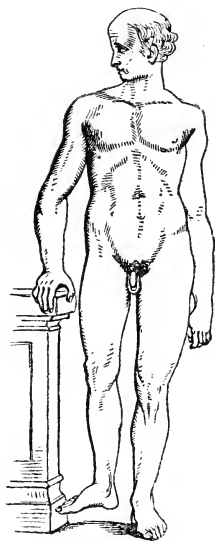
The *neck* may be fractured partly within and partly without the capsule, in which case the prospect of union is much more favourable. Or, the extremity of one fragment may be driven into the cancellated structure of the other, constituting an *impacted* fracture; in these cases, crepitus is obscure, the displacement is slight, and there is considerable power and motion of the limb, and but little shortening and eversion. They are produced by great direct force, and are attended with great pain, swelling and constitutional disturbance. The treatment may be successful in many instances, without the use of splints.

The *trochanter major* may be fractured; the process is drawn upwards by the glutei muscles, and a space can be felt between the fragments. Approximation and retention are difficult, and the union generally ligamentous. The cure is to be effected by rest, position, and relaxing the muscles.

Fracture of the condyles is a serious injury, especially when communicating with the joint. After the fragments are somewhat consolidated by rest and position, passive motion must be established to prevent ankylosis.

Fracture of the *shaft* is easily recognised by shortening, crepitation, &c. &c. The deformity is greater when it occurs in the upper part, especially when just below the trochanters, the lower end of the

Fig. 6.



upper fragment being tilted forward by the action of the psoas magnus and iliacus internus muscles.

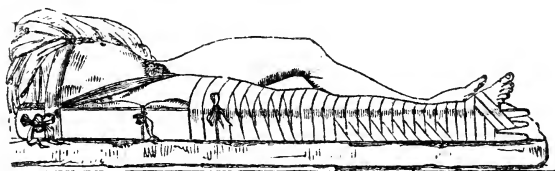
*Treatment.*—The principles of treatment are, as in all fractures, coaptation and retention, but the means to effect it are various.

The double inclined plane is a simple contrivance. The leg is secured to one plane, which furnishes the means of counter-extension, and the thigh rests on the other; the weight of the body produces the extension.

*Dessault's Apparatus.*—Consists of an outer splint, three or four inches wide, reaching from the crest of the ilium to four inches beyond the foot, each extremity having a hole in it; an inner splint reaching from the perineum to the sole of the foot, and an upper splint reaching to the knee.

The counter-extension is made by a band in the perineum, which is secured to the upper end of the outer splint by means of the hole in it. The extension is made by a band or handkerchief applied to the ankle, and secured to the hole in the lower end of the outer splint. Liston uses only the outer splint, as represented in the figure.

Fig. 7.



*Dr. Physick's modification* consists in an elongation of the outer splint, nearly to the axilla; by this means counter-extension is made in a line more nearly parallel with the axis of the body, and a block was placed upon the inner side of the lower end of the same splint, below the foot, for the purpose also of preventing the line of extension being oblique, which might produce pain and deformity. Bags of bran are placed on each side of the limb, so as to secure uniform pressure from the splints, and the whole is secured by bandages.

*Hagedorn's Apparatus* consists of one splint reaching from the hip to a foot-board.

The counter-extension is made at the acetabulum of the sound side, and the extension by the foot of the injured side. The splint is first applied to the outer side of the sound limb, and the foot secured to the foot-board; and the extension is made by drawing the foot of the fractured limb down to the foot-board, and securing it. This avoids the necessity of a perineal band, which may excoriate.

*Dr. Gibson's modification* of this apparatus consists in an elon-



gation of the splint as high as the axilla, which will prevent any lateral inclination of the body; and the application of a similar splint to the fractured limb.

#### FRACTURE OF THE PATELLA.

The accident may result from muscular contraction or direct violence. It is sometimes attended with an audible snap and falling of the patient; the pain is not severe, and a simple fracture is not dangerous. The limb is bent partially, and there is no ability to extend it.

The direction is usually transverse, and a separation of the fragments can be felt. There is no crepitus. Considerable swelling usually follows.

Longitudinal fractures are rare, and are not attended by the same symptoms.

*Treatment.*—Leeches and lotions should be applied to reduce swelling and inflammation, and then the limb should be extended, a roller and figure of 8 bandage applied to coaptate the fragments and compress the muscles of the thigh. A long splint, reaching from the ischium to the heel, applied to the back of the limb, will prevent motion.

Bony union is not to be expected; a strong ligamentous connexion is usually formed, which answers the purpose extremely well. Passive motion should be made after five or six weeks. Sixty or seventy will elapse before the limb can be used, and even then caution should be taken that the newly-formed ligament is not broken, or the patella of the opposite side, from increased muscular exertion of the sound limb, and possessing the same structure which disposed to the fracture in the broken limb.

#### FRACTURE OF THE LEG.

A frequent accident, occurring in one or both bones, from a fall or direct violence. The *tibia* is most frequently fractured, on account of its exposed position, and sustaining the weight of the body. The fracture may occur at any part, but the deformity is greater, as it may be nearer the lower extremity; if nearer the upper extremity the deformity may be slight and the patient even walk about.

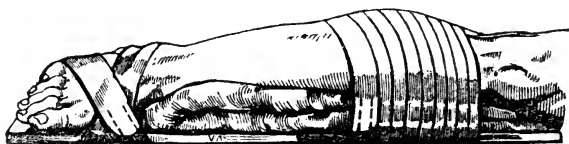
The fibula may be fractured by direct or indirect force. Little deformity results, unless the fracture is below its middle. When nearer the ankle, dislocation may be produced. The most frequent seat of fracture is from two to three inches above the malleolus. There is immediate lameness; the foot is turned out; crepitus is distinct, and a depression exists over the fractured part.

*Both bones* are often fractured at once by falls or blows; they

occur at the weakest points. The signs are evident: crepitus, pain, want of motion, &c. There is seldom any great shortening, and the deformity is readily reduced.

*Treatment.* — When both bones are fractured, when the tibia alone is fractured, or, when the upper part of the fibula is fractured, the best and most simple apparatus is the fracture-box and pillow. The fracture-box has a foot-board, to which the foot is secured by a bandage, thus preventing any lateral inclination. In lieu of this, two splints of the length of the leg, applied on either side of the pillow, will answer the purpose, care being taken to support the foot by a bandage or handkerchief.

Fig. 8.



Fractures of the lower end of the fibula are to be treated by Dupuytren's or Physick's apparatus; which consists of a single splint, placed on the inner side of the leg, and reaching beyond the foot. It is provided with a wedge-shaped pad, which reaches only to the ankle, the larger end of which, being applied to the internal malleolus; a bandage is carried over the ankle in such a manner as to produce inversion of the foot, making the sole of the foot approximate the splint, and thus fragments are adjusted and the deformity removed.

#### FRACTURES OF THE BONES OF THE FOOT.

The *os calcis* may be fractured by great violence connected with the action of the sural muscles. The tuberosity will be drawn up by the tendo Achillis, and the patient is unable to stand.

The *treatment* consists in overcoming the action of the triceps suræ, flexing the leg upon the thigh, and extending the foot upon the leg. The fragments are to be approximated by a figure of 8 bandage.

The *astragalus* is rarely fractured; it may occur at the posterior part where the tendon of the flexor longus pollicis plays over it; or it may occur between the body and the head. In the first instance the foot will be inverted, in the latter but little deformity will occur.

It can be *treated* successfully by a simple fracture-box. Should caries take place it may become necessary to extirpate it.

The *metatarsal* bones and the *phalanges* are seldom fractured, unless the injury be complicated or compound.

## COMPOUND FRACTURE.

Unless a wound communicate with the fracture it is not compound. The wound may be produced by the means which broke the bone, by the bone protruding, or by subsequent ulceration. Great danger may result from the shock, hemorrhage, tetanus, suppuration, hectic, or typhoid fever.

Primary amputation is necessary if the bone is much shattered; if a joint, especially the knee-joint, is opened; if large arteries are torn; if the soft parts are extensively lacerated or bruised, particularly if the patient is old or enfeebled by disease.

The *treatment*, if it be determined to try to save the limb, will be to convert the fracture into a simple one, by arresting bleeding, removing pieces of bone, clots, &c., so the wound will heal without suppuration. To reduce the protruding fractured extremities, it may be necessary to saw off a portion; to arrest the hemorrhage, it may be useful to envelope the parts in bran, or stuff the opening with lint, which must be removed as soon as suppuration occurs.

The subsequent part of the treatment may require antiphlogistic, but more frequently tonic measures, such as bark, wine, good diet, &c., especially if the discharge is profuse. Secondary amputation may be necessary at last.

## DISLOCATIONS.

Dislocation or luxation, is the removal of a bone from its articulating cavity. The ball and socket joints are most liable to the injury.

The *predisposing causes* are the peculiarity of the construction of the joint, weakness or paralysis of muscles, elongation of the ligaments, particular position of the parts, accumulation of fluids in the joint, or diseases and fractures of the bones.

The *exciting causes* are external violence; such as blows, falls, &c., and muscular contraction.

The *symptoms* are deformity, swelling, and a hollow where none should be, shortening or elongation, pain and immobility of the limb.

The *consequences* are rupture of ligaments, effusion of blood and serum; lymph coagulates, forms new adhesions, and fills up the old socket, and the head of the bone gradually accommodates itself to its new position, there always being some attempt to form a new socket; and thus considerable motion is subsequently acquired by the limb.

Dislocation is to be distinguished from fracture by the absence of crepitus, the rigidity of the limb, the peculiarity of the deformity at the articulation, and by the absence of deformity after reduction; whereas in fractures, it will recur without being prevented by dressings.

*Treatment.*—This essentially consists in overcoming the action of the muscles which retain the bone in its unnatural position, and

also in bringing the head of the bone into such a situation that the action of the muscles may draw it into its place.

*Constitutional* means are often necessary to effect reduction in the larger joints, such as bloodletting, warm baths, emetics, in order to produce relaxation of the muscles. The local means are extension and counter-extension. The extension must be made gradually, in order to overcome the action of the muscles, and to place the head of the bone in such a situation as to be drawn into its place, and the extension must be withdrawn suddenly, in order that the muscles may leave the effect by their contraction.

The treatment subsequent to the reduction consists in maintaining the limb at rest, and applying leeches and cold applications to remove swelling and pain. Afterwards, if any stiffness remains, stimulating friction may be used.

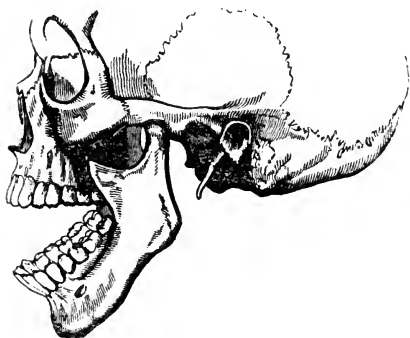
*Subluxation* implies a partial removal of the head of a bone from an articulating surface. *Recent* and *old*, are terms applied to luxations with reference to the period which may have elapsed, and the changes which may have occurred by adhesions, &c.

*Compound Luxation*.—This is connected with a wound in the integuments, fracture of bone, laceration of large vessels, &c. The same principles apply as in compound fracture. The same contingencies of age, temperament, and constitution, will influence the treatment. The question of amputation is first to be considered, and then the reduction. The after treatment would be that for a wound of the joint: careful closure of the wound,—prevention of inflammation by antiphlogistic means; if possible preventing suppuration, ankylosis, and tetanus.

#### DISLOCATION OF THE JAW.

Dislocation of the jaw may be caused by spasm of the pterygoid muscles when yawning, or by a blow on the chin when the mouth is wide open. The condyles are pushed forwards, and rest in front of the base of the zygomatic process of the temporal bone.

Fig. 9.



*Symptoms*.—The mouth gapes and cannot be shut, the glenoid cavity is vacant, and there is a prominence felt beneath the zygoma;—the saliva trickles, articulation is prevented, and there is great pain.

*Treatment.*—The patient should be seated on a low stool, and the surgeon standing in front, should press his thumbs, properly protected, upon the last molar teeth, at the same time elevating the chin with the fingers. The condyles are thus extricated from their unnatural position, and returned to their socket by the normal action of the muscles, which produces an audible noise. In difficult cases, greater leverage may be obtained by using two forks or strong pieces of wood, connected by a string in such a way that it will elevate the chin, whilst the ends are pressed against the teeth in place of the thumb. When the resistance is great the efforts may be directed first to one side at a time.

After reduction, the chin should be confined by a bandage for a week or ten days.

#### DISLOCATION OF THE SPINE.

This accident rarely happens unless connected with fracture; although it has occasionally occurred in the cervical vertebræ.

It may be produced by the muscular efforts of convulsion and mania, but more frequently is the result of violence; for instance, falls from a height, crushing by wheels, hanging, &c.

The chance of life is but small on account of injury done the spinal marrow. The displacement is easily recognised by the deformity, paralysis, &c.

Dislocation of the atlas upon the dentata may occasion instant death, by the intrusion of its dentate process into the spinal marrow. Dislocations of the oblique processes simply may terminate with no other inconvenience than contortion of the neck and restricted motion of the head. The action of the diaphragm may be suspended by compression of the phrenic nerve.

Dislocations of the bodies of vertebræ of the neck and back, are almost necessarily accompanied by fracture.

*Treatment.*—But little is to be expected. Great care is required in extension and coaptation. In the neck, danger is to be apprehended from an attempt to reduce the deformity. Contusion of the muscles may produce a deformity which may resemble dislocation.

*Subluxation* or *partial* dislocation is more common; and it may terminate without permanent injury to the spinal marrow; provided the antiphlogistic system is pursued in all the details of rest, diet, purging, cups, &c.

#### DISLOCATION OF THE RIBS.

The *vertebral* extremity of the ribs can only be dislocated by severe falls, or blows upon the back; on account of its double articulation, and its protection by the muscles of the back. The *sternal* extremity is sometimes loosened from the cartilage by violent bending of the body backwards;—great pain and difficulty of

breathing follows. Reduction can be effected by deep inspiration, slightly bending the body backwards and making some pressure on the projecting point. The subsequent treatment is the same as that for fracture of the rib.

#### DISLOCATION OF THE CLAVICLE.

The clavicle may be dislocated at either extremity, and is more rare than fracture.

The *sternal* end may be dislocated upward, backward, and forward, fig. 10. When dislocated upward, the sternal extremity approaches its fellow, and is much more elevated than the acromial extremity. When dislocated backward, which is more rare, there is a depression over the articulation, pain and stiffness in the neck, and difficulty of swallowing. When the direction is forward, which is the most frequent, it is produced by force applied at the opposite extremity. It is characterized by a projection over the spot, inclination of the head to the affected side, pain upon moving the arm, and the shoulder is brought near to the chest.

The *reduction* is easy,—by means of extension and counter-extension; there is more difficulty in preventing a recurrence of the accident. Dessault's apparatus for fractured clavicle should be applied. But even with the greatest care, greater or less deformity commonly remains, which, however, does not interfere with the motions of the arm.

The *scapular* end is generally dislocated upwards. Although sometimes it slides beneath the acromion. It is usually the result of a fall; and is recognised by pain, impeded motion, depression of the shoulder, and the clavicle resting on top of the acromion occasions a projection.

Reduction is effected by elevating the shoulder and depressing the corresponding end of the clavicle. Dessault's bandage is then to be applied, and the part kept at rest. Some displacement usually remains, which does not prevent motion of the shoulder.

#### DISLOCATION OF THE ARM.

This is the most frequent dislocation, on account of the mobility of the shoulder joint, its constant exposure to injury, and the shallowness of the glenoid cavity, compared to the size of the head of the humerus.

It may be displaced in three directions; viz., inwards, downwards, and backwards. In dislocation inwards, the elbow stands out from the body, and is inclined a little backward; a protuberance is felt beneath the pectoralis major muscle, and there is frequently shortening of the limb.

In dislocation downwards, which is the most common displacement, the arm is lengthened, and there is great rigidity and

immobility; the elbow stands out from the body; there is a hollow under the acromion process, and a prominence in the axilla.

In dislocation backward, which is most rare, the elbow is inclined inward and forward, the head of the bone forms a prominence beneath the spine of the scapula, and there is a hollow beneath the acromion, together with rigidity and immobility.

Violence and contraction of the muscles *pectoralis major*, *latissimus dorsi*, *teres major*, and *deltoid*, are the causes of dislocation of the arm. The immediate injury is a laceration of the capsule, contusion of the muscles, and effusion of blood, and often paralysis of the *deltoid* muscle from compression of the axillary nerve. Unless reduction is effected the parts become united by adhesions,—after which reduction cannot be produced without danger of lacerating the artery.

Fig. 10.

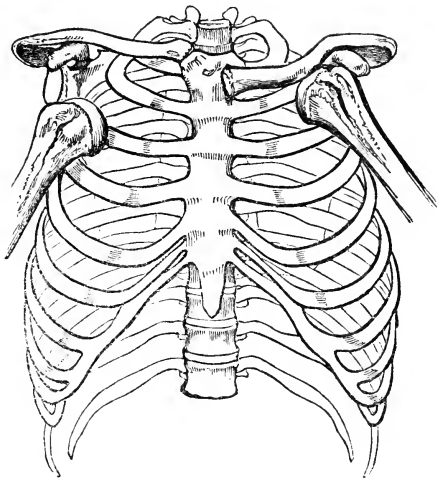
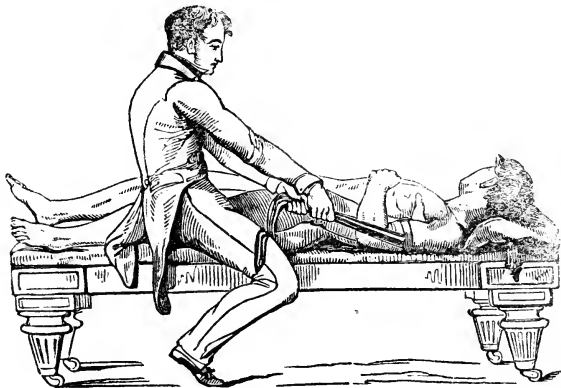


Fig. 11.



The *reduction* is managed in different ways. The ordinary plan is to place the patient on the bed, and then to place a spherical pad in the axilla. The surgeon makes counter-extension with his foot upon the pad, and extension with his hands. If this force is not sufficient, counter-extension may be made by passing a folded towel or sheet under the axilla, and securing the ends to the bed-post; and extension by fastening a folded sheet or long towel to the wrist or elbow by a damp roller; thus several assistants can make extension at once. If this force is not sufficient, pulleys may be employed, taking care that the extension be made very gradually.

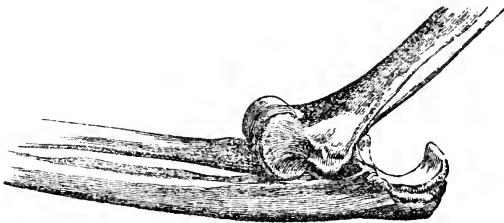
The elbow has this advantage over the wrist, as a point of application of the extending band,—the elbow can be bent, and thus a greater rotatory movement of the head of the bone produced. The wrist is preferred by some, on account of there being no muscles compressed, whose contraction might interfere with the reduction.

After reduction, which is recognised by cessation of pain, rotundity of the shoulder, and mobility of the limb, the arm should be kept in a sling, and not used for several days. Should paralysis of the deltoid continue, it may be relieved by stimulating lotions, blisters, moxas, &c.

#### DISLOCATIONS AT THE ELBOW.

When both radius and ulna are dislocated at the elbow, the forearm is bent nearly at a right angle, and is immovable. The olecranon forms a prominence behind, and the articular extremity of the humerus, covered by the brachialis anticus muscle, forms a protuberance in front. The coronoid process of the ulna is received

Fig. 12.



into the greater sigmoid cavity of the humerus, and tends to maintain the bones in their unnatural situation. A *lateral* dislocation inwards may also occur, in which there is a great projection of the external condyle of the humerus, in addition to the symptoms of the first variety.

When the ulna alone is dislocated backwards, the olecranon forms a marked projection posteriorly, the elbow is bent at right angles, and the forearm is pronated.



*Reduction* of the above forms of dislocation is effected by making forcible extension of the forearm over the surgeon's knee, which is to be placed at the elbow, to make counter-extension. The forearm is to be bent while extension is produced.

The *radius* is dislocated at its upper extremity, either forwards or backwards. Backwards is the most frequent displacement. The head of the bone forms a prominence behind, the arm is bent and the hand is prone. When displaced anteriorly, there is a distinct prominence in front, the arm is slightly bent, but cannot be completely flexed, and there is some pronation.

The *reduction* is effected by making forcible extension and pronation at the same time, if the displacement be anteriorly; if the displacement be posteriorly, supination is to be produced with extension. In both the head of the bone is to be pressed upon by the surgeon's thumb, in order to facilitate its sliding into its proper place.

Dislocation at the elbow occurs but rarely, on account of the ginglymoid character of the joint, and is generally accompanied by considerable laceration of the soft parts. Rest, cold applications, a sling, are subsequently required and together with general anti-phlogistic means.

It is produced, most frequently, by force applied to the wrist, and when complicated with fracture of any of the processes, ankylosis, gangrene, and other dangerous results may follow, especially if the reduction is delayed, and adhesions have formed.

#### DISLOCATIONS AT THE WRIST.

The *radius* and *ulna* may be separated from the carpus, either anteriorly or posteriorly. When dislocated *forwards* there is a great projection in front, and the hand is bent backwards; when backwards, the projection is behind, and the hand is flexed.

It is produced by violent bending of the hand, and is accompanied by rupture of the ligaments and stretching of the tendons. The *reduction* is easily effected by extension and pressure. Pain, swelling, and stiffness of the joint may follow, which are to be obviated by cold applications, rest, lotions, &c.; if there should be a tendency to its reproduction, a light splint may be applied.

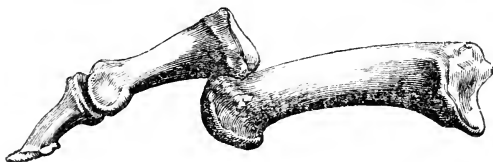
If the *radius alone* is dislocated from the carpus, which is generally anteriorly, the hand will be somewhat twisted, the radial side of it being thrown backward. The *ulna* may be dislocated backwards upon the radius, rupturing the sacciform ligament, and producing a projection on the back of the wrist, by which it is easily recognised. It is readily reduced by pressure and extension. A splint and bandage may be necessary to prevent its recurrence.

#### DISLOCATION OF THE BONES OF THE HAND.

Displacement of the bones of the *carpus* rarely occurs. Occa-

sionally there is a dislocation of the *phalanges* of the fingers, but more frequently the dislocation backwards of the first phalanx of the thumb, upon the metacarpal bone.

Fig. 13.



Reduction is effected by making extension in a curved line, by means of a narrow bandage or tape, firmly applied by a clove-hitch upon the phalangeal extremity. In some instances it may be necessary to divide the lateral ligament.

#### DISLOCATIONS OF THE FEMUR.

Dislocations of the thigh may occur in five directions:—1st, upwards and backwards, on the back of the ilium (Fig. 14); 2d, in-

Fig. 14.



Fig. 15.



wards and downwards, into the foramen ovale (Fig. 15); 3d, backwards and downwards, into the ischiatic notch (Fig. 16); 4th, upwards and forwards, on the horizontal ramus of the pubes (Fig. 17); 5th, downwards, under the tuberosity of the ischium. The first is the most common, the fifth is the most rare.

Fig. 16.



Fig. 17.



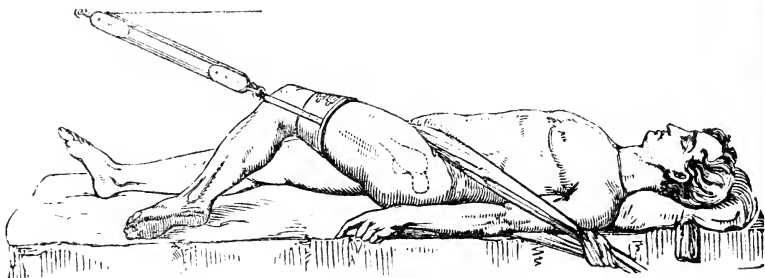
In the most frequent displacements *upwards and backwards*, the limb is shortened from an inch and a half to two inches and a half; the toes rest on the opposite instep; the knee is turned inwards and slightly bent; the limb may be bent across the other, but cannot be moved outwards; the trochanter is less prominent, and nearer the spine of the ilium; and if the patient is thin, and there is no swelling, the head of the bone can be felt in its new position, and the rounded form of the hip is lost. It is to be distinguished from a fracture of the neck of the bone by the position of the foot and the rigidity of the limb.

The reduction is the most difficult of all dislocations, and must be attempted as soon as possible after the displacement. If it is not produced, the head of the bone will adapt itself to its new position by the formation of a new cavity, and the patient will gradually be

able to walk, the toes merely touching the ground. Bleeding, a warm bath, and tartar emetic must be administered, according to the patient's constitution, in order to produce relaxation of the muscles. Counter-extension is to be made by a folded sheet or large towel placed in the perineum, the patient being in the recumbent position, and secured to a ring or hook firmly fastened in the wall or floor.

Extension is to be effected by securing a folded towel or sheet above the knee, by means of a damp roller; this towel is to be acted upon gradually, by numerous assistants or by pulleys. The

Fig. 18.



extension is to be made gradually, in such a direction as to draw the thigh across the opposite one, a little above the knee. A third band or towel is to be passed around the pelvis, in order to fix it more firmly, the ends of which are to be tied on the sound side, which is to be given to an assistant.

Dislocations *backwards and downwards* in the sciatic notch are next in point of frequency. The head of the bone rests on the pyriformis muscle, between the sacro-sciatic ligaments and the upper part of the notch, a little above the level of the middle of the acetabulum. The shortening and inversion of the foot is not so great as in the first variety; the head of the bone can seldom be felt; the joint is extremely rigid, and motion of the limb almost impossible. In reducing this dislocation it is necessary that the head of the bone should first be brought out of the notch, before it can be restored to the acetabulum.

Dislocations *downwards and inwards* are comparatively rare; the limb is elongated nearly two inches; the foot is advanced, though neither inverted or everted; the thigh is abducted, and cannot be brought near to its fellow; the psoas and iliacus muscles form a ridge which can be seen or felt; the trochanter is flattened and depressed, and the space between it and the anterior superior spinous process of the ilium is much increased. To reduce this form, counter-extension is to be made outwards by a band across the upper and inner

part of the thigh; extension is to be made at the knee, which is gradually to be made to approximate its fellow.

In dislocation *upwards and inwards*, the head of the bone rests upon the horizontal portion of the pubes, under Poupart's ligament, where it forms a tumour. The limb is shortened an inch, and the foot is turned outward, and cannot be rotated. The reduction is effected by extension in the axis of the body.

Reduction of the thigh is indicated by an audible noise when the head of the bone returns to its socket, by the natural length and direction of the limb, by the cessation of pain, and the free motion of the joint.

After reduction there is sometimes a slight elongation of the limb, which depends upon the swelling of the ligaments of the joint. The patient should be kept at rest, and may require antiphlogistic treatment; walking should not be attempted for several weeks.

#### DISLOCATIONS OF THE KNEE.

Dislocation at this joint is rare on account of its great strength. The displacement may be forwards, backwards, and laterally; is usually incomplete and readily reduced.

The reduction is accomplished by extension of the leg and coaptating the extremities of the bones. Subsequent inflammation and its results, ankylosis, suppuration, &c., are to be avoided by strict antiphlogistic means; sustaining the weakness of the joint by splints or rollers, and removing the stiffness by lotions and frictions.

The *semilunar cartilages* are sometimes displaced by twisting the joint, especially if an unusual relaxation of the ligaments should exist. The limb is immediately rendered stiff, and the pain is severe parts to their position, although the pain and swelling remain for and sickening. Extreme flexion usually is sufficient to restore the some time and require attention.

#### DISLOCATIONS OF THE PATELLA.

The patella may be dislocated anteriorly, posteriorly, and laterally. *Outwards* is the most frequent displacement, and is characterized by the leg being stretched, a prominence externally formed by the patella, and a projection internally of the internal condyle.

Reduction is effected by raising the leg and resting the patient's heel on the surgeon's shoulder, thus relaxing the muscles of the thigh; at the same time the patella is to be forced into its place with the hand. This bone can only be displaced *upward* by a rupture of its tendon, and *downward* by a laceration of the rectus muscle. It may be displaced by semi-rotation, one edge resting on the trochlea of the femur, and the other forming a prominent ridge. Extreme flexion and coaptation will reduce it.

## DISLOCATION AT THE ANKLE.

This accident is usually the result of severe force, and accompanied by fracture of the malleoli. The displacement may be forward, backward, inward, and outward.

Dislocation of the tibia *inward* is the most frequent, and owing to a fracture of the external malleolus, the foot is everted and the internal malleolus greatly projects.

*Reduction* is effected by extension of the foot and flexion of the leg, so as to relax the gastrocnemius muscle. Dislocation of the tibia outward is occasioned by a fracture of the internal malleolus, and the deformity is the reverse of the last. Dislocation backwards may result from a fracture of the posterior extremity of the astragalus, in which instance the foot is inverted as in varus; this is more rare than dislocations forward, which result from fractures of the lower end of the fibula. There is danger of suppuration and gangrene, especially if connected with an external wound. Amputation will often be the best resort, particularly when the constitution of the patient is bad.

## DISLOCATION OF THE BONES OF THE FOOT.

The *astragalus* is more frequently dislocated than any bone of the tarsus; and it may either be forward or backward. Unless reduction can be effected, which is difficult, excision of the bone may be necessary, or amputation at the ankle. Dislocation of the other bones of the tarsus are usually compound injuries, and are to be treated upon general principles.

## INJURIES OF THE HEAD.

## THE SCALP.

*Contusion* of the scalp may be very severe, on account of its being stretched over the resisting bony surface of the cranium, and being frequently connected with a lacerated wound. Owing to its vascularity, great swelling will occur from extravasation of serum or blood; in many instances a fluctuating tumour being produced beneath the integuments. The swelling which results being readily depressed in the middle, may give rise to the idea of a fracture, which is to be carefully diagnosticated.

The *treatment* will require cold applications. In no instance is a coagulum of blood to be evacuated by incision or puncture; but absorption is to be promoted and depended upon, even if slow and tedious. It may be that the clot will produce inflammation and suppuration; then a free incision should be made, and the exit of the pus favoured. Healthy granulation contracts the cavity, and the wound unites by the formation of a cicatrix.

The constitutional treatment required may be different in the early stages from the latter, being antiphlogistic or tonic, as the symptoms demand.

*Wounds of the Scalp.*—Simple incised wounds of the scalp give little trouble but that of hemorrhage, which is best arrested by a ligature or torsion; a curved needle will be found more convenient to secure the vessels than the tenaculum. The edges are to be drawn together by adhesive straps, in preference to stitches, on account of the danger of erysipelas. When a large portion of the scalp is lacerated, and hangs like a flap, it is not to be cut, even though it is attached by a very small process; but, after being carefully cleaned, it is to be adjusted accurately, and retained in its place by proper bandaging. It thus protects the bone from exposure, and by granulation becomes firmly united to the adjacent parts. Blindness may result from a wound upon the forehead injuring the supra-orbital nerve.

#### CONCUSSION.

*Concussion.*—By this is meant a jarring or shaking of the brain without any great lesion, though function is temporarily impaired; inflammation is apt to follow. The force may be directly from a blow upon the head, or indirectly, from alighting upon the feet. The patient is stunned, is somewhat insensible, lies motionless, pale and cold. Insensibility is not complete, for questions will be answered, and pain manifested by pinching; respiration is feeble, the pulse is rapid, small, and fluttering; the pupils are insensible to light, sometimes contracted, and sometimes dilated; nausea and vomiting often follow. After reaction, inflammatory symptoms commence, the pulse becomes full and hard, the skin hot and dry, the face flushed, the eyes bloodshot, great pain, especially in the head, restlessness and delirium.

*Treatment.*—In the first stage, that of prostration, the chief care of the surgeon is to prevent some bystander from bleeding the patient, in common with the vulgar notion. No active treatment should be resorted to until reaction has taken place. In the meantime the patient should be undressed and put to bed, and his limbs carefully examined; the head should be shaved, wounds dressed, &c.

Should the prostration continue, and danger impend from syncope, stimulation is to be resorted to in the most gradual and cautious manner; warm frictions are to be employed, small quantities of tea, wine, and water are to be administered with care, lest they pass into the air-passages, and produce asphyxia. After reaction commences, stimulants are to be suspended, lest they increase subsequent inflammation. By hurrying on reaction, life is as often endangered as by the too early abstraction of blood. So soon as inflammatory symptoms fairly manifest themselves, we should endeavour to repress

them by excluding all kinds of excitement, especially light and noise, and by the application of ice and evaporating lotions to the head, which should be elevated upon pillows. If great reaction occur, manifesting itself by delirium, convulsive movements, a full and active pulse, pain, &c., local and general bleeding, together with enemata and purgatives, are to be resorted to; opium will also have a beneficial influence if administered judiciously, especially in connexion with calomel and tartar emetic. For some time after the violence of the inflammation has subsided, the brain remains weak and requires watchful care; excitement, both physical and mental, is to be avoided, the diet regulated, and the head kept cool. The memory is often impaired, the conversation childish and incoherent, the eye wild and vacant in its expression, the demeanour either most timid and gentle, or entirely the reverse; occasionally one or more of the special senses, such as hearing or smell, is lost; such consequences may be temporary or permanent. The treatment most suitable is a mild mercurial course, long-continued counter-irritation, regulated diet, avoidance of all excitement, and exposures to changes of weather, together with the use of the cold shower-bath.

#### FRACTURES OF THE CRANIUM.

These occur more frequently in adults than in children, on account of the unyielding and brittle nature of their bones, whereas the bones of a child's head are pliable, and yield to the force without fracture. Fractures of the cranium are classified, by the extent of injury, into simple fissure, stellated, depressed, and camerated fractures, fractures of the external or internal table, &c. The dangers attendant are various: there may be concussion, compression, hemorrhage, and inflammation of the brain and its membranes.

*A simple fissure* is of but little importance, even should it be extensive, and traverse a suture, which it often does. The fracture itself requires no treatment, unless accompanied by symptoms of concussion, compression, or inflammation.

*Fracture at the base* of the cranium is a very serious injury, and usually attended with laceration of the membranes, and internal hemorrhage. It is usually suspected, from the early appearance of symptoms of compression, the manner in which the injury was received, escape of blood from the ears, and sometimes from the nose and mouth. This latter symptom, although generally considered a most dangerous one, may be the result of mere laceration of the lining membrane of the ear or the nose. The treatment required will be that for inflammation or compression.

*A depressed Fracture.*—This is to be carefully diagnosticated from a fracture of the external table alone, and from a depression in the middle of a tumour occasioned by the effusion of lymph. It is



dangerous, from the complications of concussion, compression, extravasation of blood, and inflammation. The treatment consists in removing the cause of compression, and combating the effects of inflammation; the former by the operation of trephining, and the latter by strict antiphlogistic means.

## COMPRESSION.

Compression may be the result of extravasated blood, depression of the bone, or the formation of pus. The symptoms which characterize it are slow, laborious, stertorous respiration; a full, regular, slow pulse, and complete loss of consciousness and sensibility; the muscles are relaxed and powerless, pupils dilated and insensible, the skin warm and moist, and the sphincters often relaxed. The patient may perish immediately from coma, or may rapidly recover from the removal of the cause of depression.

Extravasation of blood may take place immediately upon the infliction of the injury, or not until reaction has followed; concussion often being produced at the same time. The extravasation may be situated between the bone and the dura mater, which is the result of a wound of the meningeal artery. This may be the result either of a direct blow, or of a counter stroke. The symptoms gradually appear, and if urgent, the trephine should be used, and the blood, if fluid, escapes at once. If the symptoms be not severe, the clot may be absorbed, and the brain gradually recover from the compression, provided high inflammatory action is prevented.

Blood may be effused within the membranes, or within the ventricles; most frequently being the result of injury to the vessels of the pia mater. The clot effused *within* the membranes is usually larger, and will produce more dangerous symptoms than one *external* to them. The most dangerous consequences result from a clot at the base of the brain.

*Treatment.* — The objects are to prevent increased effusion and diminish subsequent inflammation, and the removal of the clot. The head should be elevated, cups and cold applications applied, with general bloodletting and purging. The action of the heart is to be diminished, in order to prevent the further extravasation of blood. The removal of the clot is accomplished by trephining, and opening the membranes. If, however, the clot is at the base of the cranium, or it is uncertain where it may be, the membranes are not to be opened, for the chances of inflammation would be much increased by the operation, and the cause of compression not certainly removed.

*Compression resulting from the formation of pus*, does not exhibit the ordinary symptoms rapidly, as is the case by the escape of blood, nor do the symptoms subside so readily; because pus is not so amenable to absorption as blood. It cannot be discharged but by

the exfoliation of the bone, which is a tedious process. The symptoms denoting the formation of this dangerous abscess, affect the system as well as the part; and the patient would manifest the same restlessness, rigor, and fever, which attend the formation of pus in other parts of the body.

#### TREPHINING.

The scalp is first to be cleanly shaved; and if a wound already exist, the cranium may be exposed simply by enlarging it; but if no previous wound exist, an incision is to be made, of a crucial, triangular, or semicircular shape,—the latter being most preferred. The pericranium is then to be detached by a scraper, unless the trephine have an additional means for removing it. That portion of the cranium should be selected which is sufficiently near the injured parts to allow of elevation of the fragments, by the introduction of an elevator, and at the same time to be sufficiently firm to bear the pressure of the trephine. The sinuses of the dura mater, the occipital cross, and the course of the middle artery of the dura mater are to be avoided. The centre pin of the trephine is to be withdrawn, after a groove is made sufficiently deep for the play of the teeth of the instrument; and great care is to be taken, lest the trephine saw through the bone unequally, owing to the want of parallelism of the two tables of the skull. The progress of the operation is to be cautiously watched, and the depth of the groove made by the trephine, ascertained by a toothpick or a small probe. The button-like portion of bone frequently comes away in the trephine; if not, it is to be removed by a forceps or elevator; the rough edges (should any exist) of the internal table, are to be taken away by an instrument called a lenticular. Through the opening thus made, the elevator may be introduced, or the extravasated blood may escape. The opening is subsequently filled up by a dense membrane, formed by the pericranium and dura mater. The edge of the opening is somewhat altered by absorption, and some deposit of bone. In some instances of compound fracture of the skull, a prominent angle may be sawed off with Hey's saw, and thus an opening be formed sufficiently large for the admission of the elevator, or the exit of the bloody clot.

#### INJURIES AND DISEASES OF THE FACE, NOSE, AND MOUTH.

Wounds of the face are usually attended with considerable hemorrhage, which sometimes requires the tying of an artery. Care is required to approximate the edges, in order to prevent deformity and an ugly cicatrix. When the supra-orbital nerve is injured, vision is impaired; when the portio dura nerve is cut, paralysis of the muscles upon one side of the face results.

*Wounds of the External Ear* do not affect the hearing; but when the cartilage is cut, a split will remain, unless the integuments are carefully united.

*Wounds of the Eyeball*, produced by great violence, such as gunshot wounds, of course destroy the sight, and are often followed by a fungous growth, which requires removal and the substitution of a glass eye.

*Wounds of the Tongue*.—Bleed very copiously, and there is some difficulty in arresting hemorrhage. This is to be effected by a ligature and styptics; and, if necessary, by the actual cautery. Sutures are necessary to approximate the edges of the wound.

*Salivary Fistula*.—This results from a wound or ulcer of Steno's duct, by which the discharge of the parotid gland opens externally on the cheek, occasioning great inconvenience and deformity, and interfering with the processes of mastication and digestion. A cure is to be effected by making an opening through the mucous membrane of the cheek, that the saliva may enter the mouth, and by closing the fistulous orifice. The edges of this orifice will require caustic, or paring with a sharp knife, or the actual cautery, to make them unite, and the internal orifice is to be kept open by a tent.

*Epistaxis*.—This implies hemorrhage from the nostril, produced by injury, plethora, or diseased state of the blood and mucous membranes. The treatment will, in a great measure, depend upon the cause. The arrest of hemorrhage by external applications, is only to be made under certain circumstances; it will be effected by an upright position, cold applied to the head and back, astringents thrown up the nostrils, and compression by lint. In some instances, the lint is to be introduced through the posterior nares, by means of Belloque's canula, or by a flexible catheter and a piece of string, where it must be allowed to remain for several days; in many instances, constitutional treatment is necessary.

*Foreign Bodies in the Nostril*.—Peas, beads, and such like substances are often inserted by thoughtless children; and by unwise efforts at removal, they are more deeply lodged in the cavity. The surgeon is to inject a stream of warm water into the nose, which will wash away any coagula of blood, and loosen the foreign body; its position is to be discovered by a probe, when it can be extricated by a scooped end of a director or forceps. A pinch of snuff will sometimes dislodge it.

*Polypus of the Nose*.—There are different varieties of polypi: the most common is a gelatinous, pyriform mass, attached to the mucous membrane of the turbinated bones. The patient has a sensation of a cold in the head, which is much increased in damp weather. It interferes with respiration, and frequently alters the tone of the voice. The sense of smell is also impaired, and deafness may be produced,

should it occupy the orifice of the Eustachian tube. It may be removed by twisting it off by the forceps; and the hemorrhage is to be arrested by astringent injections and lint. *A dense fibrous polypus* is best removed by a ligature or wire, applied by means of a double canula, for the purpose of strangulation. *Malignant polypi* may be regarded as incurable.

*Lipoma of the Nose*, is a hypertrophied condition of the skin and fat of the apex, and alæ of the nose; seldom occurring but in aged free-livers. When the growth is large, it is to be removed by the knife.

*Ozæna*.—Is an obstinate, profuse, and fætid discharge from the mucous membrane of the nose, with disease of the bones beneath. The disease often extends to the frontal sinus and antrum. In adults, it is often dependent upon syphilis, or the abuse of mercury; in children, upon scrofula.

The *treatment* will in a great measure be constitutional, although benefit and comfort will be derived from the use of astringents and chlorine washes, and promoting the free discharge of the matter.

*Abscess of the Antrum*.—May result from a blow, or the irritation of a decayed tooth. It is attended with permanent, deep-seated aching of the cheek, the pain often becoming intense, together with rigors and fever. The cavity bursts, either internally or externally, which gives great relief. The earlier that leeches and emollient poultices are applied, the better; but, after the cavity has become filled with matter, there is necessity for immediate puncture just over the third molar tooth; or, a tooth must be extracted, and a trocar pushed through the socket. The discharge of pus can be facilitated by syringing with warm water.

*Epulis*.—Is a solid tumour of the gum, of a non-inflammatory character. It commences in the form of a seed-like excrescence upon the gums, between the interstices of the teeth. Being without sensibility, it may occasion but little inconvenience, except by its size. As it grows, it loses its dense fibrous structure, and may become fungous; sometimes it becomes malignant.

*Treatment*.—Nothing will suffice but complete extirpation of the adjacent portion of the gum and alveolar process. Several perfectly sound teeth may have to be drawn, in order to apply a fine saw or bone-pliers. The hemorrhage is to be arrested by muriated tincture of iron, and pressure by lint.

*Parulis*.—Is a gum-boil; occasioned usually by a decayed tooth, or a stump, or a tooth whose nervous pulp had been destroyed previous to plugging. The swelling is slow at first, though the pain is intense while the pus is forming. Unless the tooth is extracted, an opening will be formed through the alveolar process and gum, for the discharge of the matter, which may remain fistulous.

The *treatment* will consist of leeches and fomentations, and the

speedy evacuation of the abscess, either by the abstraction of a tooth, or by puncture.

*Ranula.*—Is a sac formed beneath the tongue, by an expansion of Wharton's duct, either from disease or obstruction. Inconvenience is felt in mastication, deglutition, and articulation.

The *treatment* consists of dilatation of the duct, or making an artificial opening. It is necessary to keep the orifice distended by a tent or loop of wire, until the cyst contracts to its normal size; otherwise it will be refilled.

## WOUNDS AND AFFECTIONS OF THE THROAT.

*Tonsils.*—*Inflammation* of the tonsil is characterized by the rapid swelling of the part, great pain in deglutition, and fever. It is to be treated by bleeding, leeches, purging, and gargles. An incision made with a bistoury will unload the vessels, and give exit to any pus which may have been formed. *Chronic* enlargement of the tonsil may result from inflammation, especially in scrofulous persons; deglutition is impeded, the voice is rendered hoarse, respiration is noisy and laborious, and there may be deafness, from the obstruction of the Eustachian tube.

The *treatment* should consist of the internal and external use of iodine, astringent gargles, and the application of nitrate of silver. If these means fail, it should be removed by the knife, or with an instrument constructed for the purpose, such as Physick's or Fahnestock's.

*Elongated uvula* may be removed simply by a forceps and scissors.

*Œsophagus.*—The œsophagus may have a permanent or spasmodic stricture.

A *spasmodic* stricture comes on suddenly, generally at meals, and is attended with pain, and a choking sensation. It depends on a weakened or hysterical state of the system, or neuralgia. Tonics, antispasmodics, and alteratives are the means of cure, with proper attention to diet, and care to avoid swallowing food that is hot or imperfectly masticated.

*Permanent stricture* is a narrowing produced by inflammation of the mucous and cellular coats, which forms a firm ring generally opposite to the cricoid cartilage. It is most frequent in females, and has these symptoms: difficulty of swallowing, which gradually increases, and is never absent; pain in the chest and neck. It is a serious complaint, and may be followed by ulceration, salivation, vomiting of purulent matter, and death from starvation or irritation.

The *treatment* should consist of a mild course of mercury, combined with some anodyne, a seton between the shoulders, and the

passage of a bougie, together with a weak solution of nitrate of silver applied to the surface.

*Foreign bodies in the Œsophagus* produce a sense of choking and suffocation, and may prove fatal.

*Treatment.*—The patient should be seated in a chair, with his head thrown back, and his mouth wide open; the surgeon should then introduce his finger, regardless of the attempts to vomit, ascertain the position of the substance, and if possible remove it by the finger, or by the assistance of curved forceps. A small sharp body, such as a fish-bone, may be got rid of by swallowing a large mouthful of bread; a large soft mass, such as a piece of meat, may be pushed down into the stomach with a probang; a rough and angular body, such as a piece of bone or glass, should be brought up, if possible, by long and curved forceps, or with a piece of whalebone, armed with a flat, blunt hook, or with a skein of thread, so as to form a number of loops. If the stomach is full, it should be emptied by an emetic, with the hope that the foreign body may be ejected with the food. It may be necessary to resort to the operation of œsophagotomy, which should be performed by making an incision as nearly opposite the foreign body as possible, through the skin, platysma and fascia, and between the sterno-mastoid muscle and trachea. Care must be taken to avoid the carotid and thyroid arteries, and the recurrent nerve. A small opening should be made in the œsophagus, by cutting it upon a silver catheter, which should be passed down the throat, and made to project into the wound; the opening should be dilated, so as to prevent hemorrhage.

*Foreign Bodies in the Larynx and Trachea.*—Food may get into the rima glottidis, whilst a person is laughing and talking at a meal; and unless immediate relief is afforded, death will result. The surgeon may sometimes be enabled to remove it with his finger; but if not, the larynx or trachea should be opened, and a probe introduced through the wound, so as to push the foreign substance up into the mouth. A foreign body may be impacted in the ventricle of the larynx, or be loose in the trachea, producing spasmodic cough, difficulty of breathing, and pain; a small body may even pass into the bronchial tube, generally the right one. Laryngotomy, or tracheotomy, may be necessary. The *larynx* is opened by a longitudinal incision through the middle crico-thyroid ligament. The trachea is opened in the median line through the skin, fat, and fascia, at the lower portion of the neck. After the tracheal rings are made bare, the patient is directed to swallow; and while the windpipe is thus rendered tense and elongated, the scalpel is made to penetrate the lower part of the wound, with its back towards the sternum, and the rings are to be divided by cutting upwards. Care should be taken, in this operation, to avoid opening large veins, or any part of the thyroid gland. This operation is sometimes necessary for

dyspnœa, when a conical curved tube should be introduced for the patient to breathe through.

*Wounds of the Throat.*—Are extremely dangerous, on account of the important parts injured, and are usually the results of attempted suicide.

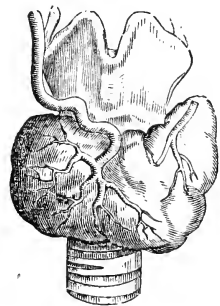
The *treatment* consists in arresting hemorrhage, obviating difficulty of breathing, and preventing inflammation. The arteries must be rapidly yet carefully tied, and the hemorrhage of the large veins restrained by pressure. If the larynx or trachea should be wounded, subsequent inconvenience may result from the introduction of cold air, clots of blood, &c.; if the pharynx or œsophagus is wounded, the use of a tube becomes necessary, in order to convey nourishment to the stomach. This tube must be introduced through the mouth, and not through the wound, as often as it may be necessary to supply the patient with food. The edges of the wound should be carefully drawn together, and dressed in the most simple manner, and should be protected from unfavourable atmospheric influences by a covering of loose gauze, or of woollen texture thrown lightly over the neck. The patient should be carefully watched, to prevent a recurrence of the injury. A fistulous opening sometimes remains in the trachea or larynx, which is extremely difficult to heal.

*Bronchocele, or Goitre.*—Is a swelling of the thyroid gland, depending for the most part upon hypertrophy, although a cyst may be formed, or calcareous matter deposited. In certain localities, it is an endemic disorder, and often associated with cretinism. It occurs most frequently in females after the age of puberty. It grows gradually, and without pain, occasioning inconvenience merely by its deformity and bulk.—Respiration is sometimes affected, and the venous blood being prevented from returning from the head, produces cerebral disorder. The cause of the disease is obscure, but probably connected with climate.

The *treatment* will consist in the use of iodine, internally and externally, with attention to the general health; or it may be necessary under the threatening of suffocation, to perform an operation. The removal of the gland is extremely dangerous, on account of hemorrhage, and does not always produce a cure.

*Torticollis, or Wryneck.*—This is a distortion of the neck to one side, generally the result of spasm of the sterno-cleido-mastoid muscle, or by a paralysis of the muscle of the opposite side. It may also result from tumours, caries of the spine, and cicatrices, especially those from burns.

Fig. 19.



The treatment will vary with the causes producing it. If it result from spasm; purgatives, leeches, and fomentations should be used; if from paralysis of the opposite side, general tonic treatment and stimulating friction will be useful. If the contraction be permanent, the muscle must be divided.

#### INJURIES AND SURGICAL AFFECTIONS OF THE CHEST.

*Wounds* of the chest may be inflicted by a sharp instrument, a fractured rib, or a bullet. Danger results from hemorrhage, and subsequent inflammation from air, or clot of blood in the pleura. The intercostal may be the source of the bleeding, and it is sometimes difficult to arrest it by the ordinary means. A curved needle, armed with a ligature, is the best means of securing the vessel, when deeply concealed in the intercostal groove. The entrance of air into the chest (pneumothorax) through the wound, is to be prevented as much as possible by the early and accurate closure of the wound; otherwise there may be compression of the lung. The suppuration of the wound may lead to inflammation and suppuration of the pleura. This collection of pus in the chest is called empyema.

When the lung is wounded, there is still greater danger from hemorrhage, inflammation, and the air. It is attended with great prostration, difficult breathing, anxiety of countenance, and expectoration of blood. The danger of bleeding results not only from the direct loss, but from its collecting in the pleura (hæmatothorax), and its filling up the bronchial tubes and trachea. The inflammation may subsequently destroy the lung and the life of the patient also by hectic. The air may also more readily enter the cavity of the chest, and not being readily discharged through the external wound, may infiltrate it into the subcutaneous cellular tissue.

The hemorrhage is to be controlled by venesection, rest, antiphlogistic means, acetate of lead, and opium. A careful examination of the wound should be made, in order that no foreign matters remain; the patient should lie on the wounded side, so as to favour the discharge of blood or pus, and it may also be necessary to prevent a closure of the wound. Emphysema may be overcome by compression, or an incision.

*Paracentesis thoracis.*—Puncture of the thorax, may be required for accumulated air, blood, or pus. The opening is most frequently for empyema. The point selected is usually between the sixth and seventh ribs, half way between the spine and sternum. If made too low, the diaphragm may be wounded; if too high, the fluid will not so readily escape. The opening should be closed with care, to avoid the entrance of air.



## WOUNDS OF THE ABDOMEN.

*Wounds of the abdomen* are extremely dangerous, on account of the important viscera contained within, and the liability to peritonitis. A simple wound of the parietes must be closed by suture if it is extensive, care being taken not to include a portion of the intestine. When complicated with a wound of the liver, fatal hemorrhage must almost necessarily result, on account of the great vascularity of the organ. A patient may survive a small wound, which will be succeeded by great prostration, pain in the liver, yellowness of the skin and urine, and a bilious discharge of the wound.

The *wounds of the gall bladder, and spleen, and urinary bladder*, if communicating with the peritoneum, are almost always fatal. Wounds of the *kidney* are also exceedingly dangerous from hemorrhage, violent inflammation, and suppuration, with excessive vomiting. Venesection, laxatives, warm bath, avoidance of drinks, with light dressings of the wound, are the proper measures for treatment.

*Protrusion of the Bowel.*—When a portion of the intestine protrudes through a parietal wound of the abdomen, it is to be returned with great gentleness and accuracy, so as to avoid inflammation and obscure strangulation. The edges of the wound are to be carefully approximated, by suture if necessary, and by moderate bandaging such pressure is to be made as to prevent reprotrusion.

*Wound of the Bowel.*—A wound of the bowel may be suspected from the passage of blood with the stools, the escape of fæces through the wound, excruciating pain over the whole belly, and a great tendency to collapse.

Extravasation into the cavity of the peritoneum does not take place from a small wound, owing to the protrusion of the mucous coat through the muscular, and the constant and equable pressure of all the abdominal viscera; lymph is also rapidly effused, and the contiguous edges are thus united. If, therefore, the protruded part be found to have sustained a mere puncture, it is to be returned as if entire. A small incision may be closed by the glover's suture; the ends are cut short, and the exudation of lymph envelopes the thread, which in time finds its way into the cavity of the bowel, and is thence discharged.

If the portion of bowel be bruised and lacerated to such an extent as to render adhesion impossible, and gangrene probable, the wounded part must be retained at the surface, and the peritoneal coat united with the integuments at one or more points; the fæces are thus discharged through the external wound, and an *artificial anus* is thus established.

*Wounds of the stomach* are recognised by vomiting of blood, and the nature of the matters which may escape from the wound. They are much more dangerous than those of the bowel. The edges of the stomach and the edges of the external wound are to be stitched

together by the continuous suture. The subsequent treatment should consist of perfect rest, and the prevention of inflammation; venesection and leeches, and large doses of opium, will probably be necessary; nothing but thin arrow-root, or mucilage, should be given as a diet, and it may be necessary to administer this by the rectum; purgatives should be studiously avoided.

#### ARTIFICIAL ANUS.

This is an unnatural opening of the intestine, through which fæces are discharged. It may be the result of a wound, or sloughing consequent on strangulated hernia. The orifices of the upper and lower portion of the intestine are united with the abdominal wall. The lower portion of the bowel becomes contracted, and receives but little fæces. The integuments around the artificial opening form a funnel-shaped cavity, the edges of which are red, everted, and excoriated. The *consequences* of the affection may be inanition by the escape of chyle, especially if the upper portion of the small intestine be engaged; a patient is liable to hernia, colic, besides the disgusting annoyance of the constant escape of fæces and flatus.

The *treatment* will consist of regulating the bowels by diet and medicine, and by supporting the orifice by a compress or truss, which will retard the escape of the discharge, and promote the contraction and cicatrization of the funnel-shaped cavity. It may be necessary to perform Physick's operation: this consists of introducing a ligature by means of a curved needle into the orifice of the upper intestine, and bringing it out through the orifice of the lower, which ligature is then to be secured with a slip-knot. The object of this ligature is to produce adhesion between the peritoneal surfaces of the upper and lower intestine: this will require several weeks; afterwards, an opening is to be formed through this adhesion by means of a bistoury, through which the fæces will pass from the upper to the lower intestine, the external orifice being firmly compressed with a truss. Dupuytren operated by means of a forceps, one blade of which was inserted into the orifice of each intestine, and the pressure regulated by a screw at the handle. The effect of the pressure of the two blades of the forceps, is first to produce adhesion between the sides of the two intestines, and by still greater pressure, to form an opening between them by ulceration.

#### H E R N I A.

Hernia signifies a protrusion, but the term is usually limited to the protrusion of the abdominal viscera. The *predisposing* cause is a weakness of the parietes of the abdomen at the natural openings. This weakness may be increased by injury, disease, or pregnancy, and there may also exist a congenital deficiency.

The exciting causes are muscular exertion, jumping, straining, playing on wind instruments, coughing, vomiting, lifting weights,

tight clothes, parturition, straining at stool, &c. *Hernia* is divided according to the site of the protrusion, into *inguinal*, *ventro-inguinal*, *umbilical*, *ventral*, *phrenic*, *perineal*, *vaginal*, *pubendal*, *thyroideal*, and *ischiatric*. The condition of hernia is also a ground of division into *reducible*, *irreducible*, and *strangulated*; and if the contents of the sac be intestine, it is called *enterocele*, if it contains omentum, it is called *epiplocele*. The sac is formed of peritoneum, and the different parts are called mouth, neck, and fundus.

**REDUCIBLE HERNIA.**—*Symptoms.*—A painful swelling suddenly forms at some part of the abdominal parietes, which is compressible and soft; can be made to disappear by pressure in the proper direction, and which often disappears spontaneously. An *enterocele* is smooth, elastic, and globular, retires suddenly, and with a gurgling noise. An *epiplocele* is more irregular in its form, has a doughy feel, and retires slowly without noise.

*Treatment.*—The treatment consists of reduction and retention. *Reduction* is effected by a manipulation termed *taxis*, the patient being placed in a recumbent position, and the muscles of the abdomen relaxed; gentle and steady pressure is made by the hand in the direction of the descent. *Retention* is effected by continued and suitable pressure over the site of the protrusion, by means of a truss. The points of a good truss are, a well made elastic spring and a pad, that can be accurately fitted. The spring is to be applied two inches below the crista of the ilium, and not above it, as is frequently done. Care must be taken to prevent excoriation, and also that every portion of intestine or omentum is removed from the sac previous to its application. By constant and careful use of a truss, a radical cure may be effected in a child, but rarely, if ever, in an adult.

**IRREDUCIBLE HERNIA.**—When the contents of the sac cannot be restored to the abdomen, the hernia is called irreducible. It may arise from adhesions between the sac and the intestine contained, or from membranous bands stretching across the sac; from great enlargement of the omentum or intestine, or contraction of the cavity of the abdomen. The patient usually suffers from flatulence, indigestion, and constipation, owing to the peristaltic movements of the bowels being partially interrupted.

The *treatment* consists in carefully regulating the bowels, avoiding any great exertions, and the wearing of a bag truss to support the tumour, and prevent further protrusion.

**STRANGULATED HERNIA.**—This is an incarceration of the contents of the sac with inflammation, and an interruption to the passage of fæces, and the circulation in the part. The inflammation is caused by the constriction, which may be the result of spasm, or sudden enlargement of the intestine by fæces or gas.

The *symptoms* are flatulence, constipation, pain in the part and abdomen, nausea and vomiting; sometimes the matter is stercora-

ceous. The countenance is pale and anxious, the skin cold and clammy, and the pulse, which was at first full, now becomes rapid and indistinct; gangrene has taken place, the pain subsides in the tumour, which feels doughy and crepitant upon being handled. The vomiting may cease, and the patient will appear more comfortable, although he is actually sinking. It may be that the integuments and coverings of the intestine may inflame and slough with the intestine; and, after a copious feculent discharge, the patient may recover by artificial anus.

When the tumour is small and recent, and the constriction tight, a few hours may produce death, if no relief is afforded; when the hernia is old and large, days may elapse.

Many of these symptoms may exist in other diseases, as in colic or ileus, but inquiry or examination should always be made as to hernia.

*Treatment.*—The great object is to relieve the strangulation. In the first place taxis should be resorted to, and an effort made to reduce the contents of the sac. In order to facilitate this object, bleeding, warm bath, purgatives, enemata, opium, and cold applications to the tumour will be found of use. A tobacco injection, made with ʒj to Oj of water, may be of use, but requires great caution in its use, on account of its prostrating effect. These remedies may so relax the system that the reduction can be effected; at any rate they will diminish the inflammation if judiciously used. If not successful, the knife must be used.

#### INGUINAL HERNIA.

*Bubonocele* is a common name for this variety of hernia, which consists of a tumour in the groin, made by a descent of the gut or omentum through what are called the rings of the abdomen. These are the weak spots at which the protrusion takes place.

Before studying the operation for strangulated inguinal hernia, it will be proper to examine the anatomy of the parts in their natural condition, and then the varieties of the disease.

For *anatomy of inguinal hernia refer to Anatomy, page 75.*

*Oblique, or indirect inguinal hernia, occurs thus:—*The intestine, or omentum, first pressing against the parietal peritoneum, distends it and forms it into a sac; this sac, containing the intestine, then presses against the fascia transversalis at that portion where it is thin, and passes from the abdomen to the cord, which spot is called the internal abdominal ring, although it is not a hole. The sac, covered by the fascia transversalis, which is now thickened by pressure, then descends the inguinal canal, behind the transversalis and internal oblique muscles, and when it reaches the external ring it is covered by the cremaster, which may be considered as a continuation of these muscles; thus covered, it escapes at the ex-

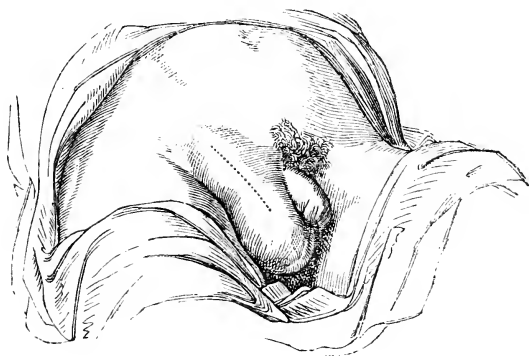
ternal ring, and there receives an investment from the superficial fascia and the skin. We thus see that the intestine is covered by a representation of all the structures forming the parietes of the abdomen, with the exception of the external oblique muscle.

*Direct, or ventro-inguinal hernia*, is a protrusion at the external abdominal ring, having its coverings formed in very much the same manner as the last, but instead of the cremaster muscle forming a covering, it is covered by the expanded tendon of the internal oblique and transversalis muscles. Sometimes this tendon is split, and there is no covering representing this portion of the parietes of the abdomen. The tumour in this variety is nearer the symphysis pubis, and is on the inner side of the epigastric artery, whereas, in the direct variety, the tumour is on the other side of the epigastric artery.

*Concealed inguinal hernia* is a term applied to a protrusion which has been detained in the inguinal canal.

The *operation* for relieving the stricture in an indirect inguinal hernia is to be performed by placing the patient upon the edge of a

Fig. 20.



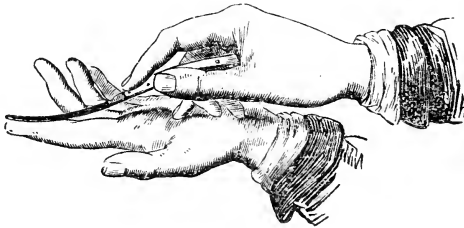
table, with each foot resting upon a chair; the surgeon sits before him, and makes an incision extending from the upper part of the tumour nearly to its base. The skin having been divided, the superficial fascia must next be divided. This will be found to exist in the form of laminæ, the most inferior of which is the thickest; having been, in the natural condition of the parts, that portion of the fascia which fills up the space between the columns of the external ring, and which is sometimes called the intercolumnar fascia. After this division the cremaster muscle will be exposed, altered from its natural appearance; the fibres being stretched and separated from each other, and being more pallid than natural. Having divided

these fibres, the next covering will be the fascia transversalis, which is continued from the abdomen upon the cord; this being done the hernial sac is then exposed.

The sac being formed of peritoneum, has been mistaken by some for the intestine, from which it is to be distinguished by not having a flexure, or crease, which the intestine always has. The sac is to be opened carefully, pinching up a part and rubbing it between the fingers, in order that no portion of intestine may be included; a small opening is to be made, and into this a director may be introduced and the sac divided freely.

Bloody serum will escape freely, and the contents of the sac be thus exposed; the convolution, or knuckle of intestine will vary in its colour, according to the period and intensity of its strangulation, between a light red and a deep chocolate colour; very often the intestine will exhibit patches upon its surface when the inflammation has been intense. The finger is then to be introduced to examine the point of stricture; if none should exist, an attempt at reduction should be made, if the intestine be in a proper condition. The stricture having been detected, a probe-pointed bistoury with a cut-

Fig. 21.



ting edge only near the extremity, is introduced flat upon the finger, and a slight cut made directly upwards to the extent of one or two lines. The only danger to be apprehended is the wounding of the epigastric artery, and this is avoided by making a vertical, instead of a lateral incision. The sac may be strictured by the external or internal ring, or in the canal by the lower edge of the transversalis muscle.

The stricture being relieved, the gut is to be returned, the edges of the wound are to be carefully approximated, and a compress applied to support the part, and prevent accidental reprotrusion. A mild laxative may be given in a few hours if there is no peristaltic motion of the bowels; sometimes the bowel seems to have been paralysed by the compression, and its peristaltic action is not recovered for several hours. Danger results then from the accumulation of medicines, food, &c., and life may be lost by inflammation of the

bowel subsequent to its reduction. The antiphlogistic treatment will be most serviceable. After cicatrization a truss must be worn to prevent a return of the protrusion, though occasionally the operation produces a radical cure. Such is the course in an ordinary case; but, it may be found upon opening the sac, that the hernia is irreducible, owing to the intestine adhering to the sac; the stricture is to be relieved, and the wound dressed, and no attempt made to restore the intestine, unless the adhesion be recent or slight.

Should the intestine be extensively mortified it is not to be returned, the only chance of life being through the establishment of an artificial anus; but, if mortified only in a few spots, the spots are to be included with a fine ligature, and the intestine returned; the ligature finds its way into the interior of the gut, and is discharged with the fæces.

In case there should be a gangrenous condition of the omentum, the gangrenous part should be cut off, and the vessels secured by fine ligatures; the remainder may then be returned to the abdomen, or be allowed to remain impacted in the outlet, and thus prevent future tendency to protrusion.

Some have successfully divided the stricture exteriorly to the sac, the sac being reduced with the hernia. The objection to this operation is the danger of there being a stricture within the sac; and if the gut should be gangrenous it will not be discovered.

Usually the cord will be found behind the sac, but sometimes it is split up, and its constituents found lying upon the sac; caution is then required to avoid wounding the artery and duct.

The operation for direct or ventro-inguinal hernia, is very much the same. There will be no cremasteric covering, but in place of it an expansion of the conjoined tendon of the internal oblique and transversalis muscles; sometimes this is wanting, owing to the tendon having been split, especially if the protrusion is sudden, and the result of great violence.

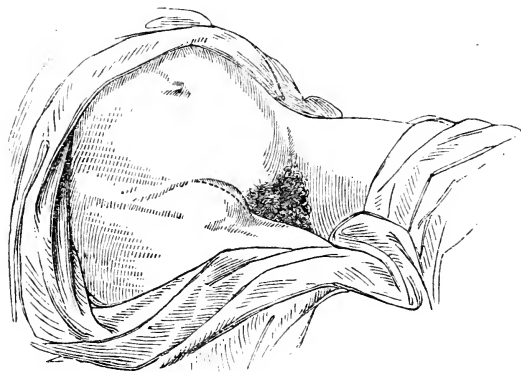
In a concealed inguinal hernia, the tendon of the external oblique must be divided, as well as the lower portion of the internal oblique and transversalis muscles.

#### FEMORAL HERNIA.

This is most common in women, owing to the natural form of the pelvis. The descent occurs at the *crural* ring; in order to understand which, it will be necessary to refer to the *anatomy of the part*, (see Anatomy, page 89.)

The tumour is more spheroidal usually than in inguinal hernia, and will be found to be beneath Poupart's ligament, instead of above. The fundus of the tumour is bent upon its neck, which curvature must be attended to in producing taxis. Strangulation is more common and more severe than in inguinal hernia.

Fig. 22.



The operation for the relief of stricture is thus performed. The patient being properly placed upon a table, and the parts being shaved, the skin is pinched up and divided by transfixion, in order that there may be no injury to the important parts beneath. The wound of the skin may be crucial in shape, or resemble an inverted T.

After dividing the skin, the superficial fascia is exposed; this being divided, the fascia propria is brought in view; that fascia is sometimes much blended with the sheath of the vessels. Under the fascia propria will be found the hernial sac. It is opened in the same cautious manner as before, when a smaller quantity of fluid will escape than in inguinal hernia, and the convolution of intestine be readily recognised. The seat of stricture is then to be sought; it may be at Hey's ligament, at Gimbernat's ligament, or, at the mouth of the sac. The stricture is to be divided with great care, for fear of an irregular origin of the obturator artery, the neck of the sac being surrounded by it.

The gut being returned, the after treatment will be the same as in inguinal hernia: the patient is to be kept in a recumbent position, and under antiphlogistic regimen. If there is no movement of the bowels in the course of several hours, a dose of castor oil may be given, or a mild enema may be useful; should there be inflammatory symptoms, leeches, calomel, and opium will be serviceable. Occasionally the patient is troubled with tympanites and flatulence, which will be relieved by a carminative, or enema of turpentine.

#### UMBILICAL HERNIA.

This is common in infants in whom the umbilicus is not consolidated. It is produced by crying; and appears as a soft, compressible tumour.



It occurs also in women who have borne many children ; though in them the point of the protrusion is not through the navel, but near it. Strangulation does not often take place.

The *treatment* in a child is simple and effective. A small hemispherical pad, made of cork, or half of a nutmeg, covered with buckskin, is properly fitted, and there secured by a broad strip of adhesive plaster, which should surround the belly of the child.

In the *adult* the tumour may become very large, and usually contains a large quantity of omentum. Pain, indigestion, and constipation are often its accompaniments. The *treatment* consists of a large truss, adapted to the case. In case it should be strangulated, the operation for relief of the stricture is performed by making an incision through the skin and superficial fascia, which exposes the sac ; this is to be opened in the usual manner. The incision for the relief of the stricture is to be made in the *linea alba*.

#### OTHER VARIETIES OF HERNIA.

*Scrotal hernia* is a term applied to the protrusion when it has descended from the groin into the scrotum. It occasionally entirely obscures the penis, and reaches almost to the knees. Its coverings are those of inguinal hernia.

*Congenital Hernia*.—This depends upon a want of obliteration of the connexion between the peritoneum and tunica vaginalis of the testicle. The intestine descends in the same manner as the testicle. It has no sac or peritoneal covering other than that in which it and the testicle are contained.

This is most common in young male children, and is easily cured by a truss ; there being a natural tendency to closure in this tubular connexion between the peritoneum and tunica vaginalis. Care should be taken in the application of the truss or compress, not to injure the spermatic cord.

In very young children a graduated compress and roller will effect a cure if properly applied.

*Ventral Hernia*, is a protrusion at any part of the belly except the navel and groin ; and it may be the result of a bruise, wounds, and unnatural weakness of the muscles of the abdomen.

*Vaginal Hernia*, is a protrusion into the vagina ; *perineal*, when the tumour is in the perineum, having descended between the bladder and rectum ; *phrenic* or *diaphragmatic*, is a protrusion through an opening of the diaphragm.

The intestine is sometimes strangulated within the cavity of the abdomen, through an opening in the mesentery, or meso-colon, or some portion of peritoneum, or peritoneal band, resulting from inflammation.

## DISEASES OF THE RECTUM.

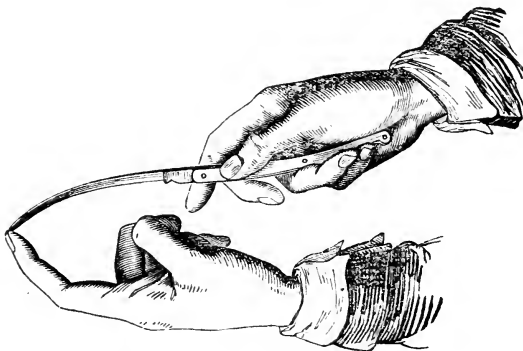
## FISTULA IN ANO.

A *Fistula* is said to be *complete* when a sinus communicating with the bowel, opens upon the nates; when it does not communicate with the bowel, but opens externally, it is called a blind external fistula; when it opens internally but not externally, it is called a blind internal fistula.

If complete, there is discharge of pus, *fæces*, and wind, and it is attended with heat, uneasiness, and pain. The sinus is sometimes very tortuous, and often multilocular. The internal orifice is usually about an inch and a half above the anus, but sometimes higher. The cause producing it may vary. It may originate in an inflammation of the rectum, or by an abscess external to it. It is very frequently connected with phthisis, caused by the constant cough in that disease.

The *treatment* for complete fistula is generally that of the knife, the object being to place the part at rest, and convert the sinus into an open sore. The bowels having been entirely emptied, the index finger of one hand being oiled, is introduced into the rectum, and a

Fig. 23.



knife-pointed bistoury is introduced through the sinus into the gut, so that its probe touches the finger; thus kept in contact, both finger and bistoury are withdrawn, completely laying open the sinus, and dividing the sphincter ani muscle. Any bleeding vessel is to be tied; hemorrhage by oozing is to be stopped by stuffing with lint; a small portion of lint is to be placed between the lips of the wound, so as to prevent their closure; the object being to make the whole track inflame, granulate, and heal from the bottom. After the

operation, a dose of morphia may be given to promote quietness and sleep; and after 3 or 4 days a dose of castor oil, which will bring away the contents of the bowel, and the dressings of the wound. Subsequently it will only be necessary to attend to cleanliness, and prevent the edges from uniting.

If the opening be very high in the rectum, it is better to use the ligature in preference to the knife, on account of the danger of hemorrhage from the hemorrhoidal arteries. The ligature only is to be used in phthisical cases; it gradually cuts itself out, and leaves the part solid behind it. A blind fistula may be readily converted into a complete one by puncturing the intestine should it be an external fistula, or the skin in case it should be an internal one.

#### FISSURE OF THE ANUS.

This is an ulceration or cracking of the skin and mucous membrane, on the verge of the anus; and is attended with intense pain, especially upon going to stool. It results very often from dyspepsia, and this circumstance must materially affect the treatment. Alteratives and laxatives are necessary to bring the bowels into a healthy condition. The local applications are caustics and anodynes, such as nitrate of silver, which has a soothing as well as antiphlogistic power; opium, in the various forms of ointment, solution, and poultice. Sometimes it is necessary to excise the part, or divide the sphincter ani muscle.

#### HEMORRHOIDS.

Piles, or hemorrhoids, are divided into external and internal. They are more common in males than in females, and rarely occur in children. The predisposing causes are whatever tends to determine the blood to the rectum, such as constipation, pregnancy, sedentary habits; and the exciting causes may be purging, diarrhœa, &c.

*External Piles* are a congeries of varicose veins, surrounded by condensed cellular tissue. In some cases, bleeding occurs from ulceration of the skin or mucous membrane covering them. When they do not bleed, they are said to be blind. When the blood has coagulated, they become hard. Usually, there is more than one.

The *palliative treatment* consists in the application of astringent and anodyne ointments, made of galls, opium, &c., and the regulation of the bowels with laxatives, such as sulphur, rye mush with molasses, &c.

The *radical treatment* is removal by scissors or bistoury; arresting the hemorrhage, and producing a healthy ulcer. A recent tense, single pile, may be successfully cured sometimes by freely evacuating its contents by a lancet.

*Internal Piles* may be of the same nature as external ones, or of

a sarcomatous character; but more frequently they consist of an abnormal development of the submucous cellular tissue, having the nature of erectile tissue: the tumour has a broad base, and its surface resembles a strawberry; at stool they protrude, and are attended with hemorrhage. The general health will suffer by emaciation, indigestion, pain, and there may result fistula, prolapsus, and disease of the genital organs.

*Treatment.*—In the first place, the stomach and bowels must be regulated by laxatives;—disorder of the liver must also be corrected, since any obstruction of the portal circulation in that organ predisposes to hemorrhages, or congestion of all the chylopoietic viscera; there being no valves in the veins forming the portal vein. Great benefit will result from the use of astringent injections, such as solutions of zinc, oak bark, &c.; but the radical cure consists in the removal of them, by strangulating with a ligature or wire applied by means of a double canula.

Piles should not always be cured in elderly persons, especially those with tendency to diseases of the head.

#### PROLAPSUS ANI.

This is an eversion and protrusion of the rectum beyond the anus, and is dependent upon relaxation.

The extent of the protrusion varies very much in different cases; in some instances being confined to a small portion of the mucous membrane; in others the rectum, and perhaps a portion of the sigmoid flexure escape. In children, worms, diarrhœa, straining, and crying may promote the disease. In old persons, it is brought on by enlarged prostate, stone, coughing, &c. When the gut habitually descends, the tumour is red and large.

The *treatment* consists in removing the cause; in regulating the bowels, and carefully replacing the intestine after each protrusion. The evacuation should be made in the recumbent position.

The general habit should be invigorated by tonics, and the tumour should be bathed with cold astringent washes. It may be necessary to lubricate the parts before reducing them, and afterwards a T bandage should be worn, to prevent the prolapse.

In extreme cases, operations have been performed. A fold of the mucous membrane has been removed, in order to contract the intestine; and a portion of the sphincter has been cut out, in order to diminish the orifice of the anus.

#### ENCYSTED RECTUM.

This consists of an enlarged and diseased condition of the sac of the mucous membrane of the rectum, just above the anus.

The treatment consists in drawing down these sacs with a bent probe, and excising the sac with a pair of scissors.

## IMPERFORATE ANUS.

This is a congenital imperfection. The rectum terminates in a cul de sac, at various distances from the ordinary location of the anus; in some instances, it is so near the skin as to form a prominence, by the constant collection of fæces. In such cases, the operation is easy and simple: a free opening being made in the proper direction, with regard to the bladder or vagina, the meconium escapes, and the edges are prevented from uniting, by the interposition of a piece of lint. In other instances, it is impossible to reach the cul de sac; then it is necessary to form an artificial anus. This is done by opening the descending colon immediately under the left kidney, making the incision through the skin and fascia, so as to expose the posterior portion of the bowel, which is not covered by peritoneum at this part; a sphincter is said to be formed in the loins, though it is necessary to wear a pad.

## URINARY CALCULUS.

Calculi are generally formed in the kidneys by a precipitation of earthy substances, and when they pass freely and frequently, the disease is termed *gravel*; when they are retained and become large, the disease is called *stone*.

The symptoms of stone in the kidneys are pain in the loins, irritation and retraction of the testicle, bloody urine, and inflammation of the kidney. The passage of the stone through the ureter causes most acute and severe pain in the loins and groin, faintness, and sickness of stomach, which may last for several days, and is only relieved by the stone entering the bladder.

The treatment for a *fit of the gravel*, as these attacks are called, consists in bleeding, warm bath, large doses of opium, soothing enemata, diluent and diuretic drinks, spirits of turpentine, &c. The ordinary result is the passage of the calculus; but sometimes it is retained in the kidney, increasing in size, and assuming the branching form of the pelvis, calices, and infundibula. It does not always produce inconvenience, but generally is attended with wasting of the organ, or suppuration, the abscess bursting into the colon or loins.

A small calculus, lodging in the bladder, and not being discharged through the urethra, serves as a nucleus for further deposit; any foreign body, such as a needle, drop of blood, or bullet, may serve, also, as a nucleus. The symptoms of stone in the bladder are, frequent, sudden, irresistible, unrelieved desire to make water; pain in the glans penis, and elongation of the prepuce; sudden stoppage of the stream in urination, and its re-establishment by change of position—the urine being mixed with mucus and sometimes with blood; but nothing but a sound can positively prove its existence. Many

of the symptoms are simulated by other diseases, such as stricture of the urethra, enlarged prostate, irritable bladder, &c. The rectum sympathizes, especially in children, and hemorrhoids or prolapsus ani are apt to occur. Stones vary in their form, size, colour, consistence, and chemical composition; some are rough on their surface, others smooth; they are more frequently of an oval shape. The size may be that of a pea, or that of a goose-egg. The most common colour is a light brown; some, however, are nearly white, others nearly black. Some are soft and friable, and crumble easily; others are flinty, and require great force to fracture them.

They are most generally composed of lithic or uric acid, lithate of ammonia, phosphate of lime and magnesia, oxalate of lime, and carbonate of lime. The lithic acid stones are perhaps the most common: they are oval, flattened, of a fawn-colour, and consist of concentric laminæ; the phosphatic stones are light-coloured and friable. The oxalate of lime forms the mulberry calculus, which is the hardest stone, of a very dark colour and a very rough surface. The number existing in the bladder at once, may vary from one to several hundred.

The formation of stone is consequent upon a derangement of health, deficiency of exercise, indulgence in animal food, defective condition of the skin, and dyspepsia. It is also dependent upon climate, age, locality, and hereditary influences. The immediate cause in every case cannot be discovered; some suppose that the character of the water drunk influences its production. Stones are sometimes encysted in the prostate gland and urethra.

*Treatment.*—Gravel may be prevented or mitigated by attention to the skin and digestion, the use of acids or alkalis, dependent upon the diathesis of the patient manifesting the disease; but, after *stone* has been lodged in the bladder, it cannot be removed by medicines: surgical means must be resorted to.

*Sounding.*—This requires great tact and care in its performance, and must only be attempted when the condition of the patient is most favourable; if performed immediately after a journey, or during a fit of the gravel, the consequences might be serious. A sound is a solid steel instrument, resembling a catheter in shape, but having its curvature much nearer the extremity, and a broad flattened handle. The patient should be placed in a recumbent position, and the urine retained in the bladder for some time previous to sounding. The instrument being carefully introduced, can be moved about in the bladder, and when the stone is touched, a distinct click will be heard, and a sensible impression of impingement will be felt. There are many sources of error in sounding: the instrument may pass over the stone, when lodged in the inferior fundus of the bladder, or the stone may be small and encysted in the mucous coat; on the other hand we may be deceived by the sound grating against a diseased

prostate or sandy matter in the urethra. In case of difficulty in detecting a stone, it is better to repeat the operation frequently, the patient being placed in different postures, than to prolong the exploration, at the risk of producing inflammation of the bladder. Having detected the stone, it is possible to form some idea of the size and number by sounding. Some have attempted the disintegration of the stone by injecting various solutions into the bladder; but the most common operations are Lithotomy, Lithotrity, and Lithotripsy.

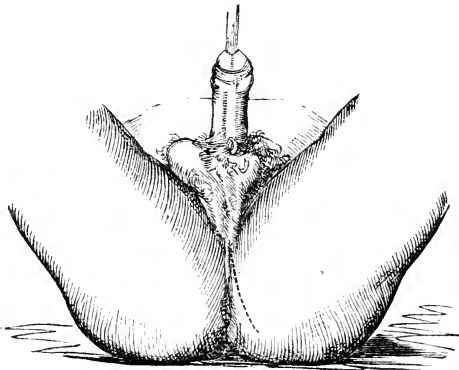
## LITHOTOMY.

This is an ancient operation, modified and improved in modern times. It is to be performed in children and in old persons, when the stone consists of the oxalate of lime, and when there is stricture, or diseased prostate.

The different modes of performing the operation are the lateral, high, and bilateral. The lateral is most common, and is performed in this manner:

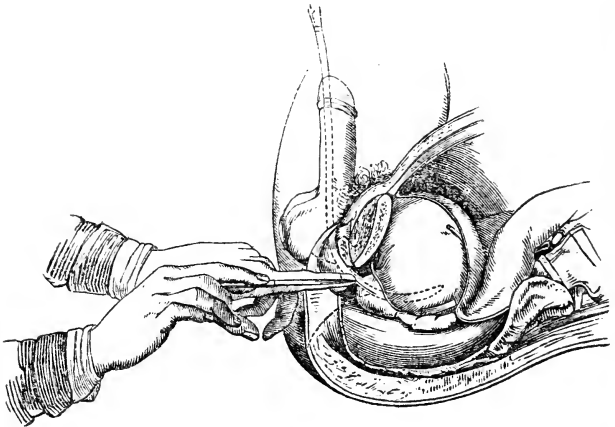
The patient, having been properly prepared by emptying the bowel and retaining the urine in the bladder, is placed upon a table of convenient height, and firmly bandaged hand to foot, with his knees elevated. A staff as large as the urethra will admit, and deeply grooved on the convex and left side, is then introduced. Two assistants separate the knees, so as to expose the perineum, which ought to be cleanly shaved. The patient is then to be brought to the edge of the table, and the surgeon seats himself in front with his instruments in good order, and conveniently at hand. The staff, being brought in contact with the stone, is well hooked up under the symphysis pubis, and not pressed down upon the rectum, and then given to a third assistant, who is directed to hold it vertically, and also charged with keeping the scrotum out of the way.

Fig. 24.



An incision is made with a scalpel in the direction of the dotted line of the drawing, (fig. 24,) of about three inches in length, commencing about one inch behind the scrotum, and extending downwards and outwards to a point between the anus and tuberosity of the ischium, and even beyond it. Various measurements are given by different surgeons as to the point at which this is to be commenced. No well-informed surgeon should depend upon an absolute measurement, on account of the difference which exists in different patients, with reference to the size and depth of the perineum. He should inform himself of the probable size of the prostate gland by an examination per anum, and then, by his anatomical knowledge, make his incision so as to expose the membranous portion of the urethra, taking care not to cut the bulb of the corpus spongiosum in front and the rectum behind. Having cut through the skin and superficial fascia of the perineum, which is very thick, especially in fat persons, the transversus perinei muscle, the transversus perinei artery, the lower edge of the triangular ligament, and it may be a few fibres of the

Fig. 25.



levator ani muscle, must then be divided. By an examination with the finger, the staff may now be felt in the urethra. By means of the finger and nail this space should be increased, and the urethra opened by a bistoury, which will be indicated by a flow of urine. The gorget should now be introduced into the wound, with its beak securely fixed in the groove; it is then pushed in the direction of the bladder, cutting through its neck and prostate gland. Care must be taken to depress the handle of the gorget whilst making this thrust, for fear of wounding the rectum. Urine gushes out, the gorget is carefully removed, for fear of wounding the internal pudic artery, and the finger introduced into the bladder to discover the stone, its



position, and size. A strong pair of forceps are then introduced, and the stone grasped in such a way that its short diameter shall engage in the wound, whence it is to be delivered slowly and gradually.

If it be impossible to remove the stone through this opening, it may be enlarged with care, on the same, or, if necessary, the other side. After its removal, the finger must again be introduced, to see if there is another stone.

The bladder being freed from all calculus by the forceps or syringe, a tube is introduced into the bladder through the wound, by which the urine is to escape. The patient is then put to bed, with the knees placed together. A small cup or saucer receives the urine from the tube. Severe hemorrhage may result from a wound of the bulb of the corpus spongiosum, or from cutting the urethrobulbar artery. If a ligature cannot be applied, it must be compressed by the finger as long as may be necessary.

There may also be a venous or arterial oozing, which is to be arrested by removing the tube and cramming the wound with lint, a catheter being introduced through the urethra. Should there be no hemorrhage, the tube is to remain until the wound has granulated around it, and the urine has commenced to flow from the urethra.

Some prefer to open the bladder with a scalpel, having confidence in their anatomical knowledge, and considering the gorget as a clumsy instrument, a remnant of olden times. Others use a concealed bistoury, cutting either upon one or both sides of the urethra. Besides which are various instruments, modifications of the gorget, and scalpels with beaks attached.

In four or five weeks the wound is healed.

The *high operation* is performed by making an incision through the linea alba, opening the bladder where it is not covered by peritoneum. This is only necessary where the stone is of enormous size, the prostate diseased, or the space between the tuberosities of the ischia contracted.

*Stone in women*, is much less frequent than in men, because the renal calculus is more readily passed by the urethra. Should it be retained, and increase in size, it may be removed by dilating the urethra sufficiently, or by the lateral operation, making the incision from the orifice of the urethra, and through the neck of the bladder. Incontinence of urine is apt to follow.

The *recto-vesical* operation consists in cutting into the bladder from the rectum.

#### LITHOTRITY.

Lithotrity signifies the boring or drilling the stone, and has been most successfully accomplished by Civiale. His instrument consists of a straight canula containing a drill and three claws which

can be protruded after its introduction into the bladder. These claws are equally liable to catch the coats of the bladder as well as the stone, and the operation has been superseded by the following.

#### LITHOTRIPSY.

This implies the *crushing* of the stone whilst in the bladder; and it is preferred to all other operations for disintegration.

The cases most favourable for this operation are adults, where the urethra is free from stricture, the bladder free from irritability and not contracted, and the prostate not enlarged. A mulberry calculus would be unfavourable for lithotripsy, on account of its hard character.

The instrument most frequently used is that of Heurteloup, or a modification of it. It consists of two blades, which slide one upon

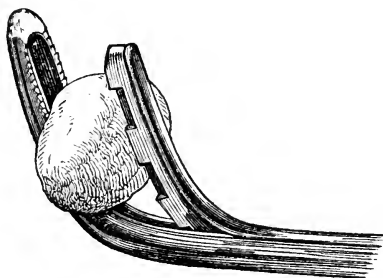
Fig. 26.



the other, the extremities being slightly bent. It can be introduced into the bladder as a sound or catheter, and afterwards the blades are separated, to grasp the stone. In the original instrument the male blade was struck with a hammer, and thus the stone was broken; now the crushing power is that of a screw, variously adapted,—that of Mr. Weiss being most simple and perfect.

The extremities of the instrument have teeth, so as to retain the stone when grasped, and also fenestræ to allow of the escape of sand or powdered stone.

Fig. 27.



The patient must be previously prepared for the operation, by regulation of the general health, dilatation of the urethra, and distension of the bladder. The patient lies on a convenient table or bed, with the pelvis elevated, so as to throw the

stone into the fundus of the bladder; the bladder must be full, so as to prevent its coats from being entangled in the instrument. If urine cannot be retained, tepid water must be injected. The instrument must be oiled and warm.

After encountering the stone and fairly grasping it, an operation which requires tact in manipulation, the stone is crushed by slowly and gradually turning the screw. Then the instrument should be withdrawn, and when the irritation has subsided, subsequently introduced, to crush the fragments. Thus many operations may be required to reduce the stone into fragments sufficiently small to pass the urethra.

It is not to be expected that fragments will escape at the first urination: the after treatment should consist of diluent drinks, and bland injections to accelerate their passage; and it may be that the hip-bath, anodyne enemata, and leeches, will be required. The sources of danger are the irritability of the bladder, and urethra; inflammation often resulting from the irregularity of the fragments, and too frequent introduction of the instrument. Sometimes fragments are arrested in their passage through the urethra: a bougie or catheter should be introduced, of large size, and the fragment pushed back into the bladder: should it become impacted, it may require a special instrument for its extraction, or an incision in the perineum.

*Jacobson's* instrument is used by many. Its extremities are connected by a link: thus a loop is formed to grasp the stone when the blades are separated in the bladder. By the operation of the screw, the female blade is pulled upon the male; whereas in *Heurte-loup's* the male is pushed upon the female,—thus there is less danger of fine fragments or sand being caught between the blades of the latter, which would impede the movement.

#### VENEREAL DISEASE.

The history of this disease is involved in some obscurity, although it is generally believed to have existed from the earliest ages. It consists of *Gonorrhœa* and *Syphilis*, which are usually considered as distinct diseases, although there are high authorities to the contrary.

#### GONORRHŒA.

Gonorrhœa is an acute inflammation of the lining membrane of the urethra, commencing in its anterior portion. It is caused by matter from another, during sexual intercourse. In about five days a discharge appears, although it may occur in a few hours, or not until ten days after coition.

*Symptoms.*—Heat, itching, redness of the glans, and swelling of the orifice of the urethra; the stream of urine is small and attended with burning and smarting; the swelling, redness, and pain increase; the discharge is no longer limpid, but turbid, puriform, and profuse, sometimes being mixed with blood; the thighs, loins, testicles, and groins sympathize in a dull pain, and there may be fever.

Chordee may occur, which is an intensely painful erection of the penis, which is bent like a bow, with the convexity upwards: this is owing to the corpus spongiosum being filled with lymph, which prevents its expansion by blood. It is aggravated by the warmth of the bed, and voluptuous dreams.

The glans may become excoriated; the prepuce œdematous, inducing phymosis; a sympathetic bubo may form in the groin, or an abscess in the perineum.

The joints may be painful as in rheumatism; the testicle swell and inflame, constituting orchitis, especially if the patient is imprudent in exercise, during which the discharge diminishes. As the orchitis declines, the discharge reappears.

Gonorrhœa is capable of self-cure; the symptoms gradually subsiding, and the discharge diminishing, and becoming mucous in its character: it is then a *gleet*, which is without pain, redness, &c., but which is readily rekindled into an inflammatory gonorrhœa by imprudence in diet or exercise.

*Treatment.*—In the earliest stage, the ectrotic or abortive plan may be pursued, if the discharge has not reached the suppurative crisis. A strong solution of nitrate of silver, used properly with a glass syringe, may cut short the disease at the outset. It should be used but once or twice, and acts by neutralizing the virus, as an antiphlogistic, and also coats the urethra with a film which protects the villous surface. This treatment often fails, especially in irritable temperaments, and when not used in the earliest stage; and if not succeeding, is followed by an aggravation of symptoms.

In the *treatment* of gonorrhœa, it is to be remembered that the first attack is generally the most severe; hence the importance of *rest*, which is seldom complied with. Low diet, purging, and tartar emetic as an antiphlogistic and antaphrodisiac; opium and camphor are also useful at night, in preventing painful erections and chordee; a warm bath is most serviceable. Mucilaginous drinks may mitigate the ardor urinæ. Leeches and ice to the perineum are sometimes very advantageous.

The discharge now must not be suddenly arrested, else by metastasis the testicle, bladder, or prostate become involved. Strong injections are very injurious, although they may temporarily arrest the discharge. As the inflammatory symptoms subside, weak astringent injections may be used with a glass syringe: sulphate of copper, zinc, alum, or iron, in the proportion of half a grain to the ounce of water.

*Cubeb*s and *copaiba* are remedies which seem to exert a specific influence on the urethra: the latter may be given in almost all stages of the disease; but the former should be restricted in its administration to the latter stage. These medicines often do harm, when persevered in too long, by inducing a chronic disease of the

bladder, attended by a slight discharge. In the chronic stage of the disease, the discharge may be benefited by weak solutions of nitrate of silver, and a weak solution of chloride of zinc. In a gleet, a large bougie introduced into the urethra, will often prove of immediate service.

Spurious gonorrhœa, or balanitis, is a discharge from the prepuce and glans, often induced by want of cleanliness, or gonorrhœal matter. A solution of nitrate of silver, and frequent application of cold water will cure it.

*Warts* are to be removed by the scissors or knife, and their bases touched with nitrate of silver, or nitric acid.

*Women* suffer less than men, although the vagina is involved as well as the urethra. The symptoms are the discharge, swelling, pain in micturition, sitting, and walking, aching in the back and loins.

The treatment is upon the same principles as in men; stronger injections may be used without the danger of stricture; and lint saturated with medicated solutions, retained in the vagina. Young girls suffer from spurious gonorrhœa and leucorrhœa, from which they are to be carefully distinguished. Leucorrhœa is chronic in its character from the first, attended with lassitude, pain in the back, pallor, irregular menstruation, and the urethra is not involved generally.

#### SYPHILIS.

This term comprises all diseases resulting from a certain virus.

*Primary Symptoms.*—After one or two days' incubation of the virus, the pustule forms, and the ulcer is established at the sixth day. It is first attended with redness, itching, and heat; then a vesicle appears, becomes purulent, breaks, and an ulcer is formed. This is circular or oval, excavated, and pale, with a bright red areola; the discharge is thin, ichorous, and infectious; finally, flabby granulations and cicatrization. If the virus touches an abrasion, the sore may appear at once. This sore is not to be mistaken for a common ulcer, or abrasion, or herpes. Most frequently it is situated on the collum behind the corona; the most unfavourable position is the frænum, which it often destroys.

*Treatment.*—If the ulcer is freely cauterized before the sixth day, the poison is destroyed, the ulcer converted into a simple one, and the system is uncontaminated. After the application of nitrate of silver, water may be used, or water medicated with aromatic wine, or chloride of soda: granulation and cicatrization are treated as in any other case, and thus a simple venereal ulcer heals.

*Hunterian or True Chancre.*—The sore is circular, much excavated, with hardened base and edges; and the surface is of a tawny or brownish hue, covered by a thin pellicle. It occurs most frequently on the glans penis or the skin, and is usually solitary, and has no areola.

It is to be *treated* by the application of lunar caustic, and the internal administration of mercury and iodide of potash. Mercury hastens the cure of the primary sore, and affords security against secondary consequences, especially of the Hunterian chancre; some general constitutional treatment may also be necessary. Blue pill may be given every night and morning, until the gums are slightly sore, and there is a slight increase of saliva: its action should be maintained at this point for several weeks.

*Phagedenic Chancre.*—These are rapid in their progress and painful; their surface yellow, and dotted with red streaks; their shape irregular; edges ragged and undermined; their discharge is thin, profuse, and sanious. These ulcers eat deeply into the skin of the penis and surrounding parts. This chancre is apt to occur in those whose constitution is broken down with drink, debauchery, prostitution, and mercury: mercury usually aggravates it.

*Treatment.*—As a local application, the nitrate of mercury is most beneficial; the chloride of zinc is also calculated to arrest the spread of the disease. The constitution must be supported with tonics, stimulants, and good diet.

*Bubo.*—Bubo is an inflamed lymphatic vessel or gland leading from a venereal ulcer; the glands may inflame from a wound of the foot or from gonorrhœa, but a real syphilitic bubo is the result of absorbed virus. Buboës vary in the rapidity of their development, and some are termed acute, others chronic; the former hastening to suppuration, whilst the latter are indolent. If one gland only is affected, and that above Poupart's ligament, it is most probably caused by chancre, if one exist; but if many glands are swelled, and they are below this ligament, their swelling is probably the result of irritation. Inoculation is the surest test.

*Treatment.*—An acute bubo will often yield to rest, leeches, fomentations, &c., but if the venereal virus shall have created pus in the interior, leeches and cold applications will rather retard the cure. Poultices, and early evacuations, are then most to be relied on. Extensive collections of pus, and sinuses, are often the result of delay in eliminating the virus. The opening of a bubo at an early stage with a sharp lancet, even should no pus exist within, empties the congested vessels, and rather promotes a cure. Blisters and iodide of potassium will be found of use in assisting in absorption. In an indolent bubo an alterative course of mercury, and good diet are necessary.

*Constitutional Symptoms.*—These are secondary and tertiary.

The *secondary* symptoms speedily follow the primary, usually during the second month; consisting chiefly of general eruption, affection of the throat, fever, change of complexion, dryness of hair, rheumatic pains in shoulder and knee, headache. Different kinds of eruption follow different kinds of primary sore, although there may

be irregularity in this respect. Periostitis is apt to manifest itself in the shins. Secondary symptoms are transmissible from husband to wife, wife to child, child to nurse.

*Treatment.*—The object is to assist nature in the elimination of the poison; hence we should not suppress the eruption, but act on the skin, kidneys, bowels, and other organs of excretion. The throat should be fomented, and touched with nitrate of silver. Mercury is not to be used if possible, especially in scrofulous, weak temperaments, or when the constitution is broken by dissipation, or the previous abuse of mercury. Small doses of corrosive sublimate, or the protoiodide of mercury, is the best form of administration. But the iodide of potash is the most effective remedy in this disease. It is given in doses of 4 or 5 grains three times a day. Baths are most important; sometimes their value is increased by medicating them. Sulphur, and weak solutions of mercury seem to exercise the best influence upon the local affections of the skin.

*Tertiary Symptoms.*—These seldom occur, except after the worse kinds of sore, unless mercury has been rashly used. The periosteum and bones are affected by a chronic inflammatory process. Suppuration, caries, and necrosis result; also, stiff joints, tubercular formations of the skin, and condylomatous tumours. Destruction of the gums, cheeks, deafness, and iritis are also among the consequences. These symptoms are not transmissible.

*Treatment.*—More dependence is to be placed upon the iodide of potassium, than any single remedy. The general remedies will consist of bathing, regimen, and alteratives. Opium and blisters are necessary to relieve the pain in the bones at night.

## DISEASES OF THE URINO-GENITAL ORGANS.

### STRICTURE OF THE URETHRA.

*Spasmodic stricture* depends on spasm of the muscles connected with the membranous portion of the urethra: It generally occurs in persons with some permanent obstruction; exposure to cold, and indulgence in drink also favour an attack, which usually occurs after dinner. Cantharides absorbed from blisters produce the effect.

*Symptoms.*—Sudden retention of urine; great straining and desire to urinate; the bladder becomes distended, the countenance anxious, the pulse quick, the skin hot; at last the bladder bursts, and extravasates into the peritoneum, or perineum.

The *inflammatory* stricture is another variety of the above, generally caused by abuse of injections, exposure, or intemperance during acute gonorrhœa.

*Treatment.*—A catheter should be introduced at once. This is managed by introducing as large an instrument as the parts will admit of, and stretching the penis forward on the catheter, whose point at the same time should be directed towards the upper surface

of the urethra, and pressed steadily, but gently, against any obstruction. Relaxation of the spasm may also be produced by bleeding, warm bath, Dover's powder, laudanum enemata, and cold water upon the genitals. Should all these means fail, and life be endangered, the bladder should be punctured from the rectum.

*Permanent Stricture.*—This is a contraction from permanent inflammation, plastic deposit having taken place in the submucous cellular tissue. The *occasion* of this inflammation may be clap, venery, kicks or blows, riding on horseback, acrid urine, drinkings, &c. The most frequent *sites* are at the commencement of the membranous portion of the urethra, and also within a few inches of the glans penis. The *extent* and *degree* of contraction vary: sometimes the stricture is very tight, but limited, as if a thread had been tied around the urethra; more frequently it is of greater extent, continuing from a quarter of an inch to several inches. Several strictures may exist at once. Behind the stricture the urethra is enlarged, and serves to catch a calculus.

*Symptoms.*—These come on gradually: middle-aged men are most liable. Urination is frequent, tedious, and painful: the stream is thin, twisted, or forked. After urination a few drops pass which had collected behind the stricture. Pain in the perineum, thighs and loins; erection is often painful: semen does not escape in coition, but passes into the bladder, and afterwards is voided with the urine; chill and fever constantly occurring, as in ague: a slight discharge is visible at the end of the penis upon rising in the morning; the testicles, rectum, and bowels sympathize, and the general health fails.

*Treatment.*—1st. *Dilatation* by bougies of flexible metal, silver, or gum elastic, of sufficient size, since small bougies are more apt to be entangled than large ones. The natural structures are not to be mistaken for strictures, viz., an enlarged lacuna in the fossa; spasmodic contraction of the accelerator urinæ muscle; the triangular ligament, and prostate gland. The operations must be frequent and cautious until the cure is complete, and even afterwards, to prevent return of this disease, which is not uncommon; indeed there is no certainty that it will not return. 2d. *Caustic* applied firmly to the stricture; it destroys irritability, but is more advantageous in stricture near the glans than the bladder. 3d. *Puncturation.*—By means of a lanceted stilet, introduced concealed in a silver canula; after the division, a catheter is to be introduced. 4th. *Opening the urethra* through the perineum, resembling a lithotomy operation; a catheter is then introduced into the bladder, and the wound heals over it.

#### FISTULA IN PERINEO.

This is usually the result of abscess of the perineum, or a wound. The patient has rigors, fever, and an exquisitely painful promi-



nence in the perineum, which opens and discharges, much to the relief of the sufferer. The opening, however, often remains, and through it the urine dribbles. This abscess may be caused by a kick, or urinous infiltration from an internal fistula, produced by a stricture.

*Treatment.*—This should be directed to the cause; if a stricture exist, this should be cured first, and then the fistula, by caustic application, red-hot wire, or paring the edges.

#### ENLARGED PROSTATE.

The gland is enlarged, from chronic inflammation, brought on by gleet, stricture, horse exercise, &c.; it is most common in middle life, and disappears upon the removal of the cause. Leeches, rest, counter-irritation, iodide of potash, laxatives, and enemata, are the proper treatment. But the gland is also enlarged in old persons,—a hypertrophy independent of inflammation. This enlargement takes place first in the middle lobe, and the lateral lobes enlarge unequally. The bladder sympathizes, and becomes irritable; the urine is fœtid, mucous, and stains often retained. Catheterism, opiates, laxatives, and regimen are the palliatives.

#### INFLAMMATION OF THE BLADDER.

This is usually a secondary affection, usually resulting from gonorrhœa, &c. There is pain in the perineum and sacrum; micturition is frequent, with straining; the urine is mixed with mucus or pus.

*Treatment.*—Bleeding, leeches, hip-bath, opiate enemata, castor oil, &c.

*Chronic Inflammation.*—*Catarrhus Vesicæ.*—May result from the same causes as the acute form; and also from over-distension of the bladder: it is attended with great irritability and incontinence of urine. The irritability and incontinence are sometimes the most prominent symptoms; and for these symptoms the injection of a solution of sulphate of morphia, or nitrate of silver will be found most serviceable.

#### ORCHITIS.

*Swelled Testicle* is a common accompaniment of mumps. It is often the result of an injury; but, oftener, of gonorrhœa and its treatment: exercise, wet, and cold, often induce it. Sometimes it is termed *hernia humoralis*.

*Symptoms.*—There is a great sense of weight, and the swelling constantly increases; the skin becomes tense, red, glistening; the pain is intense, often producing fever and vomiting. The cord is often swollen and painful. The epididymis is chiefly affected. The urethral discharge diminishes.

*Treatment.*—Bleeding, in a plethoric habit, leeches, purgatives,

tartar emetic, and opium; cold or warm lotions, according to the patient's feelings. Low diet, and the recumbent position are essential. The weight of the tumour must be sustained by a suspensory or handkerchief. After the acute symptoms have subsided, friction with mercurial ointment, astringent lotions, and compression by adhesive straps will be useful. In discussing the hardness and swelling which generally remain, the iodide of potash has the best effect. Abscess may result, but oftener results from chronic inflammation or sarcocele.

*Neuralgia* of testes causes such severe pain that patients frequently apply to be castrated. The cause should be ascertained before treatment is commenced.

#### HYDROCELE.

This is a collection of serum in the tunica vaginalis testis; commencing at the lower part of the scrotum, and gradually ascending. It is smooth on its surface, fluctuating. The testicle is situated at the posterior part of the sac, near the middle. It is to be distinguished from hernia by its transparency and progress: there is no impulse upon coughing; it does not retire by recumbency.

*Treatment.*—The *palliative* treatment consists of evacuation of the serum by a trocar. The *radical* cure is performed by injecting stimulating fluids, such as port wine and water, or solutions of zinc and iodine into the sac; or, by introducing a seton.

#### CIRSOCELE.

Varicocele or cirsocele is a varicose condition of the veins of the cord. Some restrict the term varicocele to the enlargement of the veins of the scrotum. The *causes* are such as produce obstruction to the return of blood; constipation, corpulence, tight belts around the abdomen, and warm climate. The left side is more frequently affected than the right, because the left spermatic vein is more likely to be compressed by fæces in the sigmoid flexure, and because it is longer and not so direct in its course. The swelling is pyriform, and feels like a bunch of earth-worms.

*Treatment.*—The disease may be palliated or cured by removing the causes, bathing the testicle in cold water constantly, and supporting it with a suspensory. The radical cure often requires an operation for obliteration of the veins,—such as the actual cautery, compression by sutures, wires, springs, &c. The scrotum may be diminished with advantage.

#### ANEURISM.

An aneurism is a pulsating sac, filled with blood, which communicates with an artery.

A *true* aneurism is the result of disease, and the sac consists of

one or more of the coats of the artery. The artery may be dilated, all the coats being entire, as is usually the case in the aorta; or, the internal and middle coats are ruptured, and the sac is formed of the external coat. The interior of the sac is lined by fibrin in a membranous form.

*False Aneurism.*—Is owing to a complete division of the arterial coats, either from a wound or external ulceration; the sac is formed in the cellular tissue.

*Dissecting Aneurism.*—Is a sac formed by the infiltration of blood between the coats of an artery. This sac may communicate with an artery at several points.

*Circumscribed and diffused*, are terms used to signify its limits; whether confined to a cyst, or extending by infiltration into the surrounding tissues.

*Symptoms.*—The most frequent form of aneurism is the *true circumscribed aneurism*. The tumour, at first, is small, gradually increasing, soft, and quite compressible, being only filled with fluid blood. It has a distinct pulsation from the beginning, synchronous with the heart's impulse, increased by pressure on the distal side, and diminished or arrested by pressure on the cardiac side. A peculiar thrill is imparted to the hand, which can be heard by application of the ear. At first the pain is slight, and merely owing to interference from the adjoining textures. By pressure upon the nerves a numbness is produced; pressure on the veins and lymphatics causes œdema, discoloration, and swelling. The strength of the part is much impaired, as the tumour enlarges; the circulation in the extremity is weaker; the diminished volume of the main artery is compensated by enlargement of the side channels, the collateral circulation conveying the blood from the cardiac to the distal side of the tumour. The tumour gradually becomes larger by the separation of fibrin, and is less compressible, and pulsates less distinctly. The clot thus filling up the sac, restrains its further dilatation by the force of the heart. Ultimately, it may become smaller by continued absorption.

During the progress of an aneurism, adjacent parts are displaced, altered, and absorbed, even bone is rendered carious and absorbed by the constant pressure of the tumour. As the tumour enlarges, pain and numbness increase, and the general health fails. At length the tumour may burst, opening upon the skin or some important cavity, and prove fatal, either by hemorrhage, or by pressure on important parts,—as the trachea, œsophagus, &c., or by suppuration or hectic.

The diagnosis from abscesses, glands, and solid tumours is important. An aneurism is soft and compressible from the first, and then becomes hard, whereas an abscess begins with induration and ends with softening. A tumour or other swelling, receiving an impulse from lying over the track of an artery, will no longer pulsate

when raised or held to one side. An aneurism expands coincidentally with pulsation; a solid tumour will not alter its volume by pressure either upon the distal or cardiac side.

*Causes.*—The disease is more frequent in men than in women, and seldom occurs before puberty; the *predisposing* cause may be said to be disease of the coats of the arteries; the *exciting* causes are muscular exertion, mental emotion, and intemperance.

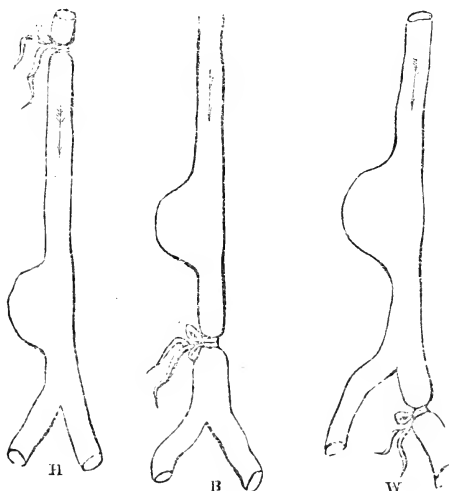
*Cure.*—This may either be spontaneous or surgical—the spontaneous being owing to pressure on the cardiac side of the tumour, occlusion of the aperture of communication, coagulation and absorption, or by inflammation from sloughing of the cyst; this however is oftener the cause of death, than a means of cure. Medical treatment may mitigate the symptoms, such as bleeding, rigid diet, horizontal position, and cold and astringent applications.

*Compression* is a means of cure which is slow, painful, and rarely effectual.

The *ligature* is alone to be relied on. Previous to the time of Hunter, the vessel was tied immediately above the tumour, and the sac opened. Hunter tied the artery at a distance from the sac, in a healthy part, and allowed the sac and its contents to be absorbed; *this* is the present mode of operating. Abernethy applied two ligatures, and divided the artery between them. Brasdor's operation is directly the opposite to Hunter's, tying the artery immediately beyond the tumour. Wardrop modified this, and tied the artery

beyond the tumour and beyond its first bifurcation. The effect of a ligature is to arrest the blood and divide the internal and middle coats; a coagulum or plug is formed up to the first branch, and lymph is effused from the cut edges of these coats, and also surrounds the ligature upon the exterior of the artery. The lymph in the artery above the ligature firmly consolidates the internal and middle coats; and the cellular coat being compressed by the ligature is subsequently destroyed, and

Fig. 28.



thus the ligature is removed with its noose entire; finally the portion of the artery will be found converted into a small cord.

The ligature should be round and small, or the coats will not be divided; inclusion of cellular tissue or a nerve will also prevent this division.

*Secondary hemorrhage* may result from the application of an improper ligature, or its premature removal, and also from the artery being too much exposed, or in a diseased condition.

#### ANEURISM OF THE AORTA.

The *arch* of the aorta is especially liable to aneurism, producing difficulty of breathing, pain in the chest, and palpitation of the heart, difficulty of swallowing, and troublesome cough, owing to its pressure upon the trachea, which is sometimes perforated; it should not be mistaken for an enlargement of the bronchial glands, or collections of serum or pus.

*Aneurism of the abdominal aorta* is usually situated just below the diaphragm, producing pressure in the thoracic duct, caries of the vertebra, dropsy, and by its rupture, death.

Astley Cooper, James, and Murray have tied it without success; it should be treated only by medical means.

#### ANEURISM OF THE CAROTID.

This occurs most frequently in labouring people: it is situated at the angle of the jaw, near the bifurcation of the artery, and produces difficulty of swallowing and breathing; it is to be carefully distinguished from glandular enlargement. It was first tied by Sir Astley Cooper in 1805. The operation is thus performed: the patient being recumbent, with the head thrown back, and slightly turned to the opposite side, an incision three inches in length is made along the inner border of the sternomastoid muscle, through the integuments, platysma and superficial fascia, extending from near the angle of the jaw to the cricoid cartilage.

The cross veins, descending noni nerve, and the omo-hyoid muscle should be carefully pushed aside, the sheath opened, and the aneurismal needle

Fig. 29.



introduced between the artery and the internal jugular vein, which is upon the outer side; great care should also be taken not to include the par vagum nerve, which is included in the same sheath.

#### AXILLARY ANEURISM.

This tumour occupies the arm-pit and sometimes extends above the clavicle, producing pain and numbness in the arm. The operation of tying the artery *above the clavicle* is thus performed: the patient is placed upon a high table and the shoulder forcibly depressed; an incision (*b. fig. 29*), is made over the clavicle, through the skin and platysma myoides, reaching from the anterior edge of the trapezius to a little beyond the posterior edge of the mastoid; the cervical fascia is then divided, the external jugular vein pushed aside, and the omo-hyoid disclosed; in the triangle formed by this muscle and the clavicle, we find the artery at the outer edge of the scalenus muscle, passing over the first rib, with the nerves forming the brachial plexus above it, and the subclavian somewhat in front and below. Great caution should be used in exposing the vessel, on account of the varieties of the arterial distribution in the neck; it should also be recollected the phrenic nerve descends upon the anterior face of the scalenus anticus muscle.

The artery is tied also below the clavicle by making a semi-circular incision, with the convexity upwards, from near the sternal end of the clavicle towards the acromial, carefully avoiding the cephalic vein and acromial thoracic artery, which pass between the outer edge of the pectoralis major muscle and the deltoid. After dividing the skin, superficial fascia, and pectoralis major, the pectoralis minor will be exposed, between the upper edge of which and the lower edge of the subclavian muscle, the artery will be found deeply imbedded in cellular tissue and fat; the vein is in front, and the axillary plexus of nerves surround the artery.

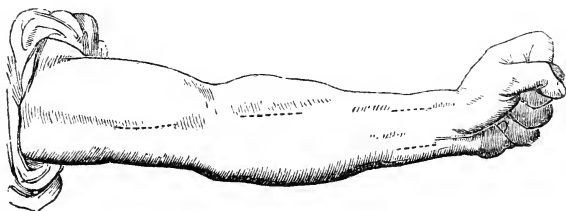
The arteria innominata has been tied, but without much success where the tumour is large. The patient lying on his back, with his shoulders raised, and head thrown back, an incision two inches in length is made on the inner side of the sterno-cleido-mastoid, reaching to the sternum; another incision is made just above the clavicle and through the sterno-mastoid: thus a flap can be turned up; the sterno-thyroid and sterno-hyoid are then to be divided on a director, and the deep fascia exposed; cautiously opening this fascia, the vein is to be pushed aside, avoiding the par vagum, recurrent, and cardiac nerves.

#### BRACHIAL ANEURISM.

This is usually the result of violence, and is very often a false aneurism; the tumour is in the bend of the arm, and inconveniences its mobility.

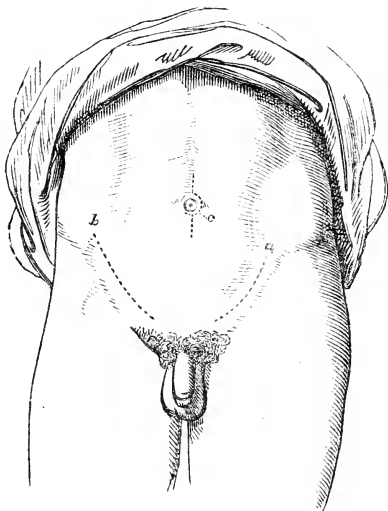
The brachial or humeral artery is tied by making an incision on the inner edge of the biceps flexor muscle, of two inches in length,

Fig. 30.



about the middle of the arm. The median nerve will be found first, lying close to the artery; this and the veins are to be carefully separated. It must be borne in mind, that the artery may bifurcate as high as the axilla. If it be necessary to tie the artery in the upper portion of the arm, an incision is to be made over the pulsating vessel, and it will be found on the inner edge of the coraco-brachialis muscle; the nerves and veins are to be carefully avoided.

Fig. 31.



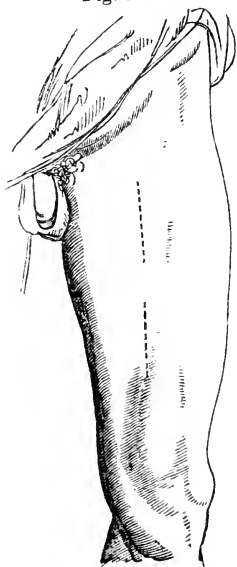
Deligation of the *radial* and *ulnar* arteries is seldom required except for wounds. Often wounds in the palm of the hand require the tying of the humeral artery. The radial may be exposed in the upper part of the forearm, by an incision through the skin and superficial fascia. By separating the supinator longus muscle from the pronator teres, the artery will be found as it passes over the tendon of the pronator. In the lower part of the forearm the *radial* may be readily exposed by making an incision through the skin and fascia on the outer border of the flexor carpi radialis; and the *ulnar* by an incision on the radial side of the flexor carpi ulnaris muscle.

## INGUINAL ANEURISM.

This is a pulsating tumour in the groin, not to be mistaken for a bubo, hernia, &c. The external iliac is tied by making an incision (*a*, Fig. 31), about  $3\frac{1}{2}$  inches in length, commencing on a level with the anterior superior spinous process, and about an inch distant from it; and continued nearly parallel with Poupart's ligament, to a point 1 inch above, and  $1\frac{1}{2}$  inches to the outside of the pubes. Carefully cutting through the skin, superficial fascia, tendon of the external oblique, internal oblique, and transversalis muscles, the fascia transversalis will be exposed, with some danger of wounding the epigastric artery. This fascia should be scratched through, and the peritoneum pushed aside, and held out of the way by an assistant with a spatula: the artery will be detected by its pulsation on the inner border of the psoas muscle: the vein being on its inner side. The operation for tying the internal iliac or the common iliac is made by making an incision *b*. The letter *c* shows the incision of Sir Astley Cooper when he tied the aorta.

## POPLITEAL ANEURISM.

Fig. 32.



This is of frequent occurrence, and occupies the space between the hamstrings behind the knee, causing pain, numbness and swelling of the leg, disease of the joint, &c.

The operation is to tie the femoral artery. The patient being properly placed, the sartorius muscle is rendered prominent by raising and adducting the thigh. An incision of two or three inches in length is made upon the inner side of the sartorius muscle, in the upper part of the thigh, according to Scarpa, where the artery is superficial. The saphena vein is to be regarded in the dissection of the superficial fascia. After opening the sheath, care must be taken not to injure the vein, nor to include the saphenus nerve. Hunter's operation is somewhat below, and in its performance the sartorius must be divided or pushed aside.—The *anterior tibial* artery may be tied in several places: at the upper part of the leg, by a free incision, so



as to get between the tibialis anticus and extensor communis digitorum. After the division of the superficial fascia, a proper allowance should be made for the breadth of the tibialis anticus, in order to strike the line of division upon the dense fascia between the two muscles. The artery will be found at the bottom of this space, lying on the interosseous membrane.

At the lower part of the leg a less incision is necessary, the vessel being more superficial. The wound is made on the fibular side of the extensor proprius pollicis. The venæ comites and anterior tibial nerve are to be avoided.

On the instep the artery may be secured by making an incision on the fibular side of the tendon of the extensor proprius pollicis.

The *posterior tibial* may be readily tied near the middle of the leg, upon the inner side; divide the skin, superficial fascia, crural fascia, and some fibres of the soleus, and the leg being flexed, the triceps sura can be pushed aside sufficiently to expose the sheath of the vessels; the artery is to be carefully excluded from the veins and nerve.

At the ankle the operation is simple. A semilunar incision is made, posterior to the internal malleolus, through the skin and superficial fascia, and a thick aponeurosis; this exposes the sheath of the vessels. The veins and nerve are to be excluded.

Fig. 33.

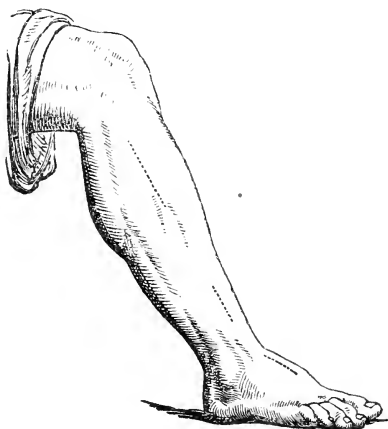
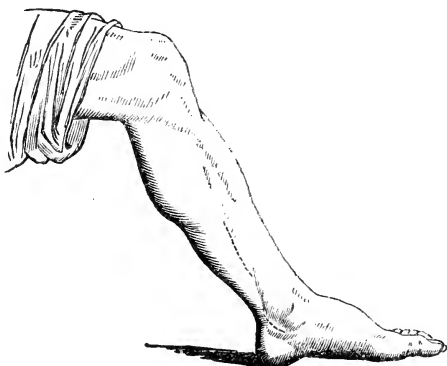


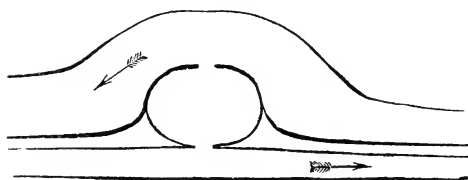
Fig. 34.



## VARICOSE ANEURISM.

This is usually the result of a wound, and occurs most frequently in the elbow after bleeding. An opening remains both in the artery and the vein, and a cyst is formed with this double communication.

Fig. 35.



The arterial blood enters the vein, and produces greater or less distension of it. This enlargement of the vein is recognised by a peculiar thrill, resembling the purr of a cat: it may exist for some time without any inconvenience, and is to be removed by tying the artery above and below the sac, and oftentimes it is necessary to tie the vein.

Aneurismal varix is another variety, occurring under the same circumstances, at the bend of the arm. The vein and artery communicate, as in the former, but without any cyst interposed; the swelling is less, but more diffused, and varicose distension of the veins is very great.

Fig. 36.



The limb below the tumour is imperfectly supplied with arterial blood, and, consequently, cold, numb and vitally weak, and also liable to congestion and œdema. It is to be

treated by pressure, so as to repress the swelling, and moderate the sanguineous mixture: this will palliate the symptoms, and permit the use of the limb. A permanent cure can only be effected by tying the artery above and below the aperture of communication.

Aneurism by anastomosis presents itself in various forms: 1. Capillaries of a portion of integument may be equally and permanently dilated, producing discoloration and slight elevation of the part. This is one form of nævus, or congenital mark, which is attended with no danger, and may be considered as a deformity rather than as a disease. 2d. The structure may consist chiefly of dilated veins fed by arterial branches. This structure is not found in the true skin, but in the adjacent cellular tissue; or it may be submucous, as is exemplified by one variety of hemorrhoid. 3d. The swelling may consist chiefly of dilated and active arteries, supplied with large tortuous veins, which are mere conduits from the tumour; the tumour is erectile, and varies in bulk and tension,

according to the state of the circulation. It often grows rapidly, and brings life into imminent peril.

Its removal may require the knife, excision or compression.

### AMPUTATION.

Amputation is not to be resorted to until all other means of cure have failed. In cases of gangrene, large malignant tumours involving a bone or a joint, diseases of the joints causing hectic and threatening life; in case of recent injury, where reparation is impossible, then amputation must be performed.

In case of injury, amputation is either primary or secondary :

*Primary* ; when performed immediately after the patient has recovered from the shock of the injury, and before febrile excitement.

*Secondary* ; after suppuration has commenced, and perhaps sloughing. Secondary amputations are also performed for diseases of the bones or joints.

Primary amputations are to be performed when it is impossible to save the injured limb. In military life, limbs are amputated for injuries, which a surgeon might attempt to save in civil life; there being less opportunity for treatment, and less favourable opportunity for secondary amputation.

*Instruments and Dressings.*—Amputating knives, Catlin's saw, tourniquets, scalpels, tenacula, forceps, needles, ligatures, sponges, bone-nippers, compresses, rollers, retractors, lint spread with cerate, charpie, adhesive strips, and warm water.

### AMPUTATION OF THE THIGH.

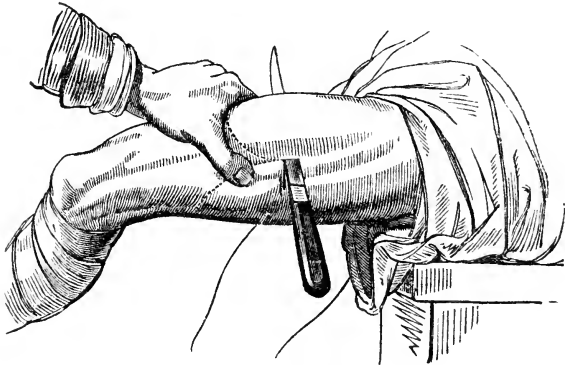
The patient having been brought to the edge of the bed, his back is supported by pillows, and his hands held by assistants. The tourniquet is applied over the superficial portion of the artery, about three inches below the groin, so as to interrupt the circulation of blood in the limb. This, like other amputations, may be performed in two ways, either by the circular incision or by the flap operation.

*Circular Incision.*—The surgeon stands so that he may use his left hand to grasp the part which he is to amputate, the leg being firmly supported, in a horizontal position, by an assistant; the surgeon then carries the amputating knife under the limb, and with one complete sweep round the limb, divides the skin, fat, and fascia. A scalpel is then used to dissect the integuments from the muscles, in order that they may be turned up, for two inches, in the same way that one would turn up the cuff of a coat. With the amputating knife, the muscles are now cut through down to the bone, the edge of the knife being inclined upwards, in order that the stump may present somewhat of a conoidal cavity; the muscles are to be slightly separated from the bone, and a retractor applied to pull them upwards. In using the saw, the heel should first be applied on the

bone, and a groove made; by steady strokes the bone is divided, care being taken to prevent splintering and roughness: in case there should be any, it may be removed by bone-nippers. The large vessels can now be tied, and the stump sponged with warm water, in order to detect orifices of smaller ones. After hemorrhage is completely arrested, and the tourniquet somewhat loosened, the end of the bone is to be covered by the muscles and skin, so as to form a rounded stump; the edges are to be retained by adhesive strips, and the ligatures brought out at the corners of the wound. The stump is now covered by lint spread with cerate, and over this a thin pledget of charpie or tow; the whole is supported and covered by a roller, which should be carried once or twice around the patient's pelvis. Having been carefully placed in bed, the stump is supported upon a pillow, and secured to it by pins; over the stump is placed a frame, to take off the weight of the bedclothes. During the winter, the dressings may remain on seven or eight days; in summer only two or three: a poultice previously applied may facilitate their removal. The after dressings may be repeated once in forty-eight hours. About the tenth day the ligatures may come away, and, generally, the wound is healed in three or four weeks. Some suppose that the stump may be better covered by the *flap operation*, especially should the integument be thin.

*Flap Operation.*—The original plan of Vermale was, to introduce a knife perpendicularly to the anterior surface of the thigh, and to

Fig. 37.



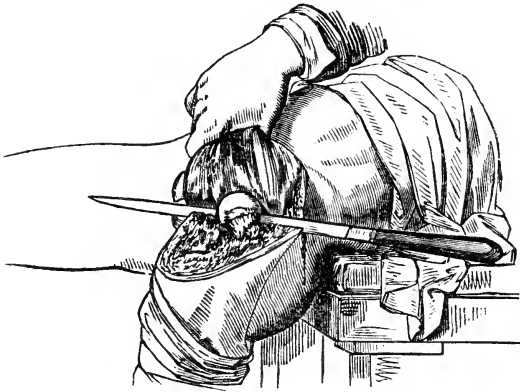
cut a lateral flap on either side. Liston and others prefer an anterior and posterior flap, which prevent the end of the bone rising at the upper angle of the wound, and protruding forwards. These are made by inserting the knife by the side of the thigh, as in Fig. 37, instead of upon its anterior surface. The objections to the flap ope-

ration are the injuries to vessels and nerves, by transfixion and oblique division.

#### AMPUTATION AT THE HIP JOINT.

This operation is rarely necessary, and is always severe and dangerous; it should never be performed for disease of the joint. The patient is to be placed on a table, with his pelvis projecting from the edge. The artery is compressed by an assistant, who must be ready to thrust his fingers in the wound formed during the formation

Fig. 38.



of the anterior flap, so that he can grasp the end of the vessel, as soon as it is cut. The knife is entered about middle way between the trochanter major and the anterior superior spinous process of the ilium. By cutting downwards, the anterior flap is formed. The head of the bone is then disarticulated, and the blade of the knife being then placed behind the bone, is carried downwards and backwards, so as to form a posterior flap; the vessels are to be rapidly secured, and the flap managed as in all other flap operations. By some the formation of a lateral flap is preferred. Very often the selection of the flap will depend upon the character of the wound which may render the operation necessary.

#### AMPUTATION OF THE LEG.

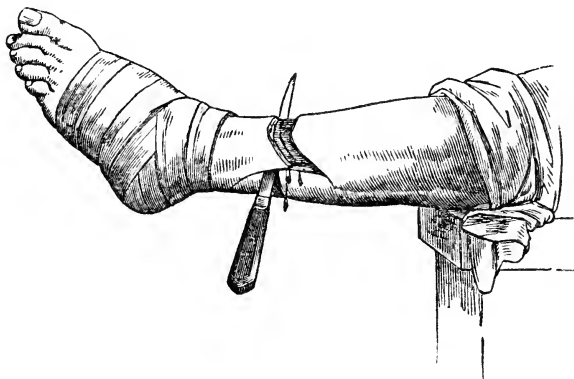
The length of the stump will, in some measure, depend upon the kind of artificial limb to be used. If the patient is to rest upon his knee, the stump should be short, in order to be bent at right angles.

*Circular method.*—The tourniquet having been applied, the integuments are to be divided, dissected up, and turned back for two inches; the muscles are to be divided, down to the bone, by a

second circular incision. Then a catlin is to be passed between the bones, so as to divide the interosseous ligament and muscles; a three-tailed retractor is then to be applied, and the bones sawn through together. If the spine of the tibia projects much, it can be removed by a fine saw, or bone-nippers. The vessels are to be secured, and the stump treated as in amputation of the thigh, the integuments being brought together in a straight line.

*Flap Operation.*—This is generally preferred, and is thus performed. The surgeon first places the heel of the knife on the side

Fig. 39.



of the limb, farthest from him, and draws it across the front of the limb, in a semicircular direction, making a semilunar flap. When its point has arrived at the opposite side, it is at once made to transfix the limb, and then the larger and posterior flap is cut. In transfixing the limb, care must be taken not to pass the knife between the bones. This amputation may also be performed near the ankle; but, in this instance, it will be necessary to shorten the tendo Achillis after the flap is made. The leg should not be amputated nearer the knee than the tuberosity of the tibia, or the joint will be opened, and inflammation result. Hence *amputation at the knee* is rarely performed, although disarticulation may be readily performed with a large scalpel. In this operation the patella should be allowed to remain.

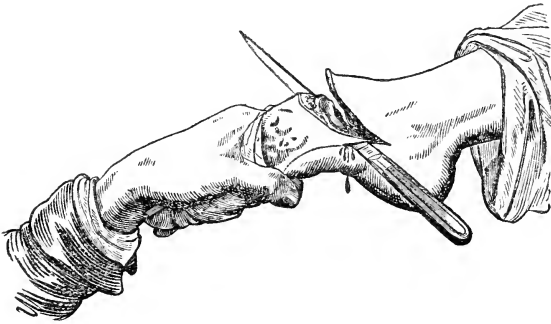
#### AMPUTATION OF THE FOOT.

The foot is amputated at two places.

*Chopart's Operation.*—A flap is made from the upper part of the instep, and the disarticulation commenced immediately behind the tuberosity of the scaphoid bone. The bistoury is passed between the scaphoid and head of the astragalus, and then between the cu-

boid and os calcis: an inferior flap is then made from the sole of the foot.

Fig. 40.



*Hey's Operation.*—The disarticulation is commenced immediately behind the tuberosity of the fifth metatarsal bone; separating the fifth and fourth metatarsal bones from the cuboid, the third and second from the external and middle cuneiform bones. The internal cuneiform is sawed through. The superior flap is made before the disarticulation, and the inferior one subsequently.

#### AMPUTATION OF THE GREAT TOE.

The most convenient mode of removing this toe is by incisions represented by dotted lines in this figure. Commencing upon the inner side of the metatarsal bone, and running round the joint obliquely, taking care not to wound the anterior tibial artery. The flap is made from the outer side of the toe. It will cover the head of the metatarsal bone more perfectly, and can be more readily retained in its position than any other.

Fig. 41.

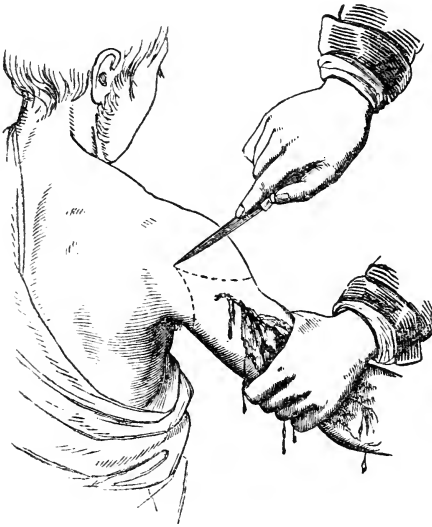


#### AMPUTATION AT THE SHOULDER JOINT.

Hemorrhage is to be restrained by pressure with the fingers, or the handle of a key well padded, upon the subclavian artery, as it passes over the first rib. The flaps may be cut by transfixion, or in the manner represented in fig. 42. The external flap should be made first, out of the deltoid, and then the head of the bone disarticulated. The internal flap is

smaller, and made last, in order that the vessel may be secured immediately upon the limb being severed. In some instances it may be necessary to remove the whole of the scapula, and one half of the clavicle. The extent and character of the injury must often determine the shape of the flaps.

Fig. 42.



#### AMPUTATION OF THE ARM.

The circular operation is most frequently performed. The artery is compressed by a tourniquet or the fingers, and the skin drawn firmly back. One circular incision will divide the skin and fascia; another will divide the muscles. If the knife is held so that the edge is directed

Fig. 43.



slightly toward the shoulder, the end of the bone will be found in a conical cavity, and can be well covered by the muscles and skin.



The flap operation is sometimes performed. The arm being transfixed, the anterior flap is made first; the vessels are divided in the posterior.

*Amputation at the elbow* is performed by making a single flap from the muscles and skin in front of the joint. The head of the radius is disarticulated first: the ulna is then to be sawed, so as to let the olecranon remain.

#### AMPUTATION OF THE FORE-ARM.

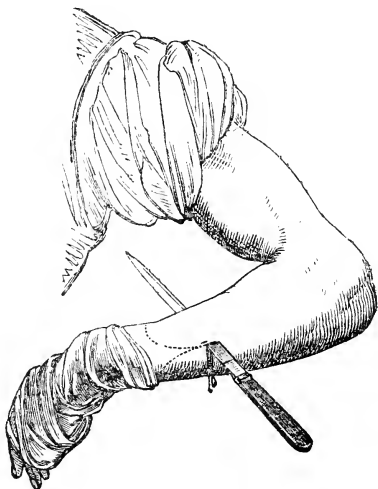
The tourniquet is applied to the brachial artery as in other operations upon this extremity.

Two flaps are formed, one on the dorsal, the other on the palmar aspect. These are best made by transfixion and cutting outwards.

Fig. 44.

The amputation should be performed as near the wrist as circumstances will admit of; although below the middle it is not easy to obtain sufficiency of flaps. But, the general rule is, to remove as little as possible from the organs of prehension: and operations are attended with less risk to life the farther they are removed from the trunk.

**AMPUTATION AT THE WRIST.**—The disarticulation of the radio-carpal joint is readily effected by commencing at the styloid process of the radius. A dorsal and palmar flap is made of the skin. The pisiform bone is to be allowed to remain.



**AMPUTATION OF THE FINGERS.**—The hemorrhage may be controlled by an assistant's grasping the wrist tightly. The finger may be amputated at a joint or in the middle of a phalanx, though it is important to save as much as possible. The operation may be circular, or with a flap, which should be made from the palmar aspect of the finger.

#### C A N C E R.

Malignant diseases change the original structure of the part, transform or destroy the surrounding tissues, travel in the course of

the lymphatics, contaminate the nearest glands, affect several organs in the same individual, and, if mechanically removed, reappear in or near the cicatrix.

Malignant growths contain granules or nucleated cells, imbedded in a fibro-cellular tissue. They are *composed* almost entirely of albumen. Their *development* is dependent upon perverted nutrition. The *causes* are perpetual local irritation, and a morbid state of the constitution, which may be hereditary. In the ordinary sense of the word they are not contagious; but cancer-cells injected into the blood of a dog, produced malignant disease of the lungs.

Cancer is a term applied to several kinds of malignant disease.

#### SCHIRRUS.

This *term* is applied to the early condition of cancer, and implies a peculiarly *hard* tumour, usually rounded, and subject to severe lancinating pain.

It cuts with the crispness of a potato, and is intersected with dense white bands, the interstices being filled with a semi-fluid dark substance.

It may occur anywhere, but most frequently in glands, especially in the female breast. Its progress varies. Generally the tumour is movable at first, and without pain. It may continue thus for a great length of time. After a time the pain increases, and the tumour swells and becomes adherent to the surrounding textures; fissures form upon the surface, ulceration softens the tumour, and an open sore results, to which the term *cancer* is most frequently applied. Its edges are jagged, undermined, and inverted. The discharge is thin, sanious, fetid, and irritating. Occasionally a few unhealthy granulations appear; sometimes the whole mass sloughs away.

*Symptoms.*—General bad health, languor, depression of spirits, emaciation, a sallow complexion, bad appetite and imperfect digestion. Hectic is induced by pain, exhaustion, and the absorption of deleterious secretions. Occasionally the bones become fragile.

The *diagnosis* must be guarded. The hardness and situation of the tumour and its lancinating pain, the age and cancerous cachexia will assist in determining the disease. Women are more liable to it than men; persons over forty than those under it.

*Treatment.*—Various applications have been used, but without success. Caustics and other powerful remedies often aggravate the disease. The only chance of cure is by extirpation when the tumour is hard, movable, and without pain. But even when performed under the most favourable circumstances, the disease most frequently returns. Relief and palliation of symptoms may be obtained often by alteratives and tonics.

## FUNGUS HÆMATODES.

The tumour is at first rounded, soft, smooth, elastic, free from pain and tenderness: it grows rapidly, and becomes blended with surrounding tissues. When the tumour is enlarged, the skin becomes livid, and the veins distinct and tortuous. The pain is aching and throbbing, but not so severe as that of cancer. Ulceration takes place, a grumous fluid discharges, and a rapidly increasing fungus grows from the aperture. This fungus is of a dark red colour, is extremely vascular, and easily bleeds. The constitution is rapidly undermined, and hectic and death soon occur.

Upon dissection, the tumour presents different appearances from that of cancer. It consists of a soft pulpy matter resembling brain, which is often termed medullary. In the midst of this are cysts filled with coagulated blood and pus. It is distinguished from cancer by occurring amongst children and young persons, by its consistence, and by its attacking internal organs, such as the brain, liver, kidneys, spleen, &c.

*Treatment.*—There never can be a radical cure: death must be the result, sooner or later. All remedies should be directed to the general health, with a view to palliation of symptoms.

## AFFECTIONS OF THE EYE.

## DISEASES OF THE EYELIDS.

*Hordeolum*, or stye, is a small painful boil, originating in the sebaceous follicles at the root of the eyelash. It is caused most frequently by derangement of the stomach: a scrofulous constitution predisposes to them. *Treatment.*—Cold applications and nitrate of silver may arrest it; generally it requires poultices, and puncturing.

*Ophthalmia Tarsi.*—This is a chronic inflammation of the edges of the eyelids. In adults the form is *catarrhal*, in children *scrofulous*. The edges are swollen and red; the eyelashes loaded with meibomian secretion; and the lids are glued together in the morning. There is itching, smarting, and a sensation of stiffness. When the disease is of long standing, the eyelashes fall out, and the new ones are misdirected, and irritate the conjunctiva. It may be the result of catarrhal ophthalmia, or be produced by cold and damp air, or intemperance. In children it may result from eruptive diseases.

*Treatment.*—Alteratives, laxatives, and tonics. The state of the skin requires attention. Fomentation will remove the incrustations. Loose and misdirected eyelashes are to be removed. An ointment composed of gr. x. of red precip. and an ounce of cerate is to be carefully applied at night; and in the morning the lids are to be bathed with tepid water, and not separated forcibly. In inveterate cases, sulphate of copper and nitrate of silver may be applied to the edges, and blisters placed behind the ears.

*Entropion*, which is a permanent inversion of the eyelid, often results from tarsal ophthalmia, and it can only be remedied by an operation, such as dissecting off the edges of the eyelids with the lashes and their bulbs; or by removing a transverse fold of the skin beyond the eyelid.

*Ectropion* is an eversion of the eyelid, caused often by a thickening of the conjunctiva from long inflammation. This is to be cured by bringing the conjunctiva to a healthy condition, by the application of nitrate of silver or sulphate of copper. Should these remedies fail, a portion of the conjunctiva is to be excised.

*Ptosis* is a falling of the upper eyelid, from a palsy of the third nerve. It is often connected with congestion of the head, and may be a precursor of apoplexy, and should be treated by bleeding, purgatives, mercury, and blisters. If persistent, it may be obviated by removing a fold of the skin from the upper eyelid.

#### DISEASES OF THE LACHRYMAL APPARATUS.

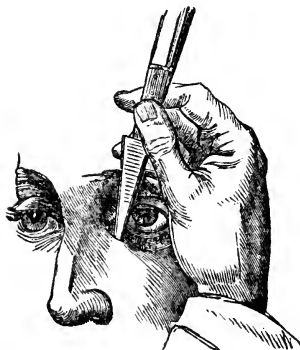
*Xerophthalmia* is a dryness of the eye, arising either from a want of secretion of the conjunctiva, or, as some suppose, from a deficiency of tears. It is to be remedied by frequently bathing the eye with mucilage.

*Epiphora* is a superabundance of tears, so that they run over the cheeks: it should be distinguished from *stillacidium lachrymarum*, which is an overflow in consequence of an obstruction of the channels that convey them to the nose. It arises frequently from scrofulous inflammation; or from the action of chemical or mechanical agents, cold winds, acrid vapours, &c. The treatment will, of course, vary with the cause.

*Obstruction of the lachrymal duct*, is known by the overflow of the tears, the dryness of the nostril, distension of the sac, and formation of a small tumour. It often leads to inflammation and abscess. In other instances it results in thickening of the tubes and duct, which may be much benefited by the use of probes.

*Fistula lachrymalis* is an aperture at the inner corner of the eye, the result of a bursting of an abscess caused by obstruction. The inflammation of the sac is to be treated by leeches and cold applications. If suppuration cannot be obviated, the tumour is to be opened as soon as it has become soft and fluctuating. The opening should be made parallel to the margin of the orbit, and below the tendon of the orbicularis.

Fig. 45.

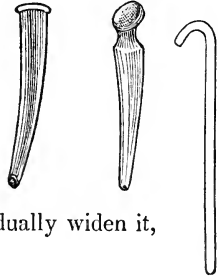


The sac should then be fomented and thoroughly cleansed, and after a few days, should any doubt exist with reference to the perviousness of the tubes and sac, an exploration is to be made by probes.

Should the obstruction be firm, the opening into the sac will remain fistulous, and then a *style* must be introduced. The object of the style is to dilate the strictured portion of the sac. The form and size is represented in the cut. They are usually made of lead, silver, or gold, and sometimes of catgut. Some have thought best that there should be a groove on the style, or that it should be hollow, but this is unnecessary; for although the style may occupy the whole of the calibre of the duct when first introduced, the tears gradually widen it, and flow readily by the side of it.

Fig. 46.

Fig. 47.



#### DISEASES OF THE CONJUNCTIVA.

*Acute Conjunctivitis.*—*Symptoms.*—Smarting, heat, stiffness, with a feeling as if dust had got into the eye. Subsequently the secretion of mucus increases; which becomes puriform. The vessels of the conjunctiva are turgid and numerous, giving it a bright red appearance. There is slight intolerance of light and increased flow of tears.

*Causes.*—Cold or damp, bad condition of stomach, or local irritation.

*Treatment.*—A dose of calomel followed by a saline cathartic; leeches, cold applications, moderately dark room, and a solution of nitrate of silver. The disease may become *chronic*; when blisters behind the ear, and astringent applications to the eye will be useful.

*Purulent Ophthalmia* or *conjunctivitis* and Egyptian ophthalmia, are more severe forms of the same affection, and are infective. The most severe form of inflammation of the conjunctiva is *gonorrhæal ophthalmia*; in this variety the eye is often lost. The treatment must be early and active.

*Scrofulous Conjunctivitis.*—*Symptoms.*—Extreme intolerance of light, the eyelids are spasmodically contracted, the head is turned away from the light, there is no general vascularity of the conjunctiva, but a few vessels running towards the cornea, terminate in phlyctenulæ, or pustules on the cornea. This disease is most obstinate and liable to perpetual recurrence, often resulting in ulceration of the cornea, or opacity from effusion of lymph between its layers.

*Treatment.*—Local applications are of no avail unless the gene-

ral health be improved. A dose of calomel and rhubarb should be followed by tonics and alkalies, and other general remedies for scrofula, such as quinine and salt baths. The nitrate of silver exercises a more sedative and antiphlogistic influence than any other local remedy.

*Granular Conjunctivitis* is a thick, rough, fleshy state of the palpebral conjunctiva, dependent upon long-continued inflammation; it causes great pain and disturbance to the motion of the eye, and if it continues will render the cornea opaque by its friction.

*Treatment.*—If the granulations are long, they may be removed by the knife or scissors; ordinarily they can be cured by scarification, lunar caustic, and sulphate of copper; at the same time the general health must be attended to, and blisters may be applied behind the ears.

#### ULCER OF THE CORNEA.

This most frequently occurs as a result of conjunctivitis, especially of the scrofulous form, but may arise from mechanical injury; it often penetrates the cornea and leaves an opaque cicatrice. When the ulcer is *healthy*, its surface is somewhat opaque, owing to the effusion of lymph; when *inflamed*, vessels will be found approaching it; when *indolent*, it is clear, and transparent, appearing as if a small piece had been cut out of the cornea. The nitrate of silver is the best application to the inflamed and indolent ulcer of the cornea. If the acetate of lead be used, a white precipitate is formed, which is liable to become fixed in the cicatrice as a dead white spot.

#### SCLEROTITIS.

This disease is often called rheumatic ophthalmia. It is known by redness of the sclerotica, slight intolerance of light, severe aching pain of the eye, and the bone surrounding it, which is aggravated at night. It is distinguished from conjunctivitis by the character of the pain, and redness. In *sclerotitis* the vessels are deep-seated, of a pale pink colour, and run in straight lines from the circumference of the eye, towards the cornea; whereas in *conjunctivitis*, the vessels are tortuous, freely anastomose, superficial, and are of a bright red colour.

*Treatment.*—Bleeding, purging, together with the administration of colchicum, warm baths, and anodyne fomentations; blisters behind the ears, and Dover's powder, are also of great avail.

#### IRITIS.

This often is *caused* by injury or cold, but oftener by scrofulous, syphilitic, or gouty taint.

*Symptoms.*—The iris changes in colour; appears rough or villous;

the pupil is contracted, and often filled with lymph; a pink zone surrounds the cornea, formed by small vessels from the sclerotica; there is intolerance of light, dimness of vision, a burning pain in the eye, and an aching pain over the brow.

*Treatment.*—The inflammation should be subdued by active antiphlogistic means, such as bleeding, purging, and leeching. The absorption of lymph is to be promoted, and its fresh effusion arrested by the administration of small doses of calomel and opium every four hours, until the gums become affected. The pupil should be kept well dilated by belladonna or stramonium, and the pain must be relieved by anodyne fomentations and nightly doses of opium.

*Artificial Pupil.*—It is often necessary to form a new aperture in the iris, owing to the pupil having been obliterated by inflammation.

#### CATARACT.

Is an opacity of the lens or its capsules. It may be caused by inflammation or injury, but is more frequently the result of impaired nutrition. There are different varieties of cataract, designated by the terms, hard, soft, radiated, capsular, &c.

*Symptoms.*—The vision becomes gradually impaired, and objects appear as if surrounded by a mist or cloud. The sight is better in the evening, or after the application of belladonna, because the pupil being dilated, more light passes through that part of the lens which may yet be transparent. The pupil is active, and behind it is an opaque body of a grayish-white or amber colour. The catoptric test is the most certain mode of distinguishing it from amaurosis and glaucoma. When a lighted candle is held before the healthy or amaurotic eye, three images of it may be seen: an erect image that moves upwards when the candle is moved upwards, which is produced by reflection from the surface of the cornea; another erect image, produced by reflection from the anterior surface of the lens, which also moves upwards when the candle moves upwards; and a very small inverted image, that is reflected from the posterior surface of the crystalline, that moves downwards when the candle is moved upwards. In cataract this inverted image is first rendered indistinct, and soon abolished; and the deep erect one is soon abolished also.

*Treatment.*—There is no cure but by an operation, which should be deferred until the patient is in good health and condition. If the iris moves freely, and there is no tendency to vascular disturbance in the eye or head, the chances are favourable.—There are three modes of operating, before performing either of which, the pupil should be dilated by belladonna or stramonium.

*Extraction.*—An incision is made through one half of the circumference of the cornea, the capsule of the lens lacerated, and the cataract extracted entire.

*Couching or Depression.*—The object of this operation is to re-

move the cataract from the axis of the vision, and is performed by a couching needle passed through the outer side of the sclerotica, about two lines from the margin of the cornea.

*Producing Absorption.*—The needle is introduced in the same manner as in depression, the lens broken up and subjected to the absorbing influence of the aqueous humour.

#### AMAUROSIS.

Is an imperfection of vision, arising from some change in the retina, optic nerve, brain, or fifth pair of nerves.

*Symptoms.*—The sight is impaired by degrees; at times vision is more impaired than at others; objects appear double, crooked, or discoloured; black spots or flashes of light, a vacant stare, dilated pupil, and but little motion of the eyelids, indicate amaurosis. There is often a want of the natural colour of the pupil, which may cause it to be mistaken for cataract, from which it is most certain to be distinguished by the catoptric test, as well as by rational signs. The usual causes are circumstances which over-stimulate the retina, such as glaring lights, heats, intemperance, tight neck-cloths; also inflammation, concussion, extravasations, tumours, &c.

*Treatment.*—Should it be inflammatory, produced by wounds, lightning, or exposure to intense light; or if there are plethora, headache, giddiness, turgid countenance, and frequent flashes of light when stooping; or if the complaint has followed a suppression of any accustomed evacuation, or the drying up of an habitual ulcer or eruption, then the antiphlogistic treatment must be adopted,—bleeding, cupping, counter-irritants, and purgatives. Should it be atonic, the result of a protracted illness, great loss of blood, over-lactation, leucorrhœa, or other debilitating circumstances, it is attended with pallid lips, dilated pupils, trembling pulse, and despondency of mind. The patient usually sees best after eating, and in a strong light. The discharge or other source of exhaustion should be corrected, and the system strengthened by fresh air, tonics, quinine, steel, good living, &c. The secretions should be well regulated, and the cutaneous and general circulation be promoted by exercise and bathing.

Should it be sympathetic, supervening on jaundice, some disorder of the stomach, or worms, the general health must be regulated before a cure can be expected. It may arise from tumours near the eye and carious teeth, which should be removed. If it follow an injury of the fifth pair of nerves, the wound should be dilated; or if it be healed, the cicatrice must be cut out. Should it follow the use of tobacco or opium, it may be relieved by a cold shower-bath, counter-irritation, and electricity. Should it be organic, the treatment should be palliative.



## STRABISMUS.

*Strabismus* or *Squinting* is the want of harmonious action of the muscles of the eyeball. It may be caused by the overaction or the paralysis of a muscle. The ordinary *varieties* are the convergent, looking inwards, and the divergent, looking outwards: the former is the more frequent. It may be congenital, but usually occurs in childhood. Sometimes it is the *result* of imitation; or it may be induced by marks or patches on the nose; but oftener it is occasioned by gastric or intestinal irritation. Cerebral disturbance is another cause, especially when the squint does not come until adult age.

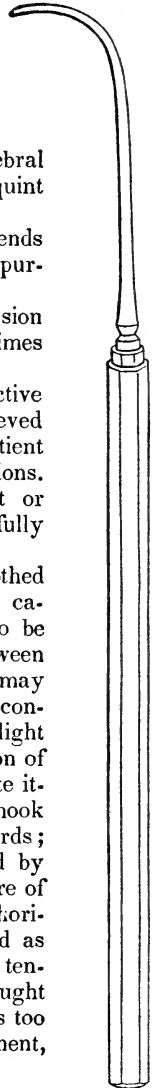
*Treatment.*—In childhood, where squinting depends on sympathetic disturbance, it is often removed by purgatives, alteratives, or anthelmintics.

Some cases of squinting may be cured by division of a muscle, but not all; in fact, a deformity sometimes results from the operation.

In almost all cases of squinting, there is defective vision in the affected eye; this defect is usually relieved when the operation is properly performed. The patient should be steadied, as for other ophthalmic operations. The eyelids are to be separated by an assistant or speculum, and the eye not to be operated on is carefully to be bandaged.

The conjunctiva is to be seized by a small toothed forceps, about midway between the cornea and the caruncle, so as to form a horizontal fold, which is to be snipped by the scissors close to the forceps, and between them and the cornea; or, this fold of conjunctiva may be divided by an iris knife. After the division, the conjunctiva is to be separated from the sclerotica for a slight distance. The third step consists in the introduction of a blunt hook, which is curved so as to accommodate itself exactly to the curvature of the eyeball. The hook is to be passed under the tendon, from above downwards; and the muscle now being secure, it is to be divided by a pair of scissors. If the pupil is now in the centre of the orbit, and if the patient cannot turn the eye horizontally inwards, the operation may be considered as complete. Should a portion of the muscle, or some tendinous fibres remain undivided, they are to be sought for by the blunt hook, and divided. If the fascia is too extensively divided, the eye will become too prominent, or an external squint will result.

Fig. 48.



After the operation, cold water is all that need be applied. The operated eye should be exclusively used for a few days. A fungous granulation often rises from the wound, which may be removed by the knife, scissors, or lunar caustic.

### CLUB-FOOT.

This deformity may either be congenital or acquired. The congenital form is dependent upon some disturbance of the cerebro-spinal system, that produces irregular contraction of the muscles, by which antagonism is destroyed.

The accidental causes by which it may be acquired, are injuries and diseases of the foot or ankle, convulsions, scarlet fever, cicatrices, rickets, &c.

The principal varieties are three:—1. *Talipes Varus*, in which the foot is turned inward, as in figure 49, and rests upon

Fig. 49.



its outer edge. There are various grades and modifications of varus. The foot is not dislocated, but the bones deviate from their normal direction, and their articular surfaces are partially separated. The astragalus is least altered in position. The ligaments on the outer side are lengthened, and those on the inner are shortened. The tendons of the tibialis anticus and posticus, and the tendo Achillis, are most contracted; the peronei are relaxed.

2. *Talipes Valgus* (fig. 50). The foot is everted, and rests on its inner edge. It is a rare form of club-foot. The ligaments on the inner side are relaxed. The peronei muscles are contracted, and the tibialis anticus and posticus elongated.

3. *Talipes Equinus*.—In this variety the foot rests upon the ball, or upon the toes. After a person has walked for a number of years the deformity is increased, as is represented in the drawing

Fig. 50.



(Fig. 51). The shortening is due to contraction of the triceps tendon, and thickening of the plantar fascia.

There are two other varieties; one in which the toes are drawn up by contraction of the extensors, and the patient walks upon the heel; and the other when the dorsum or instep comes in contact with the ground. Besides which there may be various complications of the above.

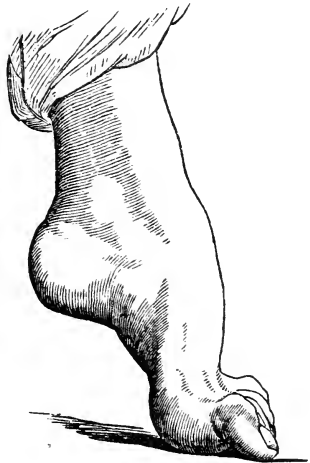
The *prognosis* will depend upon the degree of contraction, the variety of the deformity, the condition of the bones, and the age of the patient.

*Treatment.*—Many cases of congenital club foot may be rectified by constantly wearing a proper apparatus, especially if the treatment be commenced in early childhood; but in confirmed cases it is

better to resort at once to Stromeier's operation of division of the tendons. The operation is thus performed.

The tendon is put on the stretch, and a narrow sharp-pointed

Fig. 51.



knife is thrust through the skin externally to the tendon; then the edge is directed towards the tendon and the knife withdrawn, cutting the tendon as it escapes.

The operation will facilitate the cure in most cases, provided the subsequent treatment be effectually maintained; and this depends as much upon the fidelity of the parent or nurse in the constant application of the apparatus as upon the skill of the surgeon.

There may be said to be little or no danger resulting from the operation.

Various foot-boards and shoes are to be worn, by which the deformity is gradually and permanently overcome.

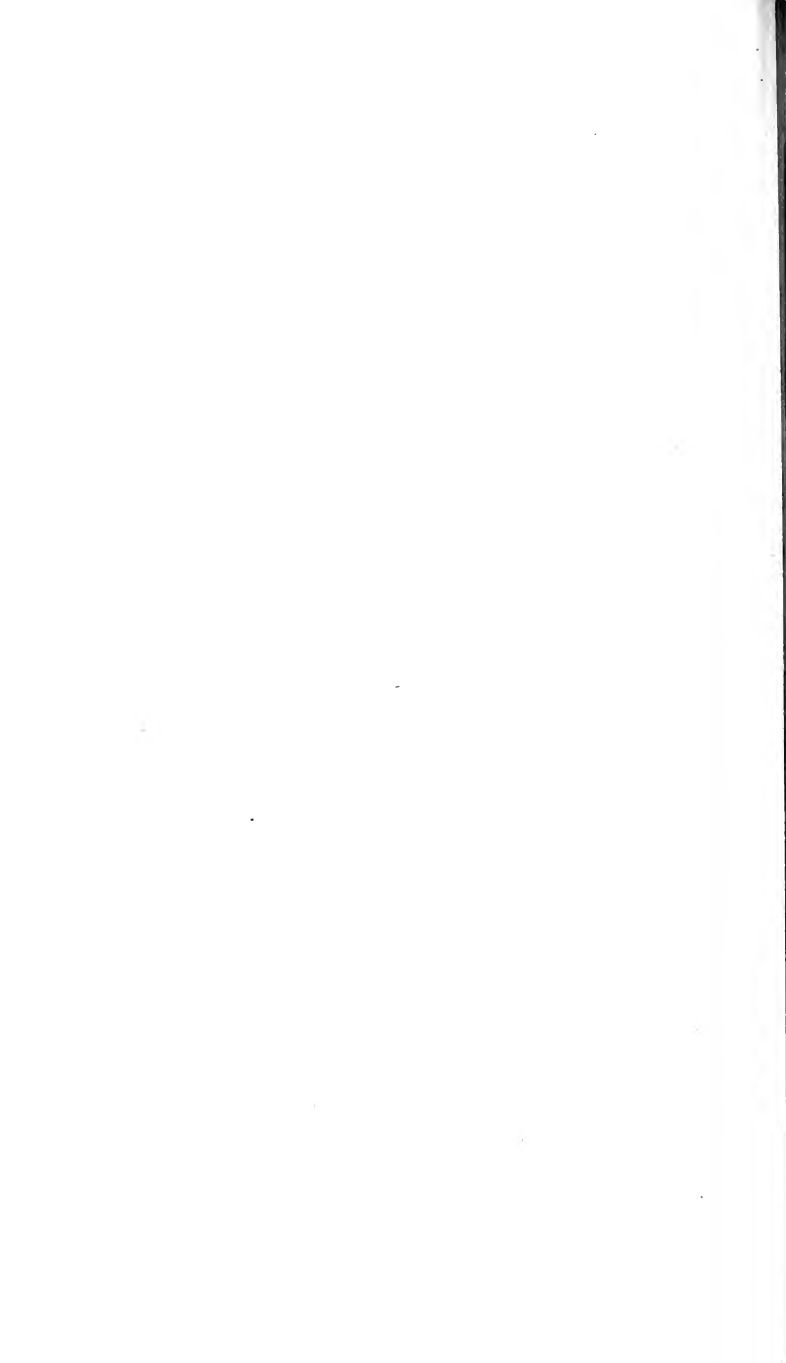
The most favourable period for the operation is between six and eighteen months. Great care is required not to produce excoriation and ulceration of the skin in a young child. Oftentimes it is better to remove the apparatus entirely than run the risk of producing fever or convulsions.

THE END.

## ERRATA.

Page 47, line 23, read : Sixty or seventy *days* will elapse before the limb can be used ; and even then, caution should be taken that the newly-formed ligament be not broken. The patella of the opposite side is liable to fracture ; for it possesses the same structure which predisposed to fracture in the other limb, and there is increased muscular exertion of the sound limb.

Page 50, line 10, read, for *leave, have*.



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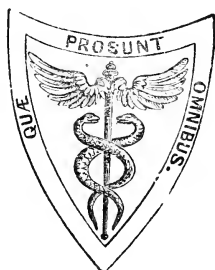
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PHILADELPHIA:  
LEA & BLANCHARD.

1848.

Entered, according to Act of Congress, in the year 1848,  
BY LEA & BLANCHARD,  
In the Clerk's Office of the District Court for the Eastern District of  
Pennsylvania.

C. SHERMAN, PRINTER,  
19 St. James Street.

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# OBSTETRICS.

## OF THE BONES OF THE PELVIS.

THE pelvis is an irregular bony cavity, situated at the base of the spinal column, and above the inferior extremities, with which it is connected by muscles and articulations, and for which, as well as for the muscles of the trunk, it constitutes "a point d'appui."

When divested of its soft structures, this organ somewhat resembles a basin, and hence its name; for the Greeks called it *πελυξ*, a wooden utensil of bowl-form; the Latins from them derived the word *pelvis*, which is the term generally adopted by English and American writers. The French call it *le bassin*, the Italians *el bacino*, all which words have the same signification.

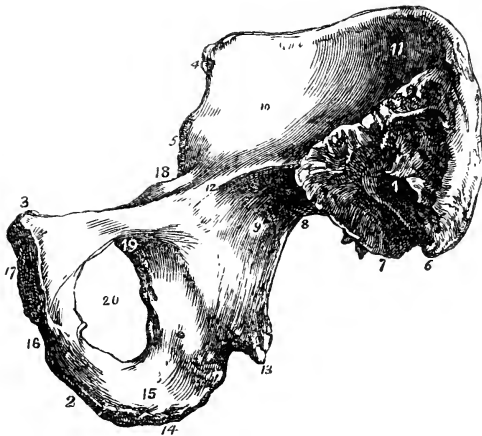
In the adult, the pelvis consists of four parts, viz.: two *ossa innominata*, the *os sacrum*, and the *os coccygis*, but in early life they are more minutely divisible.

Each *os innominatum* at an early period of intra-uterine life consists of cartilage only. Subsequently bony depositions take place, which at birth have coalesced so as to form three bones separated by cartilage. The process of ossification continues till these three bones meet in the acetabulum, two-fifths of which are formed by the ilium, two-fifths by the ischium, and one-fifth by the pubis.

The breadth of each *os innominatum*, from the *anterior superior spinous process* to the *posterior superior spinous process* is six inches, and the height, from the *tuber ischii* to the *crest of the ilium*, is seven inches.

*Os ilium*, *hip*, or *haunch bone* (Fig. 1), is the largest of the three divisions of the *os innominatum*, and is uppermost in position. It has an *outer* and an *inner* surface; the *outer*<sup>(1)</sup> is called *dorsum*, and is irregularly convex, and marked by eminences and depressions affording attachments for the *glutæi* muscles. The *inner*<sup>(10)</sup> is concave and smooth, and is called *venter*; it is occupied by the *iliacus internus* muscle. The *lower* portion, the *base*, or *body*,<sup>(6)</sup> is the thickest part of the bone, and enters largely into the composition of the acetabulum, a cavity for the reception of the head of the femur. Just above the base, the bone narrows into a kind of neck, from which springs the *ala* or *wing*. The *ala* terminates superiorly in a ridge running along its whole extent, called the *crista ilii*, or crest of the

Fig. 1.



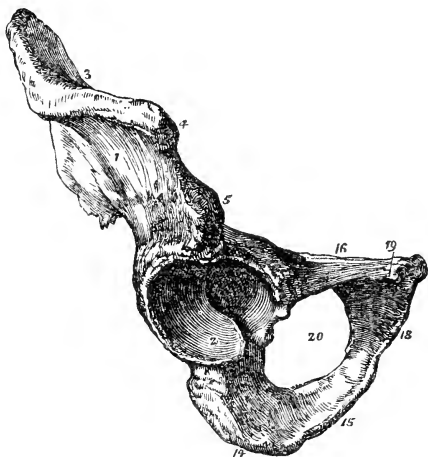
ilium. To different parts of the *crest* are attached the oblique and transverse abdominal muscles, the latissimus dorsi, the erector spinæ, and the quadratus lumborum. It terminates *anteriorly*, in the *anterior superior spinous process*, and *anterior inferior spinous process*,<sup>(4,5)</sup> and posteriorly in the *posterior superior* and *inferior spinous processes*.<sup>(6,7)</sup> The *anterior superior spinous process* gives attachment to one end of *Poupart's* or *Gimbernat's* ligament, the *tensor vaginæ femoris*, and the *sartorius muscles*. From the anterior inferior arises the longer portion of the rectus femoris. Into the *posterior* are inserted strong ligaments, which bind this bone very firmly to the sacrum. Below the posterior inferior spinous process there is a deep arch, the *sciatic notch*, which is divided by ligaments into the two *sciatic foramina*; through the *upper*, which is the larger, pass the gluteal, sciatic, and pudic arteries, the sciatic and pudic nerves, and the pyriform muscle; through the *inferior*, the pudic arteries and nerve re-enter the pelvis, and the obturator internus muscle passes out. The posterior part of the crest is very rough, and marks the connexion between the ilium and sacrum, called the *sacro-iliac symphysis*, of which there is one on each side of the sacrum. The body of the bone is divided from the ala internally by a ridge running horizontally,<sup>(12)</sup> forming a portion of the *pelvic brim*, *linea innominata*, or *linea ilio-pectinea*. The ilium is connected with the ischium and pubis in the acetabulum, and posteriorly with the sacrum.

*Os ischium*, is the second in size, and lowest in position of the divisions of the innominatum. It is noted for a *base* or *body*, a *spinous process*, its *tuberosity*, and *ascending ramus*. The base, or body, (Fig. 2,<sup>2</sup>) forms the inferior portion of the acetabulum, and is the thickest



part. Below this is a narrowed portion called the *neck*; from this a pyramidal process juts out called the *spine*, or *spinous process*, affording attachment to part of the *sacro-sciatic* ligament. It varies in length and direction, and is at times of importance obstetrically. In its descent from the neck, the bone bulges out into a protuberance called *tuber ischii*,<sup>(14)</sup> and turning upwards at an acute angle, becomes the *ascending ramus* of the *ischium*.<sup>(15)</sup> The internal surface of this bone is smooth and even, and

Fig. 2.



forms one of the *inclined planes* of the pelvic cavity; the external is rough, and gives attachment to the *sacro-sciatic* ligament, and several muscles. The ischium is connected with the ilium and pubes in the acetabulum, and articulated with the sacrum by ligaments.

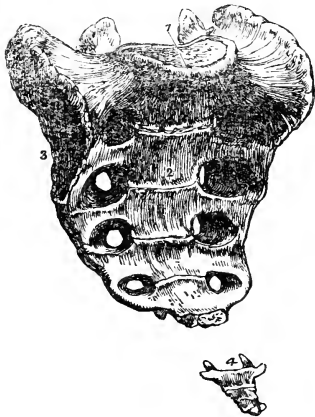
*Os pubis*, is the smallest and most anterior of the three divisions. It has a *base* or *body*, two rami, a *horizontal* and a *descending*, a *spinous process*, and a *symphysis*. Its *base* is the thickest part, and forms the *anterior* and *smaller portion* of the acetabulum, beyond which the bone narrows, and proceeding forwards forms the *horizontal ramus* (Fig. 2<sup>16</sup>). This terminates in a wider sheet, and its edge, the point of junction with its fellow bone, is called the *symphysis pubis* (Fig. 1<sup>17</sup>). From the inferior part of the symphysis, the *descending ramus* (Fig. 2<sup>18</sup>) proceeds downwards to meet the ascending ramus of the ischium, and with it forms one side of the *arch of the pubis*. On the interior, running along the upper margin of the horizontal ramus, is a ridge, which is part of the *linea ilio-pectinea*, and at its pubic extremity is a small spinous process, affording an attachment to the pubic end of *Poupart's ligament*, and near it to the *pectineus*; whilst the inner and outer edges of this portion of bone afford insertions to the abdominal muscles. The os pubis is connected with the ilium and ischium in the acetabulum, with the ascending ramus of the ischium, and with its fellow, by the symphysis. In the *anterior part* of the os innominatum is seen the *obturator foramen*,<sup>(20)</sup> formed by the ischium and pubis, which is nearly filled in the recent state by the obturator ligament; through the hole at the superior part pass the obturator vessels and nerve. The object

attained by this arrangement is lightness of structure where strength is not needed.

Of the three bones, the ilium forms part of the brim of the pelvis but none of the outlet; the ischium part of the outlet, but none of the brim; whilst the pubis forms part of both brim and outlet.

*Os sacrum* terminates the vertebral column; in form it is triangular with the apex of the pyramid downwards, and rather backwards. It is the lightest bone in the body when its size is considered, and is spongy in structure. It has *four* surfaces, an external and internal, and two lateral, is about four and a half inches in length, four inches in width, and its greatest thickness is about two and a half inches. The *external surface* is convex and rough, and has three or four processes like those of the vertebræ, which may be called *the spinous processes of the sacrum*; anterior to these we find a hollow cavity for the reception of the *cauda equina*, with four holes on each side,

Fig. 3.



which communicate with the cavity for the transmission of nerves. The *internal surface* (Fig. 3<sup>2</sup>) is smooth and concave to the depth of half an inch, and crossed by four transverse white lines, which mark the former division of its bones by cartilage. There are also four pairs of holes on this surface, which transmit nervous filaments, which afterwards form part of the great sciatic nerve. The upper edge of this bone completes the brim of the pelvis, and from the projection of the central part it is called the *promontory of the sacrum*.<sup>(1)</sup> The *lateral surfaces*<sup>(3)</sup> are rough and uneven, the irregularities corresponding with those on the ilium

and forming with them the *sacro-iliac symphysis*.

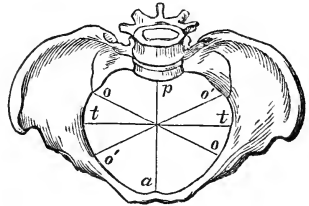
*Os coccygis*, is attached to the apex of the sacrum, and is so named from its resemblance to the beak of a cuckoo.<sup>(4)</sup> It is composed of three or four pieces, which play upon each other by separate joints, and is of much importance in obstetrical study. The small sciatic ligament and the ischio-coccygeal muscles are inserted into it.

*Dimensions of the pelvis*.—The pelvis is divided into the true and false; the upper and the lower; and the greater and the lesser, by the *linea ilio-pectinea*, all above that line being the upper, the greater, or false pelvis, all below receiving the other denominations. The *lower* or *true pelvis* is of most importance to obstetricians, and is divided into *brim*, *cavity* or *excavation*, and *outlet*.

The *brim* is defined by the *linea ilio-pectinea*, and is shaped like

the heart on a playing card. It has *three diameters*, an *antero-posterior*, called also, *straight* or *conjugate*, from the promontory of the sacrum to the inner edge of the symphysis pubis, which measures about four inches. (Fig. 4, *a. p.*) The *transverse*, across the widest part of the brim, and at right angles to the antero-posterior, is about five inches and a quarter. (*t t*) The *oblique*, from the *sacro-iliac junction* on either side to the opposite side of the brim above the acetabulum, five inches. (*o o*)—These measurements are of course less in the living body in consequence of the presence of the soft structures. The circumference of the brim is about thirteen inches.

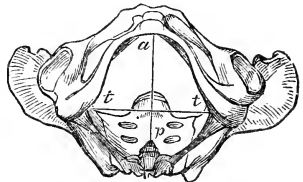
Fig. 4.



The *cavity* or *excavation* is the space included between the *brim* and the *outlet*. It is an inch and a half deep in front, three and a half at the side, and from five to six inches from the sacral promontory to the tip of the coccyx. The brim of the pelvis is also called the *superior strait*.

The *outlet* is of an irregularly oval shape, and its diameters are the reverse of those of the superior strait; thus, the antero-posterior diameter, from the arch of the pubes to the tip of the coccyx is four to four and a half inches. (Fig. 5, *a. p.*) The transverse, from one tuberosity to the other, is four inches. (*t t*) The outlet is bounded by the tip of the coccyx at the back, by the lower edge of the under fasciculus of the sacro-sciatic ligaments posteriorly and laterally, by the tubera ischii at the sides, by the rami of the ischia and pubes anteriorly and laterally, and by the symphysis pubis in front. Its circumference is about twelve inches, and it is also called the *inferior strait*.

Fig. 5.



The *planes of the straits*.—If a piece of card or paper be cut so as to fit within the *linea ilio-pectinea*, it will represent the *plane* of the *superior strait*. Now hold the pelvis in the position it occupies when the individual is either sitting or standing, and it will be found that the plane of the strait has an inclination of about thirty-five degrees, which may be increased or diminished at will by extending or flexing the lumbar vertebræ. The plane of the *inferior strait* may also be described in the same way, viz. : by fitting a card into it. It will be found that they incline towards each other anteriorly, and would meet, if produced, about one and a half inches in front of the pubes. The whole position of the pelvis in regard to the trunk of the body is *oblique*, so that a line drawn through the trunk in the direction of its axis

would, in falling downwards, strike on the centre of the symphysis pubis.

*The inclined planes of the pelvis.*—These are four in number, an *anterior* and a *posterior* on the right side, and an *anterior* and *posterior* on the left side. To demonstrate them, let two vertical cuts be made through the lesser pelvis and at right angles to each other. The first should be made through the symphysis pubis, and the median line of the sacrum and coccyx, and the second, or transverse, should commence behind the tuberosity of the ischium on either side and run upwards perpendicularly through the apex of the spine of the ischium, up to the *linea ilio-pectinea*. By these two vertical cuts there will be an *anterior* and *posterior* inclined plane demonstrated on each side of the pelvis, of which the anterior will be the longer.

*Axes of the pelvis.*—There are two axes of the pelvis, one of the brim or superior strait, which is a line drawn perpendicular to the *plane* of that strait, and, if produced, would extend from the coccyx to a little above the umbilicus; the other, of the *outlet* or *inferior strait*, which is a line drawn perpendicular to the plane of that strait, and, if produced, would extend from the promontory of the sacrum to the central space between the tubera ischii. The axes of the upper and lower straits of the pelvis form an obtuse angle with each other. By combining these axes with the inclination of the pelvis we can obtain a correct notion of the *direction* of the *canal* of the *pelvis*, which, it will be readily seen, is curved. By having a correct knowledge of the axes of the trunk and pelvic entrance, the obstetrician is enabled to place his patient in the position most favourable to the ready descent of the child's head through the brim into the excavation.

#### OF THE FŒTAL HEAD.

The head is of an oval shape, and largest at its occipital extremity; so that in vertex presentations the largest end necessarily descends first, and its smallest circumference, which is about ten and a half inches, will be nearly parallel to the successive planes of the canal. It is the largest part of the child, and its lateral and superior parietes are most compressible. The bones of the head which require our study are the two *parietal*, the *frontal*, which is divided into two, the *occipital*, and the two *temporal*, for a minute description of which, see the division on *Anatomy*. The bones of the child's head are not dove-tailed into each other as we find them in the adult, but are separated to some extent by intervening lines and spaces of membranous formation; the lines are called *sutures*, the spaces *fontanelles*; from their having been supposed to distil a moisture, they are also called *bregmata*, from βρέχω, to moisten. The sutures are the *coronal*, *sagittal*, *lambdoidal*, and *squamous*. At the two extremities of the sagittal suture are the two fontanelles, the *anterior* and *posterior*, named from their position. The anterior is the larger, and is

of a quadrangular shape ; it is formed by the rounding off of the four corners of the two frontal and the two parietal bones. The posterior is triangular, and formed by the union of three bones, the superior posterior angles of the two parietal, and the upper angle of the occipital. A knowledge of these fontanelles is of great importance in the practice of midwifery, as they are the chief means of diagnosticating the position of the child's head in labour. The great advantage gained from this arrangement of the child's head, is that it allows a more uniform growth and development to the brain than could have taken place had the cranium been solid, and what is perhaps of greater importance, it allows the bones to overlap, and thus permits a certain amount of compression, which enables the head to be pushed through a smaller space than if it had been formed of one continuous piece.

The dimensions of the foetal head have been variously stated by obstetrical writers, each basing his report upon the result of his own observations. The following table, modified from Churchill's, is the best average.

The longitudinal or occipito-frontal diameter, Fig. 6, (1 <sup>2</sup> ) is from . . . . .	4 in. to 4½ in.
The transverse or bi-parietal, from one parietal boss to the opposite, . . . . .	3½ to 4
The occipito-mental, or oblique, (3 <sup>4</sup> ) . . . . .	5 to 5½
The cervico-bregmatic, (5 <sup>6</sup> ) . . . . .	3½ to 4
The trachelo-bregmatic, . . . . .	3½ to 4
The inter-auricular, . . . . .	3
The bi malar, . . . . .	3
The fronto-mental, (7 <sup>8</sup> ) . . . . .	3 to 3½
The transverse diameter of the shoulders, . . . . .	4 to 5 reducible to 3
“ “ “ “ hips, . . . . .	4 to 5

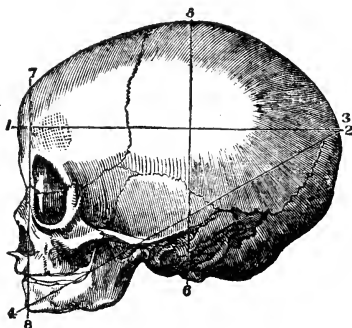
In general, it may be observed that all the measurements are larger in the male than in female children.

*Regions of the head.—Vertex.*

A circle of an inch in radius around the posterior fontanelle as a centre. *Top of the head.*

—Sometimes called the bregmatic region ; besides which the terms *lateral*, *chin*, *face*, *forehead*, *base*, are used to define different regions of the head which may present. By the *base* is understood all the immovable parts of it, viz. : the sphenoid in the centre, the temporal bones laterally, together with the bones of the face.

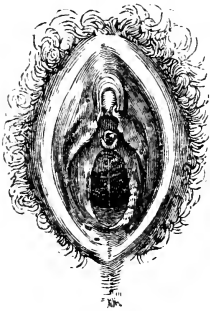
Fig. 6.



## OF THE ORGANS OF GENERATION.

These are generally divided into the *external* and *internal*. The external consist of the *mons veneris*, *labia externa*, *perineum*, *clitoris*, *nymphæ*, *vestibule*, *meatus urinarius*, *hymen* in virgins, and *caruncula myrtiformes* in matrons. The internal are the *vagina*, *uterus*,

Fig. 7.



and *uterine appendages*, which latter are the *broad ligaments*, *round ligaments*, *two ovaries*, and *two Fallopian tubes*.

The *mons veneris* (Fig. 7) is placed at the lower part of the abdomen, and upper part of *symphysis pubis*; it consists of dense fibro-cellular, and adipous tissue, and is covered, in the adult, with hair, among the roots of which are numerous sebaceous follicles.

The *labia externa* are two folds of skin and mucous membrane, which commence in front of the symphysis pubis, and extend downwards and backwards to the perineum, where they again meet. The superior junction is called the *anterior commissure* of the vulva, the posterior, is called the *posterior commissure*. Their texture is principally *cellular* and *vascular*, and their use is to protect the organs situated between them. The *perineum* extends from the lower union of the labia externa backwards towards the anus. It is composed principally of highly distensible cellular tissue, but does not possess a great deal of fat, and the skin is very scantily supplied with hair; it is somewhat triangular in shape, and its medium breadth in women who have not borne children is from an inch to an inch and a half, being narrower, of course, in women who have. It is capable of great distension.

The *nymphæ*, *labia interna* vel *minora*, arise from nearly the same point, at the anterior commissure, and run downwards and backwards about an inch, to the middle of the orifice of the vagina, where they are lost in the general lining of the labia externa. They are covered with mucous membrane, and consist of cellular and erectile vascular tissue, and do not disappear during the distension of the external parts by the escape of the child's head.

The *clitoris* is seated just below the point of junction of the nymphæ, and is the analogue of the male penis, excepting that it has no corpus spongiosum, and no urethra; it is erectile, and extremely sensitive.

The *vestibule* is a triangular space, bounded superiorly by the clitoris, and laterally by the nymphæ, it is covered by smooth mucous membrane, and at its lower portion we find the orifice of the urethra, easily recognised by its soft, prominent, circular rim.

The *urethra* is about an inch and a half long, dilatable, and extends from before backwards and upwards, running under and behind the symphysis pubis.

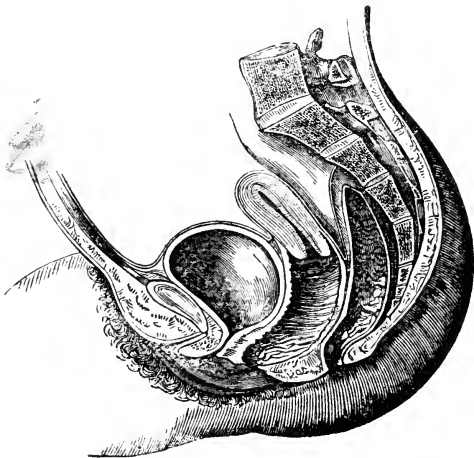
The *hymen* is a fold of mucous membrane, generally of a crescentic shape, with its concavity upwards, which is found just within the orifice of the vagina; it is generally ruptured at the first sexual intercourse, and its remains constitute what are known as the *caruncule myrtiformes*. The space between the hymen and the fourchette is called the *fossa navicularis*.

The *external organs* in the aggregate are often spoken of under the name *puendum*.

#### THE INTERNAL ORGANS.

The *vagina* is a musculo-membranous canal, extending from its origin in the vulva obliquely through the cavity of the pelvis to the uterus, in its progress describing a curve, which is greater even than that of the sacrum and coccyx, having the neck of the bladder, the urethra, and the symphysis pubis anteriorly, and the rectum posteriorly. It is about four or five inches long, and three in circumference, being shorter and more capacious in those who have borne children. It has three coats, an external cellular, a middle muscular, and internal mucous. It is well supplied with blood-vessels, which are much multiplied and interlaced at its anterior extremity, constituting what is known as the *plexus retiformis*. Its mucous membrane is of a pink colour, and is arranged in transverse rugæ anteriorly and posteriorly, which allow great distension of the vagina. Its orifice

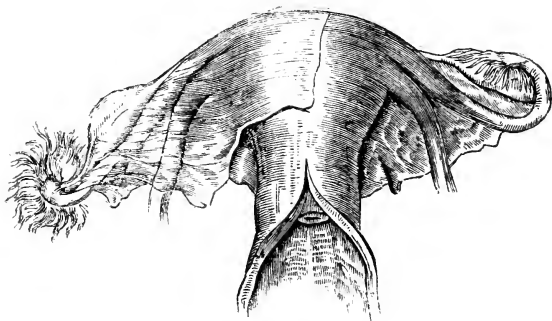
Fig. 8.



is surrounded by a collection of muscular fibres, called the *sphincter vaginae*. At its superior and posterior portion, it receives a reflection of peritoneum. (Fig. 8.)

The *uterus* is placed at the upper part of the vagina, and hangs in the centre of the pelvis behind the bladder, and before the rectum with its long diameter parallel to the axis of the superior strait, and its superior edge a little above the brim of the pelvis. As the axis of the vagina is nearly parallel with that of the inferior strait, it meets the axis of the uterus at an obtuse angle; any deviation from which, implies a displacement of the womb. It is a hollow pear-shaped body, rounder posteriorly than anteriorly, about  $2\frac{1}{2}$  to 3 inches long, 2 inches wide, and very nearly an inch thick. Anatomists divide it into fundus, body and neck. The fundus is that portion above the Fallopian tubes, the cervix is the inferior, cylindrical portion, and the body is that part between the fundus and cervix. (Fig. 9.)

Fig. 9.



The uterus has three coats, a serous, a muscular, and a mucous. It is covered anteriorly and posteriorly by peritoneum, which is reflected laterally to the sides of the pelvis, near the sacro-iliac symphysis, forming the *broad ligaments*, which serve to steady the uterus. The *middle coat* of the uterus is muscular, and classed among those muscles which are called *non-striated*, and which are also found in the middle coats of the arteries. There are three sets of fibres, circular, longitudinal, and oblique, which, by their contraction, tend to diminish the cavity and expel the contents of the uterus. The amount of muscular fibres is much increased during pregnancy. The *internal coat* is generally considered to be a mucous membrane, though there are some obstetrical physiologists who deny it. It extends down into the cervix, whence it is continuous with that of the vagina; it also lines the Fallopian tubes. Its colour is a pale pink except during menstruation. The uterus is supplied with blood by the spermatic and uterine arteries, and with *nerves* from the *aortic*



*plexus*, and from the *hypogastric nerves* and *plexus*, being a mixture of sacral sympathetic nerves. The *cavity* of the uterus is triangular, its base being directed upwards, and the superior angle corresponding to the points where the Fallopian tubes enter it; in size it is about equal to a split almond, and the internal walls are nearly always in contact. Its inferior angle communicates with the vagina through the canal of the cervix, which is barrel-shaped, and from half to three quarters of an inch long. The contraction at the upper extremity of the canal is called the *internal os uteri*, whilst that at the lower extremity is called the *os uteri* or *os tinæ*; the latter name from its supposed resemblance to the mouth of the tench. The *shape* of the *os uteri* varies, in some being transverse, and in others circular, or ragged; the latter especially in women who have borne children. In the mucous membrane of the cervix are found the *glandulæ Nabothi*.

The *broad ligaments* of the uterus are two duplicatures of peritoneum, one on either side, extending from the sides of the uterus to the ilia, in the line which divides the anterior from the posterior inclined planes of the pelvis; they act as *stays* to the uterus, and contain the *Fallopian tubes*, which run along their upper margin, and the *ovaries*, which are enclosed in a posterior fold.

The *Fallopian tubes* are two cylindrical canals, about four inches long, which arise from the superior angles of the uterus. They open *obliquely* into the uterus, at which point the canal narrows; it afterwards expands, and again contracts at the point where it opens into the abdomen. In the unimpregnated state it is about the size of a bristle. Externally they are equally thick throughout, except at their terminal extremity, where they expand into a trumpet-shaped enlargement, called *fimbria*, or *morsus diaboli*, which applies itself to the ovary. They have three coats, an *internal mucous*, a *middle muscular*, and an *external serous*, or *peritoneal*, and they are looked upon as the excretory ducts of the ovaries.

The *ovaries* are two in number, and are the analogues of the male testis. They are situated on the posterior face of the broad ligaments, and are attached to the uterus by a ligament of their own, called the *ligamentum ovarii*. They are oval in shape, and have two coats, an external peritoneal, and an internal, the *tunica albuginea*. On removing these we come to the proper tissue of the ovary, called its *stroma*, which consists of dense cellular tissue, containing within its meshes or areolæ, numerous little vesicles, named *Graafian vesicles*. These vary in number and size, the largest being generally seen near the surface of the ovary; they are found early in life, but are more developed about the period of puberty.

The Graafian vesicle has two coats, an *external*, the *tunic of the ovisac*, and *internal*, the *ovisac*, (Barry.) Within the cavity formed by these membranes is found, floating in an albuminous fluid, the *ovum* or *egg*, which is exceedingly small, and resembles in all its

details the egg of the chick. The ovum also contains within its capsule or membrane, which is called the yelk membrane, a granular fluid termed the *yelk*, and in the centre of the yelk a little vesicle, the *germinal vesicle*, and on the walls of the germinal vesicle its nucleus is seen, named the *macula germinativa*, or germinal spot. As each Graafian vesicle rises to the surface of the ovary it bursts, and allows the contained ovum to escape, which is seized by the fimbriæ of the Fallopian tube, and transmitted to the uterus. The cavity of the Graafian vesicle, (which still remains in the ovary,) becomes filled up either with a clot of blood, or a new deposit, which, assuming a yellow colour, is called from that circumstance, *corpus luteum*, or *yellow body*. There is no correspondence between the number of corpora lutea found in the ovaries of a woman, and the number of children she may have borne, as ova are being constantly discharged irrespective of fecundation, hence the corpus luteum is no evidence of previously existing pregnancy.

#### MENSTRUATION AND ITS DISEASES.

By the term *menstruation*, is understood that function in the female economy by which a certain amount of sanguineous fluid is eliminated by the uterus, and discharged from the vagina every month. This discharge, from its occurring at this regular interval, is called the *menses*, or *catamenia*, and the female in whom it so takes place is said to be *regular*.

This function generally commences at the age of puberty, which in this country is about fourteen or fifteen, and lasts till about forty-five, when it disappears; to this latter period is often applied the terms, *critical period*, *change of life*, &c. During the whole of a woman's menstrual life she is capable of conceiving; after this, her reproductive function ceases. The approach of puberty is announced by other changes than those mentioned. The mammæ are developed, the form becomes rounded, the pelvis expands, and the pudendum is covered with a growth of hair. The flow generally returns every twenty-eight days, and lasts from four to six, and the amount discharged varies from four to eight ounces, though about this there is no certainty, as every woman is a law to herself; what would be a profuse discharge in some, is merely normal in others. The first menstrual flow is generally preceded by languor, lassitude, pain in the back, headache, chilliness, &c., which generally disappear when the discharge takes place. The after occurrences are often unaccompanied by any premonitory or attendant symptoms. The theories that have been brought forward to explain the efficient cause of menstruation are too numerous, and too unsatisfactory to detain us here. The most popular is that which looks upon the maturation and escape of ova as the efficient agent. It is said that every twenty-eight days a Graafian vesicle rises to the surface of the ovary, and

during its development and enlargement puts the tunica albuginea and peritoneal coat upon the stretch, and thus becomes a source of irritation; in consequence of which there is an afflux of blood to the parts (that is, to the ovaries, tubes, and uterus), which is discharged into the latter organ; the vesicle finally ruptures, the irritation is removed, and the flow ceases. This view is supported by Drs. Lee, Gendin, Negrier, Pouchet, Raciborski, and others; but is denied by Dr. Ritchie and others, who contend that ova may be discharged without menstruation, and the reverse, that the maturation of ova is an *effect*, and not a *cause*; but the whole is yet in a transition state. That the ovaries *are* concerned seems proved by the fact, that in their absence there is no menstrual flow. The blood that is discharged in menstruation is considered by Mad. Boivin to be identical with venous blood, and the opinion is adopted by Prof. Meigs and M. Dugés. Although there are many, and the larger number, who look upon it as altered blood, and deficient in fibrin, the first opinion would seem to be supported by the microscopic investigations of M. Donné and others.

The uterus is congested during menstruation, so are the Fallopian tubes and ovaries; the vagina is relaxed and distensible, and the os uteri is soft, pulpy, and swollen. All of which conditions disappear when the flow ceases, and the parts return to the normal condition.

*Amenorrhœa*.—By this term is understood an absence of the menstrual flow. There are two varieties: *emansio mensium*, when they have never appeared; and *suppressio mensium*, when, having once appeared, they have been arrested from any cause. The first may depend upon several causes, viz.: congenital malformation, as absence of the ovaries, uterus, or vagina, closure of the cervix, imperforate hymen, &c.; or, it may be dependent upon the health or habits of the patient. The diagnosis is not always easy; if malformation be suspected, recourse must be had to a per vaginam examination, and the defect, if possible, relieved by an operation. If the retention be dependent on constitutional causes, remove them. If the patient is of a full habit, venesection, mild diet, hip-baths, &c. When the reverse obtains, an opposite plan of treatment must be followed; tonics, as iron and its preparations, a generous diet, exercise, warm clothing, hip and foot baths, always bearing in mind that the woman is not *sick* because she does not menstruate, but that she does not menstruate because she *is* sick, or in other words that amenorrhœa may be merely a symptom of deranged health.

*Suppressio mensium*, occurs also in two forms: *Acute*, when the discharge is arrested during the flow; as, by cold, emotions, &c.; and *chronic*, where it occurs in consequence of the acute, or from gradual failing of the health, disease of ovaries, and critical period, &c. The most important point in the early treatment is not to confound the disease with pregnancy. In the *acute form*, if there

is much constitutional disturbance, venesection, or cups to the loins, laxatives, baths, and opium to relieve pains. In the *chronic form*, if possible, remove the cause: *tonics*, *aloetics*, and the means above mentioned; there being but few direct emmenagogues.

*Dysmenorrhœa*.—*Painful or difficult menstruation*.—This may be dependent on a faulty condition of the system, upon neuralgia of the uterus, or an inflammatory state of that organ, or it may depend on mechanical constriction of the cervix. The discharge is often scanty, accompanied with great pain in the back, loins, fever, &c. and often with the elimination of membranous or shreddy coagula. The *treatment* during the paroxysm is antiphlogistic, as cups to the loins, revellents, baths, anodyne enemata. In the interval, tonics, if debilitated; alteratives, if inflammatory; and dilatation by the bougie, as recommended by Dr. Mackintosh, if there be stricture of the cervix. Females afflicted with this disease rarely conceive.

*Menorrhagia*, is an increase of the menstrual flow either in frequency or in quantity, and it may be either active or passive, the former occurring in robust plethoric habits, the latter in the reverse. The most common causes are nervous and vascular excitements, fevers, internal congestions, displacements of the uterus, and approach of the critical period, &c. It may be confounded with the hemorrhage arising from abortion, foreign growths, &c., within the uterus. The *treatment* varies; in persons of a full habit venesection may be necessary, rest, revulsives, saline laxatives, astringents, &c. In the interval, moderate diet, cold baths, &c. In debilitated cases, rest, tonics and astringents, and opium, good diet, &c. When the hemorrhage occurs about the critical period, it often resists the ordinary treatment. Under such circumstances, the *ergot of rye* often answers a good purpose. It may be given in doses of from 5 to 10 grs. twice or thrice a day. All stimulating and hot drinks should be avoided, and the patient kept in a horizontal position on a hard mattress. As soon as the discharge is entirely arrested, a blister should be applied to the sacrum, and kept open, and vaginal injections of cold water, or of a solution of acetate of lead, or other astringents, used two or three times a day. In taking the injections, the patient should assume the horizontal position, and endeavour to retain the fluid for a short time. If displacements exist, rectify them, avoid sexual excitement of all kinds, warm clothing, frictions, &c.

*Vicarious menstruation*.—Seems a provision to obviate the ill effects of suppressed menstruation, by substituting a similar discharge from some other part. It occurs from various parts of the body, sometimes from the gums, nostrils, eyes, lungs, anus, stomach, or even from an amputated stump. The fluid sometimes resembles ordinary blood, at others, it has the characters of the catamenial fluid. It may occur at any time, and in any constitution. It is not, however, usually attended by any serious consequences.

*Treatment.*—After once occurring, the patient should be watched, and the system relieved by some other means; venesection, astringents, sedatives, mineral acids, and if debilitated, tonics may be used.

*Leucorrhœa.*—An excessive and altered secretion of the mucus furnished by the membranes lining the vagina and uterus, by the follicles of the interior of the cervix uteri, and by the lacunæ of the vestibulum; generally white, or nearly colourless and transparent, sometimes yellow, or green, or slightly sanguineous, and of varying degrees of consistency. The amount of constitutional derangement depending on the severity of the affection, and the susceptibility of the patient (*Ashwell*).

The seat of the discharge may be diagnosticated by examining its characters. If it be of a jelly-like consistence, resembling partly coagulated albumen, and taking place at intervals, and in small quantities at a time, it probably comes from the muciparous follicles of the neck of the uterus.

If, on the contrary, it be of a whey-like or creamy consistence, and varying in colour from white to green, or brown, it probably comes from the mucous membrane of the vagina. In such cases the mucous membrane is commonly found studded over with red points, the inflamed orifices of mucous follicles.

There is sometimes an offensive sanious ichor discharged, whose origin is probably in the cavity of the uterus, or the Fallopian tubes themselves.

Acute vaginal leucorrhœa is accompanied by a sense of weight, heat and soreness in the vagina, tenesmus, irritation of the bladder, pain in the lower belly and thighs, &c. The discharge, at first thin and acid, becomes whitish, or yellowish, and more consistent. The occurrence of the discharge generally relieves the urgent symptoms.

*Treatment.*—If the patient be plethoric, bleeding should be practised, either general or local. Fomentations, rest, spare diet, and vaginal injections should also be used.

*Chronic vaginal leucorrhœa* is one of the most frequent diseases during menstrual life; sometimes, however, it precedes the menses. By most writers it is considered as a local disorder, inflammatory in its nature. It is frequently caused by cold, excessive coition, parturition, pessaries, displacements, and irritating food. There is seldom any pain accompanying it. If the discharge be great, weakness and pain in the back and loins may ensue.

The *treatment* consists in the use of depletory measures if required. The removal of pessaries. Tonics if the patient be weak; opium if pain be present; and the use of the balsams and astringent injections.

The *uterine leucorrhœa*, which is also often accompanied by constitutional symptoms, requires the use of depletory measures at times, with the use of astringent injections, and tonics if the health be feeble,

particularly the preparations of iron. A solution of nitrate of silver, applied by means of a speculum to the interior of the cervix uteri, has succeeded when other means have failed. Should there be any suspicion of a syphilitic taint, the remedies proper in such cases should be used.

#### HYSTERALGIA, OR IRRITABLE UTERUS,

May be defined, a permanent and painful sensibility of the uterus, especially of its neck; often accompanied by increased frequency of pulse, a dry hot skin, and generally, in protracted cases, with gastric and renal derangement. The disease commonly occurs in the middle period of life, though it is sometimes met with in early youth.

The *local symptoms* are pain in the small of the back and sacrum, extending down the thigh to the knee, and around the brim of the pelvis to the lowest part of the abdomen. There are also sometimes erratic pains in the thorax and loins. The character of the pain is that of *soreness*, slight pressure relieves it, but it is aggravated by rough handling. Sometimes it is spasmodic, like those of abortion. Dewees describes the pain as often pulsating.

The pain is aggravated by excitement of any kind, by exercise, and sometimes by standing. Straining, either in defecation or urination, constipation, flatulence, and diarrhœa all aggravate it.

A per vaginam examination may prove the uterus to be either displaced or engorged, but not altered in form, size, or density; extremely painful to the touch, in the body as well as in the neck, the pain is "as if a knife had been plunged into it."

*Causes.*—Among the predisposing causes may be placed, education, fashionable life, prolonged lactation, and temperament. Among the exciting causes, bodily exertion during menstruation, astringent injections, abortions, prolapsus and sudden arrest of the menses from any cause.

*Diagnosis.*—From neuralgic dysmenorrhœa, by the constancy of the pain. From acute inflammation of the cervix, by the absence of heat, swelling and throbbing; by the absence of discharges, and by the slight change of the cervix compared with the amount of suffering.

*Pathology.*—Gooch considers it a permanently painful condition of the uterus, neither accompanied by, nor tending to produce change in its structure. Ashwell considers it a modified inflammation, or at least, closely allied to inflammation or congestion.

*Treatment.*—Two indications present themselves, viz.: 1. To mitigate local suffering; 2. To sustain and improve the general health. The first indication will be fulfilled by the use of anodynes, either by the mouth, rectum, or applied directly to the uterus itself; by the application of nitrate of silver, by dilating the cervix by

bougies, and by anointing the cervix with anodyne unguents, especially the unguent. aconiti. The second indication, by rest, exercise in a recumbent posture, or, if it suits best, on foot or horseback, tonics, nutritious food, cold bath, or the douche, and cheerful society. Scarifications to the neck of the uterus are highly recommended by Dr. Ashwell, especially if there be any congestion. The introduction of the pessary is often followed by marked relief, especially if there be any descent.

#### PROLAPSUS UTERI,

Signifies a sinking of the uterus nearly or quite down to the os externum; when it protrudes beyond the vulva it is called *procidencia uteri*. The position of the uterus has been already described. (Page 22.)

*Causes.*—Heaviness of the uterus itself; hence it often occurs in early pregnancy; congestion of the uterus; ovarian and other abdominal tumours; tympanitis; distention of the colon; relaxation of the ligaments, and too early “getting up” after labour; tight lacing; dancing, running, or any severe muscular exercise; leucorrhœa and other exhausting discharges, straining, coughing, &c.

*Symptoms.*—In some cases there is no suffering at all, or merely a sense of fulness. At others, there is pain in the back and groin, extending down the thighs to the knees or toes. The patient suffers great distress in standing or walking, and in voiding the urine and fœces. Strangury is sometimes present from the extension of the irritation to the bladder. Sometimes leucorrhœa is present, at others menorrhagia. The stomach and bowels sympathise; there is anorexia, loss of tone in both stomach and bowels, constipation or diarrhœa, and sometimes tympanitis. The patient often becomes morose and irritable. In *procidencia* the patient often suffers no other inconvenience than that arising from the external presence of the organ, or its acrid discharges.

*Diagnosis.*—In addition to the above symptoms, a per vaginam examination reveals the nature of the disease. The presence of the os uteri, at the lower part of the tumour, felt in the vagina, is almost infallible. From prolapsus of the bladder, rectum, or vagina, it may be distinguished by their greater softness and elasticity, and by the absence of the os uteri. *Procidencia* may be distinguished from partial inversion, by the presence of the os uteri at the lower portion of the tumour; by the absence of severe floodings, and by the smooth surface of the tumour.

*Treatment.*—Opinions differ much on this point. Nearly all agree as to the necessity of mechanical support in most cases. The difficulty is, *as to the mode*. In slight cases, rest in a horizontal position, with cold or astringent injections are often sufficient. In

prolapsus after confinement it is particularly necessary. Bandages, when they relieve, act by supporting the abdominal muscles, and those of the back, hence they may be useful in women who have borne many children, and in whom these muscles are much relaxed. They can never be regarded as *uterine supporters*. In decided prolapsus, and almost invariably in procidentia, mechanical support by means of *pessaries* becomes necessary. These differ in shape according to the end to be obtained, and the peculiar views of the practitioner using them. The mode of introduction is as follows: The patient being placed on her side or back, the long diameter of the instrument is to be placed in accordance with the long diameter of the lower outlet; then gently introduced by steady pressure. When fairly introduced it must be partially turned so as to place it transversely across the pelvis and above the tubera ischii. The globe pessary is more easily introduced and requires no turning. In procidentia the uterus should be first returned, and then retained by means of the pessary. In addition to these means the patient should use cold injections, or hip-baths, astringent injections, rest, for a season at least, tonics if her health be enfeebled, laxatives if the bowels are constipated, and astringents if diarrhœa be present. It has been proposed to cure the disease by cutting out part of the vagina, or to produce cicatrices by caustic, which, by their contraction, shall support the uterus.

#### GENERATION.

By this term is understood, *that function by which the species is reproduced*; and it is effected by the union of the two sexes. There are two principal theories of generation, viz.: that of *epigenesis*, in which each parent contributes a part to the development of the new being, and that of *evolution*, in which the mother supplies all the material necessary to the development of the new being, the male merely awakening the plastic powers resident in the female product. The popular belief is that each parent supplies material; the male, the seminal fluid; the female, the ovum; that a union of these two takes place, and from thence results the *tertium quid*, the new being. A great point of difficulty is, as to where this union takes place; some contending that it is in the ovaries, others, that it occurs in the uterus; the ovum having been previously discharged from the ovary, meeting the male sperm at that place. The only point that seems entirely settled, is the necessity of *actual contact*, mere *aura* not being sufficient to effect fecundation. The immediate effect of this contact, or of successful intercourse, is the production of great excitement and vascular turgescence of the uterus, ovaries, and Fallopian tubes, which lasts for some time. After fecundation has taken place, both ovum and uterus undergo changes, the ovum developing itself by its own plastic action upon the materials it derives from the



mother, at first by absorption through the villi of the chorion, and afterwards by the placenta, and the uterus increasing in size, and producing upon its interior face a membrane called the *caducous*, or *deciduous*, the formation of which has been variously explained. According to Dr. W. Hunter, the whole interior of the uterus becomes coated with a pulpy fluid, which covers over the cervix and Fallopian tubes; this becomes hard, and resembles coagulated lymph, and is called the *decidua vera*. As the ovum now descends the Fallopian tubes on its way to the uterus, it comes in contact with this membrane at the orifice of the Fallopian tubes, and pushes it before it, at the same time that it is reflected over itself, thus forming the *decidua reflexa*. According to Dr. Carpenter, this is not altogether the true account of it. It appears from the late researches of Dr. Sharpey and Professor Weber, that the decidua is really composed of the inner portion of the mucous membrane of the uterus itself, which undergoes a considerable change in its character. Dr. Reid has described a tubular structure on the free surface of the uterus, which becomes thickened and increased in vascularity within a short time after conception; and when the inner surface of a newly impregnated uterus is examined with a low magnifying power, the orifices of its tubes are very distinctly seen, being lined with a white epithelium.\* This is perhaps the more correct view, since the decidua reflexa is found to be different in its structure from that of the vera, which would not be, were they formed as described by Hunter. When an ovum has been thus fecundated, and brought to maturity in the uterus, before extrusion, it is called *viviparous generation*. This is the variety which occurs in the human female.

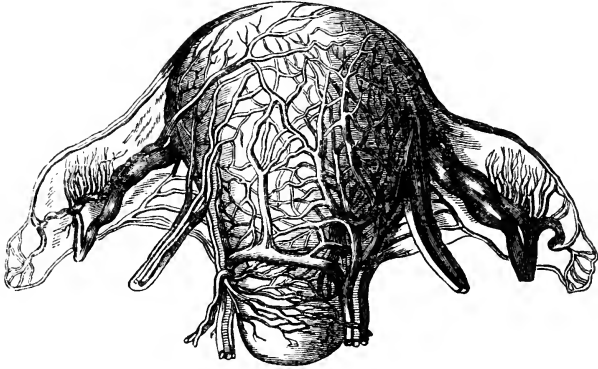
#### PREGNANCY, ITS PHENOMENA AND DISEASES.

Before entering upon the consideration of the signs by which a woman knows herself to be pregnant, it will be proper to examine what farther changes take place in the uterus itself. It has already been stated that the uterus becomes more vascular, after conception has taken place, and that its interior lining becomes altered; the vessels, arteries, veins, and lymphatics are increased in size, and it has been said by Dr. Robert Lee, that the nerves are also increased in numbers, although this latter change is doubted by many. The proper tissue of the uterus also undergoes great changes. In proportion as the ovum is developed, the fibres are separated from each other, and increased in number, leaving spaces between them which are filled by the enlarging vessels (Fig. 10). That the amount of substance is absolutely increased, is shown by the difference of weight between a virgin uterus, and one at full term, just emptied; the former weighing one ounce, the latter nearly twenty-four. The increase in

\* Human Physiology, Am. edition, p. 201-2.

the development of the womb is not uniform from the first, but commences at the fundus, gradually extending to the body, and last of all, about the fifth month, to the cervix. Up to the fourth month the uterus is generally retained entirely within the pelvis; shortly after

Fig. 10.



this, its fundus may be felt above the symphysis pubis in thin persons; about the fifth month it reaches midway between the pubes and umbilicus, gradually ascending till the eighth month, when it is as high as the ensiform cartilage. After this, although it increases in capacity, it no longer ascends; on the contrary it rather falls. Its capacity is also greatly increased; according to Levret's calculations, its superficies may be estimated at 339 inches, and its cavity will contain 408 inches; its length being from 12 to 14 inches, its breadth from 9 to 10, and its depth from front to rear, 8 to 9 inches. The weight of the whole organ and its contents, at full term, is about twelve pounds. The *form* of the gravid uterus differs also from that of the unimpregnated state, and this difference appears to depend in a great measure upon its increase in size, and the form of the cavities it occupies. In the non-gravid state, when it occupies the cavity of the pelvis, its anterior surface, corresponding to the bladder, is flattened, while its posterior aspect is convex. The reverse, however, obtains during the latter half of pregnancy. The anterior surface is now *convex*, being merely covered by the yielding anterior wall of the abdomen; whilst posteriorly the uterus is nearly concave, corresponding to the prominence of the lumbar vertebræ. This condition of things may be readily ascertained by examining the abdomen of a pregnant female in the last months of gestation, whilst she is lying down.

The situation and position of the uterus are also changed; in the

non-gravid state, the fundus inclines somewhat backwards, the os uteri being nearly in the centre of the pelvic cavity ; the gravid uterus, during the later half of pregnancy, has its fundus inclined forwards, and the os uteri directed backwards towards the upper part of the hollow of the sacrum.

*During the first month*, the changes are not very appreciable, the uterus is larger, softer, and more vascular, the *os* and *cervix* are soft, and cushiony, as during the menstrual period, and the transverse fissure is more *oval*.

*During the second month*, abdomen somewhat flat, cervix increased in size, and the os uteri can be felt lower than natural ; its shape also is changed, being round and smooth in primiparæ, while in multiparæ it is larger and irregular in shape. The canal of the cervix is closed by a gelatinous plug.

*During the third month*, slight protrusion of the abdomen, os uteri not so easily reached, and somewhat changed in position ; it is no longer in the middle of the pelvic cavity, but inclines towards the hollow of the sacrum, while the fundus approaches more nearly to the anterior parietes of the abdomen.

*During the fourth month*, the fundus may be discovered two or three inches above the symphysis pubis in thin persons by pressure, having first relaxed the abdominal parietes, and emptied the bladder and rectum.

*During the fifth month*, the cervix is drawn out by the expanding uterus and shortened, and the fundus may be felt half way between symphysis pubis and umbilicus.

*During the sixth month*, the cervix has lost very nearly one-half its length, the fundus is as high as the umbilicus, and the navel depression begins to disappear.

*During the seventh month*, the cervix is only half its original length ; the fundus rises a little above the umbilicus, which often becomes pointing. The head may also be felt per vaginam by *ballotement*, and the movements of the child detected through the abdominal walls.

*During the eighth month*, the cervix is not more than a quarter of an inch long, abdomen increased considerably in size, and the os uteri so high as scarcely to be reached. The fundus is about midway between umbilicus and scrobiculus cordis.

*During the ninth month*, the neck is obliterated, so that upon making an examination, we find the vagina closed superiorly by the rounded lower end of the uterus, and in primiparæ the fundus is at the scrobiculus cordis. During the last few weeks of pregnancy the fundus sinks a little, the abdomen falls, the os uteri appears only as a little dimple, and its edges are thin and membranous ; it occupies now the upper part of the hollow of the sacrum. In women who have borne many children the cervix does not entirely disappear.

## SIGNS OF PREGNANCY.

These are divided into the *rational* and *sensible*, the latter of which only can be depended upon, as the former may occur in abnormal conditions of the uterus, independent of pregnancy. The rational signs occur in the earlier months; the sensible or physical, after the ovum is somewhat developed. The diagnosis is at all times difficult in the early periods.

*Rational signs.*—Plethoric condition and fibrinous blood; variations in temper and taste; altered functions of stomach, bowels and kidneys; change in the colour of the skin; *cessation of the menses*, though not invariable, is one of the earliest signs; *morning sickness*, from the sympathy between the uterus and stomach; *salivation*, not to be confounded with mercurial ptyalism, from which it may be distinguished by the absence of sponginess of the gums, and the peculiar fetor; *enlarged and painful mammæ*, and in many cases a *darkened areola*, and enlargement of the follicles situated in it, with a soft and moist state of the integuments; *milk in the breasts*; this fluid is sometimes found in the breasts during the latter stages of gestation, but is not invariable, nor always to be depended on when present. *Quickening*; this sensation has been variously described, some authors say it is caused by the first movements of the child; others assert that it is caused by the sudden rise of the uterus from the pelvis into the abdominal cavity, producing fainting, sickness, &c. As a sign of pregnancy it is almost valueless, since females are very apt to be deceived in this respect by the movements of flatus in the bowels, by occasional spasmodic twitching of the abdominal muscles, &c.

*Kiesteine.*—During pregnancy a peculiar substance, analogous to caseine, is found in the urine, forming a thin pellicle upon its surface when it is allowed to stand, which emits an odour resembling cheese. It is not, however, peculiar to pregnancy, but may occur whenever the lacteal elements are not eliminated by the mammary glands. At the same time the probabilities are as 20 to 1, that the female is pregnant, if the kiesteine be present.

*Blue colour of the vagina*, has also been looked upon by M. Jacquemix, and M. Parent Duchatelet, as among the rational signs of pregnancy.

The *Sensible* or *physical* signs of *pregnancy*, are those by which the presence of a fœtus in utero are detected by an exploration of the organ itself.

*Enlargement of the abdomen*, begins to be perceptible about the end of the second month; before this the abdomen is often flatter than usual. “A ventre plat, enfant y’a.”

*Ballottement*, is practised thus: The patient should be in the *upright position*, or at least in a semi-recumbent posture; now let

the operator place the left hand upon the fundus uteri to steady it, and introduce the index finger of the right hand to the cervix uteri, then suddenly but gently jerking the finger upwards, he will feel a sensation as if something had receded from it, and then settled down upon it again. This test is most available about the fifth and sixth months. (Fig. 11.)

*Auscultation*, was applied to the detection of the presence of a *fœtus* in utero, first by M. Mayor, of Geneva. Three sounds have been heard by different observers, viz. : that of the *foetal* heart, that of the placental circulation, and that of the pulsation in the cord. The first of these is the most certain; the second may be imitated by the pressure of a tumour upon any great vessel, and the last can only be heard under very favourable circumstances, as where the cord lies between the child and the abdomen of the mother. The situation in which the *foetal* heart is most distinctly heard, is about the middle point between the *scrobiculus cordis* and *symphysis pubis*, generally to the left. The frequency of the pulsation is about double that of the adult, ranging from 120 to 140 per minute, and entirely independent of the maternal circulation. The sound resembles very much the ticking of a watch under a pillow. In *breech* presentations it is usually heard a little higher.

This is a most valuable diagnostic sign, and if once heard, unequivocally, the real nature of the case is established beyond doubt.

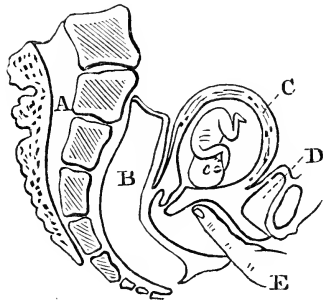
The *placental uterine souffle* may usually be detected by the stethoscope low on the sides of the abdomen after the fourth month; it is a peculiar blowing sound, corresponding to the pulse of the mother.

The *movements of the child* may frequently be detected by placing a cold hand on the abdomen of the mother, after the sixth month, but this is not a certain sign, as above stated, since it may be imitated by movements of flatus, &c.

The following *resumé* of the signs of pregnancy, is taken from the "Elements of the Principles and Practice of Midwifery," by Prof. Tucker :—

\* A, vertical section of sacrum; B, rectum; C, uterus and ovum; D, bladder; E, finger in the vagina with its extremity pressing up the uterus.

Fig. 11.\*



*During the First and Second Months.*

## RATIONAL SIGNS.

1. Suppression of the catamenial discharge.
2. Nausea, vomiting, ptyalism, anorexia, &c.
3. Unnatural flatness over the hypogastrium.
4. Tumefaction and tenderness of the mammæ.

## SENSIBLE SIGNS.

1. Increase in the size and weight of the uterus.
2. Slight prolapsus of the uterus.
3. Diminished mobility of the uterus.
4. The cervix uteri is directed towards the symphysis pubis.
5. The os uteri, round and regular in primiparæ, but in multiparæ, irregular in its circumference and more or less open.
6. Ramollissement of the mucous membrane, covering the cervix uteri. The fibres of the neck not yet softened.

*During the Third and Fourth Months.*

1. Suppression of the catamenia.
2. Continuance of nausea, vomiting, anorexia, ptyalism.
3. Slight prominence over hypogastrium.
4. Depression of the umbilicus.
5. Tumefaction of the breasts increased, with increase in the prominence of the nipple, and a slight discoloration of the areola.
6. Kiesteine in the urine.

1. The fundus uteri elevated rather above the pelvic brim, at the end of the third month. At the termination of the fourth month, it rises two inches above the pubis.
2. Fulness and dulness over the hypogastrium.
3. Existence of a small tumour in hypogastric region.
4. The direction of the long diameter of the uterus is now changed, so as to correspond with the axis of the pelvic brim. The os uteri is considerably elevated in the excavation.
5. Ramollissement of the inferior portion of the cervix is more marked; os uteri more open in the multiparæ, but still closed in those who have not borne children.

*During the Fifth and Sixth Months.*

1. Suppression of the catamenia.
2. Cessation of nausea, vomiting, &c., now usually takes place, though they may continue throughout pregnancy.
3. Increased prominence of the umbilical region.
4. The size of the abdominal tumour is increased, it is round, elastic, and if the abdominal walls be thin, the inequalities of the fœtus may be felt.
5. The umbilical region more full.
6. Discoloration of the areolæ more marked, with an enlargement of the subcutaneous glands.

1. At the end of the fifth month, the fundus uteri is within an inch of the umbilicus.
2. Movement of the fœtus is now active.
3. The bruit de souffle and the fœtal pulsations may now be distinguished.
4. Ballotement.
5. Between the cervix and the pubis a tumour may now be felt, either soft and fluctuating, or round and hard.
6. Ramollissement of one half of the cervix uteri.
7. In the primiparæ, the os uteri is still closed, but in the multiparæ, it is

## RATIONAL SIGNS.

7. Kiestine in the urine.

## SENSIBLE SIGNS.

sufficiently open to admit the half of the first phalangeal bone.

*During the Seventh and Eighth Months.*

1. Suppression of the catamenia.
2. Nausea, vomiting, &c. ordinarily absent.
3. Abdominal tumour much increased in size.
4. Pouting of the navel.
5. Increased discoloration of the areolæ, with enlargement of the sebaceous follicles, and increased prominence of the nipple.
6. The milk may now be pressed from the swollen mammæ.
7. Kiestine still exists in the urine.

1. Increase in the size of the abdomen.
2. The fundus uteri, at the end of the seventh month, has risen two and a half inches above the umbilicus: at the eighth, it is placed within the epigastric region.
3. Active movement of the fœtus.
4. The fœtal pulsations and the bruit de souffle still continue.
5. Ballotement perfectly felt during the seventh month, becomes obscure in the subsequent months of pregnancy, on account of the increase in the size of the fœtus.
6. The ramollissement of the cervix is more extensive, and at the end of the eighth month is nearly complete.
7. In the primiparæ, the cervix is ovoid and somewhat shortened; the os uteri is still closed.
8. In the multiparæ, the os uteri is wide enough open to admit the whole of the first phalangeal bone; the upper orifice is firmly closed.

*During the first half of the Ninth Month.*

1. Re-appearance of vomiting, not from nausea, but from pressure of the gravid uterus against the stomach.
2. The abdominal tumour is increased in size.
3. Respiration difficult.
4. All the other symptoms are augmented in intensity.

1. The fundus uteri occupies the epigastric region.
2. The movements of the fœtus; the pulsation of the fœtal heart are still present. At this time, ballotement has disappeared.
3. The whole cervix uteri is softened, except the internal orifice, which remains firm and closed. The os uteri in primiparæ is slightly opened, though not sufficiently to admit the finger, as is the case in multiparæ.

*During the last half of the Ninth Month.*

1. The vomiting ceases, as the abdominal tumour sinks from the epigastrium.
2. Respiration less oppressed.
3. Considerable difficulty exists in walking, owing to the sinking of the presenting part into the pelvic excavation.

1. The fundus uteri has sunk lower down in the abdomen.
2. The sensible signs still persist, except ballotement, which is usually, though not always, absent after the fœtus has acquired considerable size.
3. In multiparæ, the internal orifice of the cervix is softened and dilated, so

## RATIONAL SIGNS.

4. Constant desire to evacuate the bladder and rectum.

5. The hemorrhoids, the œdema of the limbs and the varicose condition of the veins of the inferior extremities are all increased.

## SENSIBLE SIGNS.

that the membranes may be felt. In the primiparæ, the internal orifice is soft and dilated, but the external remains partially closed. During the last ten or twelve days, owing to the dilatation of the internal orifice of the cervix uteri, the whole cervix becomes enlarged, so as to increase the size of the uterine cavity; so that *in touching*, the finger reaches the membranes, in the primiparæ, after having passed the thin and even margin of the os uteri. While in the multiparæ, the external orifice of the cervix is thick and unequal.

## DEVELOPMENT OF THE FŒTUS.

It has already been stated, that after impregnation, the ovum develops itself by its own plastic power, out of the materials supplied it by the mother. It will be remembered that it was originally contained within the Graafian vesicle, and that it contains a yelk similar to that seen in the hen's egg, although much smaller, in the centre of which is found the germinal vesicle, on whose walls is the germinal spot or nucleus, from which all the various parts of the new being are developed. According to some physiologists, impregnation takes place in the ovary, and before the rupture of the Graafian vesicle; according to others, the Graafian vesicle is ruptured first, the ovum escapes into the Fallopian tubes and meets the male sperm on its way to the uterus. After impregnation, the germinal vesicle becomes filled with cells, which are developed from the nucleus, until the whole mass resembles a mulberry, which, from this circumstance is called the *germinal* or *mulberry mass*. From this is developed the *germinal membrane*, by layers of cells, which pass round the yelk of the ovum, so as to enclose it, the whole being still contained within the yelk membrane. The germinal membrane consists of three layers; the external, which is formed first, is called the *serous*, the middle is called the *vascular*, and the internal is called the *mucous*. The external layer becomes the integument; the middle, the vascular system; and the internal, the digestive apparatus.

The *umbilical vesicle* is formed by the doubling in of the mucous layer under the abdomen of the fœtus, so as to enclose a cavity containing the yelk, which communicates with the digestive tract. Upon this yelk the embryo subsists as long as it lasts, the umbilical vesicle becoming smaller and smaller as it is absorbed, until finally only a narrow orifice remains, which ultimately closes up and the umbilical vesicle is thrown off; it may, however, be detected upon the umbilical cord up to a late period of pregnancy. (Fig. 12.)

*The Allantois*.—After the yelk has been entirely absorbed, it



becomes necessary that the fœtus should have some other means of support, and the following are supplied. From the inferior or caudal extremity of the fœtus there arises at the point where the urinary bladder is afterwards seated, a delicate membranous sac, which is formed from the mucous layer, and has distributed upon its surface, a number of minute blood-vessels, from the vascular layer; this vesicle gradually extends itself between the amnion and the chorion, until it comes in contact with that part of the uterine surface, where the villi of the chorion are most abundant; here the vessels which it carries, attach themselves in order to form the placenta, and the allantois having fulfilled its function shrivels up, although traces of it may be found in the cord. In its development the allantois passes out of the anterior part of the abdominal cavity, in the region of the umbilicus, which at this time is open. As the cavity is closing, by the gradual development of its walls towards the median line, it is separated into two portions which communicate; that part which is within the body, forms the urinary bladder, with its urachus or tube of communication. (Fig. 13.)

*The Amnion.*—The outer or serous layer of the germinal membrane at the point where the embryo is developing itself, rises up on each side of it in two folds, forming the inner membrane of the ovum, which is called the amnion. These two folds gradually approach each other till actual contact takes place, in the space between the general envelope and the embryo, so as to form an additional investment to the latter. As each fold contains two layers of membrane, a double envelope is thus formed, of which the outer layer (fig. 12, *d, e,*) afterwards adheres to the inner surface of the chorion;

Fig. 12.\*

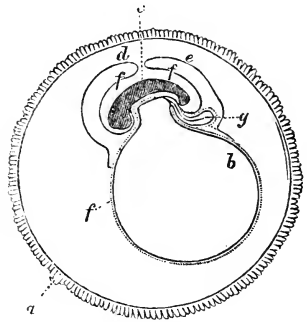
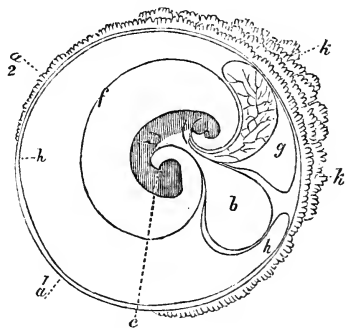


Fig. 13.†



\* *a*, chorion; *b*, umbilical vesicle, surrounded by the serous and vascular laminae; *c*, embryo; *d, e,* and *f*, external and internal folds of the serous layer, forming the amnion; *g*, incipient allantois.

† Diagram representing a Human Ovum in second month; *a, 1*, smooth portion of chorion; *a, 2*, villous portion of chorion; *k, k*, elongated villi, beginning to collect into placenta; *b*, yolk-sac or umbilical vesicle; *c*, embryo; *f*, amnion (inner layer); *g*, allantois; *h*, outer layer of amnion, coalescing with chorion.

whilst the inner one (fig. 12, *f, f*.) remains as a distinct sac, to which the name *amnion* is given.

“The membrane thus formed embraces the embryo very closely at an early period, and is continuous with the common integument of the fœtus, at the open abdominal parietes. At a later period it is distended with fluid, and so separated from the fœtus, and after being reflected upon the funis, of which it forms the outer coat, it terminates at the umbilicus. It is thin and transparent, but of a firm texture, resisting laceration much more than the other membranes. Its external surface is somewhat flocculent, but internally it is quite smooth, like serous membrane, and like it secretes a bland fluid.” This fluid resembles dilute serum, and is called *liquor amnii*. It varies in amount from half a pint to several quarts, the average quantity being about half a pound.

It subserves several useful ends. It probably serves as nutriment to the fœtus during the early months; it preserves an equable temperature for it while remaining in utero, it protects it from the effects of sudden blows, shocks, &c. It is also useful in dilating the os uteri, by protruding the membranes in the commencement of labour.

*The Chorion.*—The outer membrane of the ovum is called the chorion, and is formed during its passage through the Fallopian tube, by receiving an additional layer of albuminous matter secreted from the walls of the tubes, and this is surrounded by a fibrous membrane. This new formation is one of great importance, as it is through this the whole subsequent nutrition of the embryo is derived; this is accomplished at first by means of a number of villous processes, which proceed from the whole surface of the chorion and give it a rough, shaggy appearance; these villous processes serve as absorbing radicles, drawing in the fluids supplied by the mother, until a more perfect communication is afforded by the placenta. As the ovum advances in age, these villi diminish in number, assume a vesicular appearance, and finally disappear altogether, except at that part of the chorion which is in contact with the uterus, and where the placenta is subsequently formed. In some animals, this connexion between the villous coat of the chorion and the uterine surface is the only one that exists, hence they are called *non-placental*.

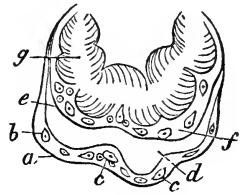
*The Placenta.*—The formation of this organ commences by the penetration of the villi of the chorion into the tubuli of the decidua already described; later we find a vascular connexion established between them and the villi, by the agency of the allantois, in the manner above mentioned, the allantois conveying the blood-vessels of the fœtus to that portion of the chorion. It must not, however, be understood, that there is any direct communication between the vessels of the fœtus and those of the mother, the fœtal tufts being merely *bathed* in the maternal blood and drawing nourishment from it by its own cells, which have the power of selecting, and of elabo-

rating their own materials. The fœtal portion of the placenta consists of the branches of the umbilical vessels, which divide minutely where they enter the organ, and constitute by their ramifications a large portion of its substance, each subdivision terminating in a villus. Each villus contains a capillary vessel, which forms a series of loops, communicating with an artery on one side and with a vein on the other. The vessels of the villi are covered by a layer of cells enclosed in basement membrane. The maternal portion may be considered as a large sac, consisting of a prolongation of the internal coat of the great uterine vessels. Against the fœtal surface of this sac the placental tufts push themselves, dipping down into it and carrying before them a portion of its thin wall, so as to constitute a sheath to each tuft. The blood is conveyed into the cavity of the placenta by the "*curling arteries*," so named from their tortuous course, which proceed from the arteries of the uterus, and the blood is returned through large uterine veins called *sinuses*. The placenta performs the twofold office of an absorbing and respiratory organ; it begins to be formed about the end of the second month, acquires its peculiar character during the third, and goes on increasing in proportion to the development of the ovum. At full term its diameter is about six or eight inches, its circumference eighteen to twenty-four, and its thickness from one inch to an inch and a half. Its internal or fœtal surface is smooth and shining, being covered by the chorion and amnion; the outer, or uterine surface, is level but not so smooth, being divided by numerous sulci between the lobules of which it is composed.

The *umbilical cord*, called also the *funis*, or *navel-string*, is the means of communication between the fœtus and placenta. It usually arises from the centre of the placenta, though sometimes from the edge, forming the *battledore placenta*. It consists of two umbilical arteries, and one umbilical vein; besides these it contains the duct of the umbilical vesicle, the omphalo-mesenteric vessels, the urachus, and sometimes more or less of the intestinal canal, the whole imbedded in the Whartonian jelly, and invested by a reflection from the amnion. The length varies much; the average, however, is about eighteen inches. Sometimes it is so short as seriously to impede the progress of the labour. To return to the development of the embryo.

\* Extremity of a placental villus:—*a*, external membrane of the villus, continuous with the lining membrane of the vascular system of the mother; *b*, external cells of the villus, belonging to the placental decidua; *c*, *c*, germinal centres of the external cells; *d*, the space between the maternal and fœtal portions of the villus; *e*, the internal membrane of the villus, continuous with the external membrane of the chorion; *f*, the internal cells of the villus, belonging to the chorion; *g*, the loop of umbilical vessels.

Fig. 14.\*



The parts first formed are those which most clearly distinguish the vertebrated animals from all others, viz., the vertebral column and spinal cord. These first make their appearance in the situation of the embryonic cell, and are included under the name of *chorda dorsalis*, which is found to be composed, wherever it exists, of nucleated cells. From cells exterior to this, is developed the vertebral column. Concurrently with this development, appears the vascular system, which is first seen in the middle layer of the germinal membrane, called the *vascular*. Vessels are formed here which serve to take up the nutriment supplied by the yelk, and carry it to the tissues of the embryo. These vessels are first seen in that part of the vascular lamina of the germinal membrane which immediately surrounds the embryo, and they form a delicate network of vessels called the *vascular area*; this gradually extends itself till the vessels spread over the whole of the germinal membrane, and it is through their agency that the nutritious matter of the yelk is conveyed to the embryo. The vessels of the yelk-bag terminate in two large trunks called omphalo-mesenteric, meseraic, or vitelline vessels, which enter the embryo at the point which afterwards is known as the umbilicus. The first movement of fluid takes place *towards* the embryo, and may be discovered before any heart is seen. The heart is formed in the substance of the vascular layer, by a dilatation of the trunk, into which the blood-vessels unite. It is at first a mere excavation, but afterwards its walls become more developed, and it is divided into cavities. Along with the development of the vascular, appears also the permanent digestive cavity; this originates in the separation of a small portion of the yelk-bag lying immediately beneath the embryo by a doubling in of the mucous layer, so as to enclose a cavity. This, by subsequent prolongation and involution of its walls, is rendered more complex, so as to form a stomach and intestinal tube. The digestive cavity communicates for some time with the yelk-bag (from which it has thus been pinched off) by the opening that is left by the imperfect meeting of the folds of the germinal membrane that forms its walls. In the mammalia, this orifice is gradually narrowed, and at last completely closed; and the yelk-bag thus separated is afterwards thrown off; it is then known as the *umbilical vesicle*, and may be seen upon the umbilical cord up to a late period of pregnancy.

At first the body of the embryo is more elongated than afterwards, and the trunk is the first part developed, at the upper extremity of which is a small prominence less thick than the rest, and separated by an indentation, which distinguishes the head. No traces of extremities can yet be discovered, or of any other prominent parts. It is straight, or nearly so, the posterior part being slightly convex, the anterior concave.

Afterwards the head becomes more rapidly developed, so that at

the beginning of the second month, it nearly equals the half of the whole body. In the fifth week, the extremities become visible, the upper generally appearing first, in the form of small blunt prominences. As they develop themselves, the distant points appear first, that is, first the hands, which seem to be fixed to the shoulders, then the fore-arm, then the arm. The same is true of the lower extremities. The external organs of generation appear after the development of the extremities, as also do the nose, ears, and mouth. Ossification commences in the base of the cranium, and the bones under the scalp are those in which the process is last completed. The length of a full-grown fœtus is about eighteen inches, the weight between six and eight pounds as the average.

*Duration of pregnancy.*—On this subject very little can be positively said, the *average* duration being about ten lunar months, or 280 days. There can be no doubt that many females fall short of this computation, as well as that there are many who go beyond it. Many well-authenticated instances are on record, under the authority of Drs. Merriman, Blundell, Montgomery, Dewees, Meigs, and others, where both these deviations have occurred. The same is true of the lower animals. Dr. Rigby supposes that the duration of pregnancy is much influenced by the time in the intermenstrual period at which conception took place; that there is at every menstrual period an irritability about the uterus, even when gravid, which disposes it to take on contraction. Hence, when impregnation has occurred immediately after an appearance of the menses, the uterus will have attained such a dilatation and weight of contents by the time that the ninth period has arrived, that it will not be able to pass through this state of catamenial excitement without contracting, or in other words, labour coming on: hence it is that we find a considerable number of labours fall short of the usual time, so much so, that some authors have even considered the natural term of human gestation to be 273 days, or 39 weeks.

If, on the other hand, impregnation has occurred just before a menstrual period, the uterus may not have attained such a development as to prevent its passing the ninth period without expelling its contents, but may even go on to the next without this process taking place. Under this view of the subject, he further remarks, “the duration of time between each menstrual period should also be taken into account, some women menstruating at very short, others at very long intervals; but although this will affect the number of periods during which the pregnancy will last, it will not influence the actual duration of time, as this will more immediately depend upon the size and weight of contents which the uterus has attained.”

The method of calculation, is to compute from a fortnight after the last appearance of the menses, and the period so fixed is usually

corrected by the time at which quickening occurs, the latter occurrence usually taking place at four months and a half.

*Extra-uterine pregnancy.* It occasionally happens that the ovum, instead of passing down the Fallopian tube to the uterus, is arrested in its progress, and an effort is made at the point of obstruction to afford space and nutrition for the fœtus. When the ovum is detained and developed in the ovary, it is called *ovarian pregnancy*. Of this variety Dr. Granville relates a case in the Lond. Phil. Transactions, part 1, 1820. When the Fallopian tube is the seat of the arrest, it is called *tubal pregnancy*; of this variety cases are reported by Dr. R. Lee in the Lond. Med. Gaz., vol. xxvi, p. 436. Also by Dr. Meigs, *vide* his work, p. 106. It sometimes happens that the ovum enters the parietes of the uterus, constituting a third and rare description called *interstitial pregnancy*. A fourth variety is called *ventral* or *abdominal pregnancy*, where the ovum falls into the abdominal cavity, attaches itself, and is developed there. It is worthy of remark, that in all these varieties, the uterus is lined with a deciduous membrane, as it is in *intra-uterine pregnancy*.

The causes are not well known, and the treatment can be merely palliative. Portions of the fœtus are often discharged from fistulous openings in the abdomen, vagina, or rectum.

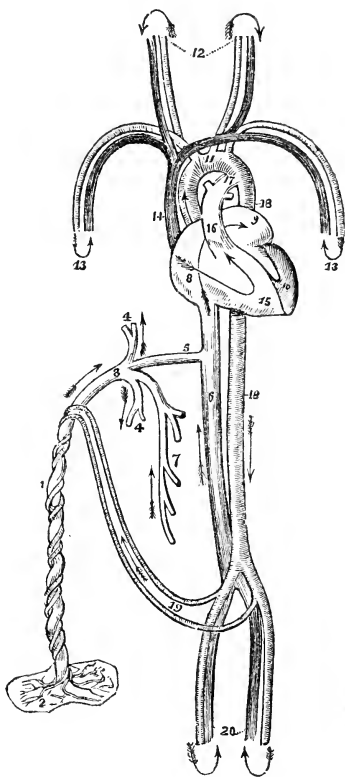
*Fœtal circulation.*—The peculiarities of the fœtal circulation, in which it differs from that function in the adult are, 1st. The *ductus venosus*, a supplementary vein, situated at the thick edge of the liver, and leading from the umbilical vein to the vena cava ascendens. 2d. The aperture between the right and left auricle, effecting a communication between them, called the *foramen ovale*. 3d. The *ductus arteriosus*, a branch given off from the pulmonary artery soon after its origin, which conducts the venous blood that has arrived at the heart from the head into the aorta just below its arch.

The following is the route of the circulation in the fœtus, starting from the placenta. The blood, after being aerated in this organ, is collected by the *umbilical vein*, which carries it to the umbilicus of the child. After entering the cavity of the abdomen, the current divides, part of it being sent through the *venæ portarum* to the liver; the remainder reaches the vena cava ascendens through the *ductus venosus*, where it is mixed with the blood from the inferior extremities. The blood that was sent to the liver is collected by the hepatic veins and also emptied into the *vena cava ascendens*, which finally discharges its contents into the right auricle of the heart. From the *right* auricle, it is directed by the Eustachian valve through the *foramen ovale*, into the *left* auricle, thence it passes into the left ventricle, by which it is distributed through the aorta to the system, a large proportion of it going to the head and upper extremities. The latter blood, (that from the head, &c.,) is

collected by the vena cava descendens, and emptied also into the *right* auricle, from whence it passes into the *right ventricle*, from thence mainly through the *ductus arteriosus* into the aorta, a small portion only passing into the pulmonary artery. From this it will be seen that the liver is the only organ that receives the blood from the placenta *unmixed*. Every other organ receiving mixed arterial and venous.

After birth, the current is entirely changed by the establishment of respiration, and its diversion into the lungs. The ductus venosus, and the ductus arteriosus shrivel up into ligamentous cords; the foramen ovale shortly closes by the apposition of its valve; the pulmonary artery and vein become dilated to receive the increased current, and the circulation, which before resembled that of the higher reptiles, becomes now that of the perfect mammal. It not unfrequently happens, however, that some arrest of development takes place, and prevents the completion of these changes ;

Fig. 15.\*



\* The fetal circulation ; 1, the umbilical cord, consisting of the umbilical vein and two umbilical arteries ; proceeding from the placenta (2) ; 3, the umbilical vein dividing into three branches ; two (4, 4) to be distributed to the liver ; and one (5) the ductus venosus, which enters the inferior vena cava (6) ; 7, the portal vein, returning the blood from the intestines, and uniting with the right hepatic branch ; 8, the right auricle ; the course of the blood is denoted by the arrow, proceeding from 8 to 9, the left auricle ; 10, the left ventricle ; the blood following the arrow to the arch of the aorta (11), to be distributed through the branches given off by the arch to the head and upper extremities. The arrows, 12 and 13, represent the return of the blood from the head and upper extremities through the jugular and subclavian veins, to the superior vena cava (14), to the right auricle (8), and in the course of the arrow through the right ventricle (15), to the pulmonary artery (16) ; 17, the ductus arteriosus, which appears to be a proper continuation of the pulmonary artery—the offsets at each side are the right and left pulmonary artery cut off; these are of extremely small size as compared with the ductus arteriosus. The ductus arteriosus joins the descending aorta (18, 18), which divides into the common iliacs, and these into the internal iliacs, which become the umbilical arteries (19), and return the blood along the umbilical cord to the placenta; while the other divisions, the external iliacs (20), are continued into the lower extremities. The arrows at the termination of these vessels mark the return of the venous blood by the veins to the inferior cava.

various malformations hence result, involving an imperfect discharge of the function.

It will be borne in mind by the student, that there is, in the fœtal circulation, a deviation from the normal function in several of the vessels. The umbilical vein and ductus venosus carry *arterial* blood; while the umbilical arteries and ductus arteriosus carry *venous* blood. (Fig. 15.)

#### PREMATURE EXPULSION OF THE FŒTUS.

The uterus sometimes expels its contents before the full period of utero-gestation is accomplished. This may occur at any time during gestation, though it appears to be more easily excited at, or previous to, the third month, owing to the frailty of the connexion between the ovum and the decidua. It is also more liable to occur at the commencement of each menstrual return, than in the interval, owing to the increased excitement of the gestative organs at that time. It is called *abortion* when the fœtus is expelled before it is capable of maintaining an independent existence, that is, before the *seventh month*. It does sometimes happen that a fœtus lives when expelled before this time, but such cases are rare. The child is hardly considered "*viable*" before this time.

*Premature labour* signifies the expulsion of the ovum before the full term of pregnancy has expired, but after the *seventh month*; in other words, after the child has become viable.

*Causes.*—These are infinitely various and numerous, and include almost every agency capable of acting injuriously on the mother, and through her on the fœtus. Mental emotions, fright, anger, joy, or sorrow, when excessive, intense pain, shocks, blows, falls, great fatigue, deficient nourishment, debilitating evacuations, acute and chronic disease, the exanthemata, syphilis, and the habits of life, either extreme, being capable of producing it. To these we may add a peculiar constitutional irritability of some females, by which they abort *habitually*.

Premature expulsion is sometimes produced by circumstances which compromise the life of the child. Thus certain pathological conditions of the amnion, chorion or decidua, malformations of the placenta, or erroneous insertion of the cord. Or it may occur from the administration of drugs exhibited for the purpose, or otherwise, such as ergot, savine, &c.

The manner in which these causes act, is either by destroying the child's life, in which method syncope, syphilis, and mercurial salivation seem to act; or by causing the womb to contract; or by partial separation of the placenta, causing the effusion of blood between that organ and the womb, and finally its entire separation, thus arresting the nutrition and respiration of the fœtus, and producing its death.

*Symptoms.*—The patient who is about to miscarry, generally



experiences a sense of uneasiness, languor, pain in the back and lower part of the abdomen, accompanied by pains of an expulsive character, and often with hemorrhage. When the ovum itself is ruptured, there is a discharge of water from the vagina, greater or less, according to the age of the fœtus, followed afterwards by pain and discharge of blood.

Sometimes the ovum is discharged with little or no pain, at others the pains are described as being more severe than those of labour at the full term.

*Treatment.*—There are two points to be observed in the treatment of these accidents; *first*, If possible, to prevent the expulsion of the fœtus, and enable the woman to complete her pregnancy; *secondly*, Where this is hopeless, to shorten the process as much as possible, and prevent further hemorrhage.

As we cannot be certain in the first instance, whether the child is dead, or not, it behooves us to act under the supposition of its life, knowing that if the vital relation between the ovum and the uterus is compromised it will be discharged.

The *preventive treatment* will consist in moderate bloodletting if the patient be plethoric and the pulse full and bounding, rest in a strictly horizontal posture, on a hard bed, lightly covered with clothes, and in a cool room, cold wet napkins to the vulva, abstinence from stimulants, anodyne enemata, and if necessary, the internal use of astringents, such as infusion of rose leaves, elixir vitriol, alum, acetate of lead and opium, &c.

If these means fail, and the hemorrhage continues, whilst the ovum is not expelled, there is little or no chance of preventing miscarriage; our endeavours must be directed to the suppression of the discharge, knowing it will generally cease as soon as the womb is emptied. The best agent we possess under these circumstances, is the *tampon*, or *plug*. This should never be used, however, if internal hemorrhage can take place to such an extent as to destroy life; in other words, not if the uterus be empty, and the patient far advanced in pregnancy. It may be used with safety and advantage, if the uterus be filled with its natural contents, or be only slightly distensible, even though empty. For this purpose some recommend a sponge steeped in vinegar, others a silk handkerchief, others, again, small, square pieces of linen pressed into the vagina till that cavity is entirely filled, the whole being retained in its place by a T bandage, or the hand of an assistant. It should be allowed to remain in situ, from six to twelve, or even twenty-four hours, the patient being still in a horizontal position, and the bladder, if necessary, relieved by the catheter. When withdrawn, the ovum, or fragments of it, will generally be found adherent to its upper part, along with a coagulum.

The tampon, it will be remembered, is not to be used under any circumstances where there is a hope of saving the pregnancy.

If the ovum is not discharged with the tampon, and cannot be reached with either the finger or hook, it is recommended to leave such occurrences in the hands of nature, rather than use force.

The *prophylactic treatment* consists in the avoidance of all causes of excitement, both mental and bodily. Small bleedings and rest if she be plethoric; a nutritious diet and tonics if otherwise, together with careful cold sponging. When the abortion is habitual, and the uterus is irritable, an efficient remedy has been found in the administration of an opiate enema every night, consisting of forty-five drops of tr. opii, in a wineglassful of starch water, rest, tonics, &c.

#### PATHOLOGY OF THE FÆTUS, AND SIGNS OF ITS DEATH.

The fœtus is liable to many of those diseases that attack the child after its birth. Many of these are entirely independent of the mother, but there are also many with which the child is affected seriously through her. As examples of the latter may be classed, those cases of premature expulsion which occur during the prevalence of epidemic diseases, and where the fœtus appears to have participated in the disease of the mother. Dr. Churchill has observed a considerable quickening of the action of the fœtal heart, some days after pregnant women have been attacked with fever. Examples are not wanting of cases where children have been born with small pox, or measles; and according to Duettel, Schweig, Zurmeyer, &c., children born of mothers, who were suffering under *intermittent fever*, have exhibited the same disease immediately after birth.

There is scarcely an internal organ that has not been described as the seat of inflammation; the brain and its membranes, the lungs and pleura, the peritoneum, the mucous membranes of the lungs and bowels, may all be the seat of inflammation during uterine life.

In addition to these acute diseases, the fœtus presents even more numerous cases of chronic affections; general hypertrophy, or atrophy, syphilitic diseases, worms, calculus, dropsy, jaundice, hernia, &c. Even the bones and joints may be the seat of disease; children are sometimes born with rickets, caries, and necrosis; and it has happened to many practitioners to meet with cases of fractures of some standing in children just born.

Unfortunately we possess neither the means of diagnosing, nor of treating these cases of intra-uterine disease.

The *signs of the death of the fœtus*, are also obscure and uncertain. Absence of the sound of the fœtal heart, is a negative sign, and its value will depend much upon the skill of the auscultator. If after repeated and careful auscultation of the abdomen no trace of fœtal pulsation can be detected, the death of the fœtus may be asserted on safe grounds. *Cessation of the movements of the fœtus* is no proof of its death, as the movements may be suspended for some days without its death. The sensation of a weight in the abdomen rolling about as she moves, is, with some rare exceptions,

a sure sign. The subsidence of the abdominal tumour, flaccidity of the breasts, after having been tense, and the general deterioration of the health, are all enumerated among the probable signs. The concurrence of all these render the diagnosis nearly certain, though separately they are of little value.

*The signs during labour* are much more accessible and certain. The loose, flabby scalp, the absence of swelling, occasional emphysema of the cellular tissue beneath, the looseness and grating of the cranial bones, and the sharpness of their edges, are enumerated by Dr. Rigby among the certain signs. The absence of pulsations at the great fontanelles, is admitted to be an important sign.

In *presentations of the face*, the lips of a dead child will be flaccid and the tongue flabby and motionless, and the presenting part slightly swelled. The contrary in a living child.

In *breech presentations*, the sphincter ani, in a dead child is relaxed and insensible to the finger. In a living child it is closed and resists the finger. The presence of meconium is a sign of no value.

In *arm presentations*, when the child is dead, the limb is cold, livid, and flabby, there is no pulsation at the wrist, (the latter is not of much value, as pressure may arrest it,) and the epidermis soon begins to peel off. In a living child, the arm will swell and become livid.

In *prolapsion of the funis*, the presence or absence of pulsation will decide. There are exceptions to this rule, however, as in the case related by Dr. Kennedy, in which the cord was prolapsed an hour, and during a pain no pulsation was perceptible; when the pain subsided he drew the funis backward towards the sacro-iliac symphysis, and then detected a faint pulsation. The child was delivered alive by the process.

*Fetid liquor amnii* is not a certain sign of the child's death, neither is the presence of meconium in it, especially in breech cases.

#### RETROVERSION OF THE UTERUS.

During the early months of pregnancy the uterus is liable to a peculiar species of displacement, known by the above name. It is where the fundus is pushed downwards and backwards into the hollow of the sacrum between the rectum and posterior wall of the vagina, while the os tincæ is tilted upwards and forwards behind the symphysis pubis.

Most of the instances of retroversion are attributable to a distended bladder; for, as this organ fills, it rises, and pulls the lower portion of the uterus upwards; at the same time the fundus is pushed backwards, by the repletion of the bladder; the os uteri therefore presses against the neck of the bladder and produces retention of the urine; the fundus presses against the rectum and prevents the passage of fæces, which thus accumulate above the point of pressure, and not only prohibit the ascent of the fundus to its normal position, but

really force it lower. The accident may also happen from falls, shocks, lifting weights, and, according to Churchill, in the early days of menstruation, when the uterus is increased in weight by the afflux of blood. The growth of tumours in the neighbourhood of the fundus is also a cause.

The *symptoms* are, violent bearing-down pains, sense of fulness and distention about the loins and hollow of the sacrum, dragging and tension in the groins, and inability to pass fæces or urine. A per vaginam examination reveals the os tinæ thrust up behind the symphysis pubis, and the vagina seems to be obstructed by a hard body, which is the fundus turned down into the hollow of the sacrum.

The *treatment* consists in emptying the bladder and rectum, and pressing up the fundus by two fingers in the rectum, assisting them, if necessary, by a finger of the other hand in the vagina, by which the os uteri can be hooked down. Venesection is sometimes necessary to relax the system. Sometimes merely emptying the bladder and rectum are sufficient, the uterus recovering itself through the muscularity of the round ligaments. Sometimes it is necessary to rupture the ovum, and let the uterus condense itself. At others, tapping the uterus is required. The after-treatment is, rest in a horizontal posture, and the avoidance of the distention of the bladder and rectum.

*General treatment of the female before labour.*—A woman should be prepared for the perils of childbirth by a course of preliminary treatment, commencing a few weeks before her term. This should consist of an occasional venesection, if she is plethoric or has headache, and the use of a gentle aperient that may serve to secure the regular evacuation of her bowels. The diet should be light and unstimulating, and the female should, as far as possible, take regular exercise either in riding or walking till the end of gestation.

#### LABOUR.

By this term is understood, *that process by which the contents of the gravid womb are expelled.* It should commence, as we have already seen, at or about the two hundredth and eightieth day from the last appearance of the menses, or about one hundred and forty after quickening. The principal agent in affecting this process is the uterus itself, assisted, however, by the action of the diaphragm and abdominal muscles.

The *cause* of labour is not well understood: it has been variously attributed to the inability of the uterus to sustain farther distension, to the struggles of the fœtus in its endeavours to breathe, and to the absence of adequate nourishment. Whatever be the cause, certain it is, that the fœtus contributes nothing to expediting the process, being entirely passive throughout, and the volition of the mother is but little concerned, farther than the assistance afforded by the voluntary contraction of the abdominal muscles and diaphragm, the action of the uterus being entirely involuntary. This action consists in the

contraction of the muscular fibres, which enter into the composition of the uterine parietes. By this contraction the cavity of the uterus is diminished in size, propulsion is produced, and eventually expulsion is effected. The action of the uterus continues even after the child is expelled, for the purpose of extruding the placenta, and closing the orifices of bleeding vessels, which might otherwise give rise to serious hemorrhage.

*The classification of labours.*—Almost every obstetrical writer has a classification in accordance with his own peculiar views, each based upon his definition of a *natural labour*. Some include under the head of natural labour, all those cases which are terminated by the natural unassisted powers, without reference to the presentation. Among these are Hippocrates, Smellie, Baudelocque, Rigby, &c. Others consider that the presentation should be taken into account, and those only which occur most frequently should be called natural. Denman, Blundell, Davis, Ashwell, Ramsbotham, &c., therefore limit natural labours to head presentations.

The simplest classification seems to be that which includes *all* under two heads, viz.: *natural*, and *preternatural*. *Natural labour*, or *eutocia*, being that which follows a natural course, and in which the woman is delivered unassisted; *preternatural labour*, or *dystocia*, signifying faulty or irregular labour, the course of which is unfavourable, and in which the assistance of the obstetrician becomes necessary.

The *general features* of labour are the same in every case, but the details are widely different. It is always attended with suffering, if the patient be conscious; and is sometimes complicated with irregularities and danger. The *duration* also varies much, as well as the amount of pain, in different women, and in the same women in different pregnancies, some expelling their children with a single pain, others requiring many to accomplish the same object.

*The symptoms of labour* may be divided into the *premonitory*, and those which indicate that the process has *already commenced*. The premonitory are, the subsidence of the abdominal tumour; some slight mucous discharge from the vagina, together with relaxation and distensibility of it and the external parts; and a peculiar irritability and restlessness on the part of the patient.

The diminution of the abdominal tumour is produced partly by the subsidence of the uterus into the pelvic cavity, and partly perhaps by the painless contraction of the same organ. It is sometimes very sudden in its approach, the woman finding on rising from her bed that she is much less than on the preceding day. It is generally a good sign, as indicating that she has a roomy pelvis. The increased discharge and relaxation of the external organs is also a good sign, showing that there is a disposition in the passages to facilitate the progress of the labour.

The irritability and restlessness is seen also in the lower animals, and is therefore not peculiar to the human female.

The symptoms indicative of the *commencement* of labour are, pain, glairy discharge from the vagina, irritability of the bladder and rectum, nausea and vomiting, and rigours or shivering, without the accompaniment of chilliness.

The *pain* felt in labour is due to the sensibility of the *resisting*, rather than to that of the *expelling* organs. The sharp, cutting pains of the commencement, which are technically called *grinders*, are produced mainly by the stretching of the cervix uteri and the vagina, and are generally referred to the lower part of the abdomen and the back, in a situation corresponding to the position of the os uteri. These generally accompany the dilatation of the os uteri, and are indicated by the cries and gestures of the patient, the former being of a moaning, complaining character, the latter, twisting and writhing.

When, however, the dilatation has gone to such an extent as to allow some of the contents of the uterus to be propelled through the opening, the pains become of a *forcing, expulsive* nature, and the gestures attending them differ from those before mentioned. The breath is held; she no longer cries out, but makes strong expulsive efforts as if straining at stool; she makes use of the muscles of respiration to fix the thorax, and then contracts the abdominal muscles upon the womb, at the same time pulling violently upon anything within her reach. The gestures and cries are valuable indications of the character of the pains. The characteristic of the uterine pains is, that they are dull, and not very acute in their character; are felt mainly in the back and loins; that under their action the uterus becomes *tight* and *hard*; and particularly, that they are *regular* and *intermittent*; that is, coming on at tolerably equal intervals, and succeeded by an entire relief from suffering.

At the commencement, the uterine pains are short, weak, and at long intervals; as labour advances, the interval becomes less, and the pains longer and stronger. It is well known that labour pains may be suspended, by any sudden emotion, particularly those of a depressing character, as well as by opiates, administered either by the mouth, rectum, or rubbed upon the general surface.

The *mucous discharge* which takes place from the vaginal surface, is known commonly by the name of *show*. It is generally mixed with the gelatinous mucus that blocked up the uterine cervix, and with more or less blood. "The more albuminous it is, the better, and it is always a good sign when lumps of albuminous matter come away from time to time; the thicker, softer, and more cushiony the os uteri is, the more mucus does it secrete." It is useful not only as a lubricating agent, but also as a topical depletion, for by unloading

the congested vessels, they diminish the vascularity and heat of the part, and render it more capable of dilatation.

The *irritability of the bladder and rectum* are among the most prominent signs of commencing labour, and are dependent upon the contiguity between the dilating os uteri and these organs, all deriving a portion of their nervous influence from the same source. The disposition to urinate exists even when the bladder is empty, and the tenesmic irritability of the rectum is equally independent of the presence of fecal matter.

*Nausea and Vomiting*, at the commencement of labour, are looked upon as favourable signs, being indicative of a general relaxation, which favours the dilatation of the os uteri. It must not, however, be confounded with that which sometimes supervenes in lingering labours, which is rather prognostic of great exhaustion, and to be dreaded accordingly. In ordinary cases, vomiting in the early stages requires no treatment, being generally relieved as soon as dilatation takes place. When, however, it is very violent, it may often be checked by an effervescing draught, with a few drops of laudanum. The *rigors*, which often occur early in labour, are likewise accompaniments of the dilating os uteri, and although often severe, are not dependent on diminished temperature of the female, or irregular arterial action; they require little other treatment than an extra covering, and diluent drinks.

#### STAGES OF LABOUR.

Some obstetricians divide a labour into three, others into four, five, or six stages, all ending with the expulsion of the placenta. The first division is the one generally adopted, and the three stages are thus enumerated. The first terminates with the dilatation of the os uteri; the second with the delivery of the child; and the third with the expulsion of the placenta.

*First stage.*—This is generally the longest and most distressing, both to practitioner and patient. The pain, although not so great as in the second stage, is of a more distressing character, and more difficult to bear. The patient is more irritable, uneasy, and alarmed as to the result. The character of the cry, as before mentioned, as well as the gestures, are peculiar to this stage, as well as diagnostic of it. Nausea and vomiting also occur during this stage, and, it is thought, assist in effecting it.

By placing the hand upon the abdomen during a pain, the uterus can be felt to contract and harden itself, and at the same time tilt forwards so as to bring its axis into accordance with that of the superior strait. As the pain goes off, the uterus becomes soft again, without, however, returning to its former state of relaxation.

The approach of a pain may often be foretold by the practitioner before its access, by auscultation. "The moment a pain begins, and before the patient is herself aware of it, we hear a short rushing

sound, which appears to proceed from the liquor amnii, and to be partly produced by the movement of the child, which seems to anticipate the coming on of the contraction; nearly at the same moment all the tones of the uterine pulsations become stronger; other tones which have not been heard before, and which are of a piping, resonant character, now become audible, and seem to vibrate through the stethoscope, like the sound of a string which has been struck and drawn tighter, while in the act of vibrating."\* As the pain grows stronger, the pitch rises. By the time the pain has reached its height, the sound has entirely ceased, or become very faint; as it departs, however, the sound again returns as at the beginning of the pain, and finally resumes its former tone, which it had during pregnancy. The noise made by the escape of the blood through the uterine veins during a contraction, is probably an important element in the production of the sound in question.

It is remarked also by the author quoted above, that the pulse increases in rapidity in proportion as the pain rises in intensity, subsiding in the same manner with it. As the labour advances, the rapidity of the pulse increases, so that shortly before the child is born, it has attained the maximum that it had during the height of the pains in the commencement.

A per vaginam examination at the commencement of labour reveals to us the condition of the parts through which the child is about to pass. If the vagina is cool, moist, and cushiony, and the os uteri soft and thick, the dilatation will most probably proceed favourably. If, on the contrary, the vagina is hot and dry, and the os uteri hard and thin, or hard and thick, the first stage will generally be tedious. *The time occupied in the first stage* varies very much in different women, and in the same women in different labours. In primiparæ, it is generally longer than in those who have had several children. Regular and genuine contractions seldom require more than six hours to perfect this stage, and often it is accomplished in much less. The dilatation also proceeds much more slowly at the commencement, than it does later; this is owing to the want of the mechanical dilatation which it afterwards receives by the formation of the bag of waters, which acts as a wedge, and forcibly distends the os uteri.

*Bag of waters.*—As the circle of the os uteri enlarges, the membranes of the ovum, containing a portion of the liquor amnii, protrude through the opening, forming a tense, elastic, conical bag; this by its mechanical pressure assists in the dilatation of the os uteri. During a pain it can be felt becoming more and more tense, and again relaxing as the pain subsides, so that the presenting part can often be detected through it.

Near the end of the first stage streaks of blood will often be

\* Rigby, p. 159.



found mixed with the mucus upon the finger, after an examination. This is commonly denominated in the lying-in rooms "*a show*," and it is usually an indication that the os uteri is dilated, or nearly so. The hemorrhage proceeds from the slight vascular twigs extending between the uterus and the membranes, which are ruptured by the increasing dilatation.

The phenomena which have been described are repeated during every succeeding pain, (the intervals being shorter and the pains longer,) until the dilatation of the os uteri is completed. During the whole period of the first stage, the pains have been acting, not so much for the expulsion of the child, as for preparing it and the passage for that purpose. The more completely the os uteri is opposite to the fundus, and the greater the correspondence between the axis of the uterus and that of the superior strait, the more speedily will the dilatation be accomplished. As soon as this has taken place, the first stage is ended.

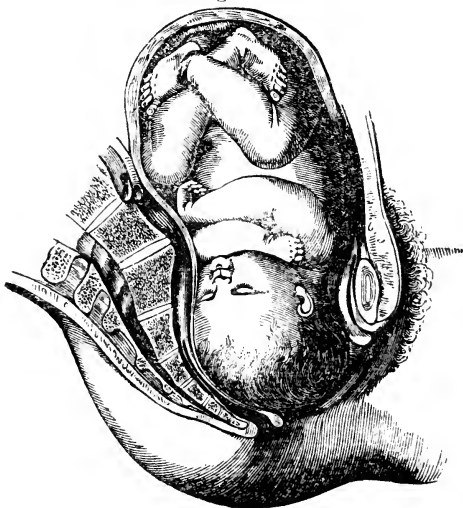
*Second stage.*—The phenomena that present themselves in this stage differ essentially from those of the preceding. The pains succeed each other with greater frequency, and last longer, and the suffering is increased; but, in consequence of the respiratory muscles being fixed, in order to supply a fulcrum for muscular exertion, the woman rarely cries out during a pain. Hence the character of the cry, as before stated, is a diagnostic sign of this stage. The pains now appear not to be so much confined to the womb; they acquire a more *expulsive* character, and are attended with strong bearing-down efforts of the abdominal muscles. Upon the approach of each pain, the woman seizes hold of anything within her reach, and brings the muscles of the extremities, back, and abdomen to aid her in the expulsive effort. These are commonly called *bearing-down pains*. If the membranes have not ruptured previously, they generally give way during one of these pains, and the liquor amnii escapes through the external organs; the fœtus, forced downwards by the same contraction, immediately fills up the space previously occupied by the bag of waters, and the uterus condenses itself upon the body of the child. This is therefore folded into a smaller space, and is much more compressed than previously.

Each succeeding contraction pushes on the presenting part; but, as the pain goes off, it again recedes, not, however, to the point it occupied before, as there generally is more or less advance on that gained by the preceding effort. If it were not for this gradual advance and recession, there would be great danger of laceration of the soft parts, from a continued expulsive effort before the passages were sufficiently dilated to receive the presenting parts. It thus not only takes away the danger of pressure, but is in itself a good sign, inasmuch as it proves that the cavity of the pelvis is sufficiently capacious. The woman during the second stage is much less irritable

than in the first. She seems to have recovered her energy and equanimity, and, if this stage be prolonged, will often sleep between the pains. The young practitioner should be on his guard, however, in relation to this drowsiness, particularly if it occur in primiparæ, and be much protracted, or accompanied with headache, as it is indicative of congestion, and may be the precursor of convulsions.

During the descent of the presenting part, particularly if it be the head, we are often informed of its progress by the occurrence of an unpleasant symptom, viz., cramp in the lower extremities, produced by pressure upon the internal sacral nerves. Under the influence of another pain the head descends along the vagina and begins to press upon the perineum, the rectum becomes flattened, and its contents are often involuntarily expelled; by the time it has reached the floor of the pelvis it is about to meet with its greatest resistance, viz.: that of the perineum. Here again we observe the gradual advance and recession, until this part is distended to such a degree as to allow the presentation to escape over it. This distension is often so great, and the perineum so thin, that the finger can scarcely distinguish it from the presenting part. Occasionally it happens that from this cause the part is rendered transparent, so

Fig. 16.



that the presentation is visible through it. Twice Madame Lachapelle has seen the hair of the foetal head through the distended perineum (Fig. 16). The presenting part has now entered the inferior

strait, the coccyx is pushed backwards, and the external orifice is dilated; the anus projects, and the whole perineum is elongated; the labia majora, and even the mons veneris, are put greatly upon the stretch, and the former disappear entirely; this is not the case, however, with the labia minora, which can be felt even at the moment of the exit, and greatest distension. The sufferings of the patient are now at their height, and the pains are frequently "double," a new one commencing before the former has quite terminated. The force is at length so great, that all resistance is overcome, and with a cry of anguish the exit is effected. There generally succeeds an interval of rest for a few seconds or more, then the pains again return, and the remainder of the child is expelled.

The second stage is now completed, and the woman is entirely free from pain. If the hand be placed upon the abdomen, it will be found flabby and relaxed, and the uterus can be felt through the abdominal parietes, large, and moderately contracted.

The *third stage* is occupied by the detachment and expulsion of the placenta; the period occupied in effecting this varies much in duration. Sometimes it is expelled with the body of the child, at others, it is retained for some time after. Usually, after an interval of ten or fifteen minutes, pains of a different character follow; by these the detachment of the placenta is effected, and it is extruded into the vagina. By the voluntary efforts of the woman, assisted by the contraction of the vagina, it is entirely expelled, and the *labour* is completed. Its expulsion is commonly accompanied by a gush of blood, from which circumstance these pains have been called *dolores cruenti*.

The placenta generally enters the vagina inverted, that is, with its foetal face looking outwards, and the bag of membranes is also turned inside out. Especially is this the case, if traction has been employed upon the cord. After the expulsion, the uterus, now emptied of its contents, contracts into a firm hard ball, which can usually be detected for some days above the symphysis pubis. In this state of condensation it is about the size of a foetal head.

#### PRESENTATIONS AND POSITIONS.

By the term *presentation*, we understand that part of the child which offers itself at the superior strait. By *position*, the relative situation of the presenting part to some point of the superior strait.

It will at once be seen that there may be a presentation for every square inch of the child's body. This, however, would lead to endless confusion; hence obstetrical writers have diminished the number greatly. Some make only *two* great presentations, viz.: of the *head* and *breech*, looking upon all others as deviations from one of these. Others include the above with their deviations, viz.:

<i>Cephalic presentations</i> , including vertex and face.	} Churchill.
<i>Breech or pelvic</i> , including the hips and loins.	
<i>Inferior extremities</i> , including the knees and feet.	
<i>Superior extremities</i> , including the shoulder, elbow and hand.	

Others, such as the back, belly, and sides, are so exceedingly rare, that it is not considered advisable to burden the student's mind with them, particularly as their treatment is the same as that of shoulder presentations.

The *diagnosis* of these different presentations may be described in general terms, as follows, viz. :

Of the *head*, by its hardness, by the presence of sutures and fontanelles, and by its shape.

Of the *face*, by its irregular shape, by the orbits of the eyes, by the nose, mouth, &c.

Of the *breech*, by its softness, by the nates, organs of generation, tubera ischii, and often by the meconium, by the *single* prominence of the os coccygis, and by the sphincter ani muscle, which contracts when irritated by the finger.

Of the *knee*, by its rounded form, and by the condyles of the femur, and perhaps by the patella.

Of the *foot*, by its length, shape, position at right angles to the leg, by the equal length of the toes, the heel, &c.

Of the *shoulder*, by its rounded shape, by the clavicle, the spine of the scapula, the axilla, ribs, &c.

Of the *elbow*, by its sharpness, produced by the olecranon process.

Of the *hand*, by its shortness, the thumb and fingers, palmar and dorsal aspect, &c.

In regard to the *positions*, it is customary to note the relation between some point of the presenting part, and some other point in the brim of the pelvis ; for instance, the first position of the vertex is that in which the posterior fontanelle is found behind the left acetabulum. The different positions will be spoken of in treating of the various presentations.

#### MECHANISM OF LABOUR.

“ When the long axis of the child's body corresponds with that of the uterus, the child (provided the passages are round) can be born in that position ; it matters little, so far as the labour is concerned, which extremity of child presents, so long as this is the case ; but where the long axis of the body does not correspond with that of the uterus, the child must evidently lie more or less across, and will present, with the arm or shoulder, a position in which it cannot be born. In stating this, we wish it to be understood, that we merely refer to the full grown living fœtus, and not to one which is premature, or which has been some time dead in the uterus, as these follow no rule

whatever. Hence the positions of the child, at the commencement of labour, resolve themselves into two divisions, viz. : where the median line of the child's body is parallel with that of the uterus, and where it is not; the first we shall call *natural*, the second, *faulty* presentations of the child."—*Rigby*.

*Vertex presentations*.—The vertex may present at the brim of the pelvis in various positions; some obstetrical writers enumerate as many as eight, others only four, whilst a third class take the intermediate number of six. The latter is the division of Baudelocque, and the one most generally adopted in the schools. These are as follows, enumerated in the order of their most frequent occurrence.

1st.	Vertex at the left acetabulum;	Forehead at the right sacro-iliac junction.
2d.	“ right “	“ left “ “
3d.	“ symphysis pubis,	“ promontory of the sacrum.
4th.	“ right sacro-iliac junction,	“ left acetabulum.
5th.	“ left “ “	“ right “
6th.	“ promontory of sacrum,	“ symphysis pubis.

Naegelè and others make four, leaving out the fifth and sixth. Rigby makes only two, viz., the first and second, whilst Ramsbotham, Flamant, &c., make eight, adding to those already enumerated, 1st, the face inclining to the right ilium, the occiput to the left, the right ear behind the symphysis pubis, the left towards the spinal column. 2d, the reverse of the first, face to the left ilium, occiput to the right, right ear towards the promontory of sacrum, left behind symphysis pubis. The remaining six follow in the order given above.

According to this table, the first three are called *occipito-anterior*, the last three *occipito-posterior*.

In regard to the *frequency* of these positions, it may be stated that Naegelè maintains that the *fourth* position of the vertex is much more common than the second, and that the fifth and sixth are so rare that they are discarded entirely by many eminent practitioners, they having never met with them.

*Cranial presentations* are by far the most numerous of the varieties that offer themselves, and of these, those of the vertex in the first position, occur most frequently. Madame Boivin states, that in supervising twenty thousand five hundred and seventeen labours at the Maternité Lying-in Hospital, at Paris, she found fifteen thousand six hundred and ninety-three cases in which the vertex presented in the first position.

The greater frequency of vertex presentations may be readily accounted for. It will be remembered that the fœtus hangs suspended in the liquor amnii by the umbilical cord; which is attracted nearer to its pelvic than cephalic extremity; the head being the heaviest part, consequently becomes the most dependent.

Neither is it difficult to explain why the head in labour more com-

monly presents itself in the occipito-anterior, rather than in the contrary way. The child in utero naturally lies on its back, with the head inclined downwards towards the orifice of the womb. The long diameter of the womb, at the end of pregnancy, and especially at the commencement of labour, dips at an angle of about forty-five degrees towards the horizon in a woman who is sitting or standing up. The child being in a complete state of flexion both as to its body and limbs, would naturally roll, so as to bring that part of its body which is convex, to adapt itself to the concavity of the womb. This will of course be its back. The uterus at the same time rests upon the abdominal muscles anteriorly, which form a soft cushion for it. The head can only pass the brim of the pelvis, (superior strait,) by the adaptation of certain of its diameters to those of the pelvis. The longitudinal diameter of the child's head is four and a half inches, whilst the antero-posterior diameter of the superior strait is only four; it must therefore adapt itself either to the oblique or the transverse; of these, the oblique is most common. Suppose it to be a first position, in which the longitudinal diameter corresponds with the oblique of the superior strait, the vertex is behind the left acetabulum, and the forehead at the right sacro-iliac junction. The two fontanelles will be at first on a level.

The first step in the mechanism of labour is the *flexion of the head*, or the approach of the chin to the breast. This is produced by the action of the uterus pressing the head downwards into the cavity. Being pressed from above downwards, the spine causes the head to bend forwards, so that the occiput sinks towards the centre of the pelvis, and the chin is squeezed firmly against the breast.

By this movement, the diameters of the child's head are brought into correspondence with such diameters of the pelvis as will allow its ready transmission. The occiput occupies the centre of the superior strait; the occipito-bregmatic diameter corresponds to the oblique diameter of the pelvis, which extends from left to right, and from before backwards; the bi-parietal, represents the other oblique diameter; the occipito-mental is parallel to the axis of the pelvic circle, and the occipito-bregmatic circumference corresponds to the plane of the strait.

Next follows *rotation*, by which is meant, the screw-like movement of the head in the excavation by which the vertex is brought to the symphysis pubis.

By the continued action of the uterus, the head is pushed into the excavation until it reaches the floor of that cavity; here its progress is arrested and the direction changed by the gliding of the occiput upon the left anterior inclined plane, from behind forwards and from left to right, so as to place itself behind the symphysis pubis. Whilst the vertex is executing this movement, the forehead glides from right to left, and from before backwards, on the right posterior inclined

plane, so as to fall into the hollow of the sacrum. In executing this rotation, or pivot motion, the head turns upon its long diameter.

The third stage is *extension*, which signifies, the departure of the chin from the breast.

This commences as soon as the occiput begins to emerge, and is completed when the child's head is entirely born. Instead of continuing to bend forwards, the head now tends to turn over backwards, so as to bring the occipito-mental diameter into correspondence with the axis of the inferior strait.

After the head is fairly engaged in the inferior strait, it is no longer in the same relation to the diameter as before; its great diameter and occipito-bregmatic circumference, however, have not undergone any change, for we find, that at the inferior strait, as well as at the superior, they still represent the plane and axis of that strait. The bi-parietal diameter corresponds to the transverse of the inferior strait, and the occipito-bregmatic to the antero-posterior. The great end of *rotation* is to produce this relation between the diameters, to effect the exit of the child's head.

The last stage is *restitution*, by which is meant, the turning of the vertex again to that side of the pelvis, towards which it was directed before the labour began, or before rotation took place. As soon as the head is born, all restraint is taken away from it, and as it is incapable of retaining the twist which brought it under the arch of the pubis, it returns to its natural position upon the shoulders, which had been temporarily changed. In the position now under consideration, the vertex turns towards the left thigh of the mother, and the chin to the right. A short interval of ease succeeds the birth of the head, after which the shoulders enter the excavation. They also enter obliquely, and perform the rotation as above described. The right shoulder is behind the right acetabulum, and rotates from right to left on the right anterior inclined plane towards the symphysis pubis; the left is at the left sacro-iliac junction, and rotates from left to right on the left posterior inclined plane into the hollow of the sacrum. The right shoulder generally appears first at the pubic arch, whilst the left escapes over the perineum; the vertical axis of the child's body is bent, so as to accommodate itself to the axis of the pelvis, which, it will be remembered, is a curved line. After the shoulders emerge, the rest of the body is expelled without anything peculiar to demand description.

In the *second position* of the vertex, the mechanism differs but little from that of the first; the same forces are brought to bear upon the child, and the same diameters offer themselves to the principal diameters of the pelvis; the head also executes the same movements as in the preceding. The vertex, however, in this case, is behind the right acetabulum, and rotates from right to left on the right anterior inclined plane, and the forehead on the left posterior inclined

plane into the hollow of the sacrum. At the inferior strait there is no difference between the two positions; but after the escape of the head, the vertex turns towards the *right thigh*, the left shoulder comes under the arch of the pubis, and the right falls into the hollow of the sacrum; but in these changes there is no variation from the proportional relations between the fœtal head and the maternal pelvis.

This is considered by some obstetricians as not so favourable a position as the first, in consequence of the impediment offered by the rectum to the rotation; this is not believed to be a valid objection, as the rectum can be easily emptied, and then offers but a slight obstacle.

The *third position* is confessedly so rare that some obstetrical writers have banished it entirely. Baudelocque admitted it rather to fill up his plan, than from any evidence of his senses. Madame Boivin met with it only six times in twenty thousand five hundred and seventeen cases. Velpeau also is sceptical as to its existence.

When it does occur, its mechanism is a little different from the preceding; the occiput is at the pubis, and the forehead at the promontory of the sacrum. In this case, the occipito-mental diameter corresponds with the axis of the superior strait, and the occipito-bregmatic circumference with the plane of that strait.

The bi-parietal diameter, however, is situated transversely, and the occipito-bregmatic from front to rear. There is no rotation necessary in this case, and none occurs, consequently there is no restitution.

The shoulders commonly enter transversely, although they generally emerge with one at the sacrum, and the other at the pubis, without our being able to tell beforehand which it will be. In the rest of the labour there is nothing peculiar.

The *fourth position* of the vertex is the most common of the occipito-posterior varieties. In this position the same diameters correspond as in the first; but, the situation of their extremities is reversed. Engagement takes place more easily, and the head descends into the excavation more readily than in the occipito-anterior positions, until it reaches the floor of the pelvis. Instead of extension occurring readily now, a greater degree of flexion is demanded so as to enable the occiput to rotate into the hollow of the sacrum, which it does, from right to left, upon the right posterior inclined plane, whilst the forehead, or anterior fontanelle, slides forward upon the left anterior inclined plane, from left to right.

The vertex is born first, over the perineum, and extension takes place backwards, so that the posterior fontanelle, the sagittal suture, the anterior fontanelle, the parietal protuberances, and the several parts of the face are successively seen in front of the perineum. Immediately after the birth of the chin, restitution takes place; the



face turns towards the left groin, and the occiput towards the posterior part of the right thigh of the mother.

The left shoulder rotates to the front under the symphysis pubis, while the right falls into the hollow of the sacrum.

M. Naegelè states that this position is more common than the second, and that rotation takes place from behind forwards, so as to bring the occiput under the pubis, instead of into the hollow of the sacrum, as already described. In this opinion he is confirmed by Professor Meigs.

In the *fifth position*, the back of the child is directed to the left and backwards, the right shoulder to the left and forwards, and the left, to the right and backwards; the bi-parietal diameter corresponds with the left antero-posterior oblique, and the occipito-bregmatic with the right antero-posterior oblique diameter; the lesser circumference of the foetal head, and the occipito-mental diameter, are parallel with the plane and axis of the strait. Rotation of the vertex takes place upon the left posterior inclined plane, into the hollow of the sacrum, while the forehead, gliding upon the right anterior inclined plane, is brought to the symphysis pubis.

After the birth of the head, *restitution* takes place, with the occiput to the inside of the mother's left thigh, while the face looks towards the right. This is said to be a more difficult position than the preceding, in consequence of the presence of the rectum, which retards the progress of the occiput.

In the *sixth position*, as in the third, there is neither rotation, nor restitution; the occipito-bregmatic diameter corresponds with the antero-posterior, and the bi-parietal with the transverse.

It is less favourable than the corresponding oblique positions, in consequence of the liability of the forehead and face to be turned downwards, and thus permit the long diameter of the head to be brought into parallelism with the short diameter of the pelvis.

In all these occipito-posterior positions, there is much greater distension of the perineum than in the occipito-anterior, in consequence of the head having to descend lower; they are therefore more tedious and painful.

It is by no means an easy matter to diagnosticate the *positions* of the vertex; it requires great delicacy of touch, and considerable experience. The movements of the child, and the stethoscope, are valuable assistants to the sense of touch. Naegelè observes that when the movements are felt most on the right side, the head is probably in the *first position*, when on the left, in the *second*.

The stethoscope also informs us of the situation of the foetal heart, and when this is decidedly known, it becomes an easy matter to define the position of the head.

## CONDUCT OF A LABOUR.

The conduct of a labour includes all that is done for a parturient patient from the beginning of her pains till the uterus is emptied, and the safety of both mother and child secured. It is not to be understood by this, that the accoucheur is to substitute himself for nature; on the contrary, he really has little to do in most cases, except to receive and protect the child, to deliver the placenta, and watch over the mother and her offspring for some hours after the delivery.

Whilst thus he is ready to let nature assist herself, he must be prompt to recognise and avert any danger that may arise.

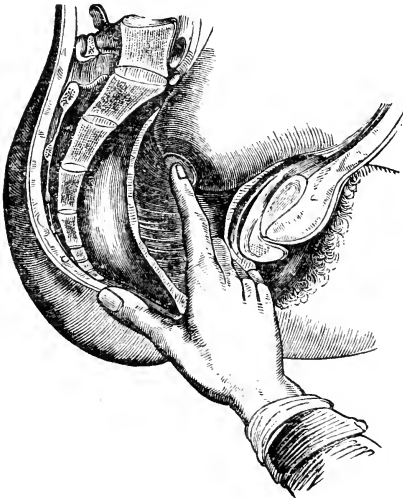
It is well for the practitioner always to be provided with a lancet and an elastic male catheter; and if he live in the country, with a little laudanum. The first duty of the attendant is, to ascertain *her present condition, whether in labour or not*, and if so, *how long she has been in labour, the nature of the presentation, the rate of progress, and probable termination*.

The first conditions will be readily discovered, by examining the skin, pulse, tongue, &c.; then directing the attention to the pains, noting their character, frequency, duration, &c., the character of the outcry, the gestures of the patient, and the state of the vaginal discharge. By these symptoms he will be enabled to judge of the

existence of labour or not, the stage and rate of progress, and also of the necessity for a more particular examination.

One of the first duties of the practitioner, after the above inquiries have been attended to, is to discover the condition of things by a per vaginam examination; this, it need hardly be said, should always be proposed in the most delicate manner. There is much information to be gained during the first examination (and it should *never* be

Fig. 17.



*needlessly* repeated;) first, whether she be really pregnant; secondly, if she be in labour; thirdly, whether the membranes have ruptured or not; fourthly, the nature of the presentation; fifthly, the stage and progress of the labour; sixthly, the state of the os uteri, vagina, and perineum; he is also to take the opportunity of estimating the capacity of the pelvis, and other circumstances which may influence the duration of the labour. (Fig. 17.)

It is scarcely necessary to repeat this examination during the first stage, if all is right; but in the second, it should be regulated by the rapidity of the advance, and when once the head has reached the perineum, the finger should be kept upon the head during each pain, so as to regulate the amount of support for the perineum. The finger ought always to be introduced *during* a pain, but the examination should also extend to the *interval*.

During the first stage, the patient need not be confined to the bed, but may be allowed to sit up, or even to walk about, if she desire it. Neither is it incumbent upon the medical attendant to remain in the lying-in room during the first stage; his presence may be a restraint upon the patient.

The condition of the bowels should always be early attended to, and if they have not been acted upon lately, should be unloaded either by an enema, or an aperient. The bladder should also be emptied, either spontaneously, or by the catheter. The diet of the patient, when the first stage is protracted, should be of a light, unstimulating character; the object being to sustain nature while under a severe effort, at the same time that we carefully avoid calling that effort in the direction of the digestive organs.

There should always be in readiness several strong ligatures for the cord, a pair of sharp scissors, some strong pins, and a "binder," or broad bandage, for the female. It is likewise the duty of the accoucheur to see that the bed is properly prepared for the patient. This is best done by spreading a piece of oiled cloth upon the mattress to protect it at the point the patient is about to occupy; over this may be placed several blankets or coverlets, folded square, to receive the discharges, &c. These latter can be easily removed after the labour is completed, without disturbing the patient, leaving the bed-linen beneath unsoiled.

The *second stage* is often announced by the rupture of the membranes. As soon as this occurs the patient should retire to her bed, and the practitioner make an examination, in order to determine more accurately the position, and inform himself of the advance of the head.

In this country and in England, it is usual to place the woman upon her left side, with her hips close to the edge of the bed, and her knees drawn up towards the abdomen. This position enables the practitioner to use his right hand with advantage, and is also sup-

posed to favour the engagement of the head in the first position. If the membranes have not ruptured at the commencement of this stage, and the head has passed the circle of the os uteri, they may be broken either by pressing the finger upon them during a pain, or by means of a probe passed along the index-finger, provided always, that it is not a first labour, and the attendant is satisfied that their usefulness as a dilating agent is at end.

When the head has reached the floor of the pelvis, and is beginning to distend the perineum, the latter should be supported by the palm of the left hand, (guarded with a soft napkin,) in such a way as to delay the passage of the head slightly, and to bear it towards the pubis, so as to prolong the curve of the sacrum, and make certain of the head being carried forward to the anterior orifice of the vagina, and not allowed to perforate the perineum for want of a just support.

As the head escapes from the os externum, it should be received in the hand of the practitioner, and allowed to perform the motions of restitution, carrying it forward as the shoulders are expelled; he should also be careful to observe whether the cord is twisted about the neck, and if it be to disengage it. The perineum should be supported during the exit of the shoulders, and the whole body carried forward in the axis of the pelvic outlet, and not by any means *pulled out*, in order to relieve the woman from pain, and facilitate the delivery.

When the child is entirely born, and respiration is established, or the cord ceased to pulsate, it may be separated from the mother. To do this, one strong ligature should be tightly tied around the cord about two inches from the umbilicus, and another about an inch further on, and the cord cut between them. The two ligatures are useful in case of twins, which sometimes have a common placenta, and also for the sake of cleanliness.

The accoucheur should then place his hand on the abdomen of the mother, for the purpose of ascertaining whether there be a second child or not, and also to discover, from the state of contraction of the uterus, whether the placenta is discharged or not.

If the uterus be well contracted, the placenta will probably be found in the vagina; as soon as it has descended so low that he can feel the insertion of the cord, he may withdraw it by gentle traction in the axis of the vagina. No force should be used in this operation, for fear lest the placenta should be still adherent, and thus the risk of inversion be produced, or the cord torn from its insertion. The pudendum should now be carefully and gently dried, and covered with warm napkins; after which the binder should be so applied as to extend from the pubes to the ensiform cartilage, and drawn moderately tight, thus affording an adequate support for the uterus and abdominal viscera.

The wet sheets, &c., may now be removed from under her, and the patient covered over to prevent chilliness, and then left to have an hour's rest before she is made comfortable in bed.

The child should be put to the breast as soon as the mother is sufficiently rested. It is not only useful to the child by supplying it with the early secretion, which is laxative, but it is also beneficial to the mother, inasmuch as it excites contraction of the uterus.

The diet of a woman lately delivered should be as light as possible, consisting mainly of the farinaceous articles; and she should be kept in a strictly horizontal position till all danger of hemorrhage has passed.

About half an hour after the labour is completed there often occur a succession of painful contractions called *after-pains*. During their presence, the discharge from the uterus increases and coagula are frequently expelled; their operation is salutary within certain limits, they prevent hemorrhage, diminish the size of the uterus and expel its contents; they are rare in primiparous women. If very severe they may be diminished by small doses of camphor and opium.

The *lochia* is the name given to the discharge that continues after labour is completed. For some days it retains the character of blood; but it finally loses its firmer portions and red globules, in consequence of the continued contractions of the uterus, and becomes of a greenish tint. It comes from the patulous orifices of the vessels on the uterine surface where the placenta was attached, and disappears as these become compressed by the uterine contractions. It usually lasts three weeks, though sometimes longer.

General directions have been given for the management of the child after birth; it sometimes happens that it requires further attention at the hands of the practitioner, owing to some pathological condition into which it may have fallen. For instance, when born it may be in a state of *defective vitality*, *asphyxia*, or *apoplexy*. The first condition may be produced by excessive uterine hemorrhage, by too early a detachment of the placenta, or by defective nutrition. This will be recognised by the feeble efforts at respiration and the weak and irregular action of the heart. Under these circumstances no advantage is gained in preserving the connexion between the mother and child; the cord should be tied and cut and the infant immersed in a warm bath of the temperature of 97° or 98° Fahr. If after a few minutes, the child does not gasp, and we observe that the heart is acting less forcibly, a longer continuance in the bath will do harm; it should, therefore, be removed, and cold sprinkling tried, or what is better, gentle stimulation by means of frictions over the general surface, and if necessary, artificial respiration.

In the *second condition*, the child is sometimes asphyxiated by pressure upon the cord, or by being delayed in the passage in a tedious labour. Here it would be obviously improper to cut the cord;

the practitioner should resort to frictions, cold aspersions, or water poured from a height upon the epigastric region, artificial respiration, &c. Should these means fail, he may try the effect of bleeding, by cutting the cord and allowing about a table-spoonful of blood to escape; if this is unsuccessful, the case is probably hopeless.

The *third condition* is most frequently produced by long-continued pressure, or, from an interval elapsing between the birth of the head and that of the body. Under these circumstances, the action of the heart is weak, and the pulsation in the cord feeble and oppressed, the surface is blue and the face livid, and occasionally it happens that the form of the head is altered. Bloodletting is here obviously indicated, and it should be done by cutting the cord and allowing from half an ounce to an ounce to escape; when it will generally be found, that the surface becomes of a natural hue, the pulse quicker and firmer, and attempt is made to respire. If the child does not breathe, a sudden puff into its face, or a slap upon the buttocks, will often establish respiration, or the means above mentioned may be resorted to.

The tumour that is often found upon the scalp of new-born children, called *caput succedaneum*, and which is produced by the extravasation of blood, or effusion of serum beneath it, generally disappears spontaneously, or by the application of spirit or some stimulating lotion.

*Hemorrhage from the navel after the separation of the cord* is sometimes very troublesome, and may be treated by means of astringents, cautery, compresses, &c.; if these means fail, Dr. Churchill recommends to stretch open the navel and fill it with plaster of Paris, either dry or moistened, allowing it to remain till solid. Others propose to cut down upon the vessel and tie it. A less formidable operation has been successfully practised in this city, by passing two needles through the navel parallel with the surface of the abdomen and at right angles to each other, and applying a ligature beneath them, as in the operation for aneurism by anastomosis.

**TEDIOUS LABOUR.**—The labour is often prolonged beyond the usual limit by a delay in one of the three stages, and yet may be completed without either manual or instrumental assistance.

In the *first stage* it often depends on an undilated os uteri; this more frequently occurs with first labours, and also in women of advanced age, than under other circumstances. On examination, the os uteri is found in one of two conditions, either thin and hard, or semi-pulpy and œdematous, and but little influenced by the pains, which may be frequent and very severe. It may also be undilatable from the presence of cicatrices.

One of the most effectual remedies for this condition is venesection, which may be carried sometimes to a great extent, provided there

be no contraindication. Dr. Dewees once took away as much as two quarts. The blood should be drawn rapidly and from a large orifice; if the patient becomes faint, so much the better. The bloodletting may be assisted by an opiate enema, by the administration of tartar emetic in nauseating doses, or by the application of belladonna ointment to the cervix. The warm bath has been recommended by some practitioners and disapproved of by others. Moral influences have, at times, a good effect; changing the dress, or the bed, changing the position, &c., are often of service. Some practitioners recommend mucilaginous injections to be thrown into the vagina.

There is another condition of the os uteri which is often a cause of delay, where the anterior lip is caught between the head and symphysis pubis and its retraction prevented. This may result either from an obliquity of the uterus, or more probably from an unequal dilatation of the anterior and posterior lips, the latter dilating most rapidly.

The remedy is simple and easily applied. During the interval between the pains, when the os uteri is soft and dilatable, the practitioner should gently push back the anterior lip over the crown of the head and hold it there during the succeeding pains,—a proceeding which, if nicely accomplished, will soon be followed by the expulsive pains of the second stage.

*Premature rupture of the membranes.*—This may occur either through their own weakness, or from violence, either accidental, or from the officious meddling of the accoucheur. The result is, that the os uteri instead of being dilated by the bag of membranes, which is soft and wedge-like, comes at once in contact with the child's head, which is not by any means so good a dilator. The only remedy is patience. An examination should be made early in order to correct the presentation without loss of time, should it be abnormal.

*Excessive quantity of liquor amnii* is sometimes enumerated as a cause of tedious labour; and this is apt to be in excess when the patient is feeble and the child small and ill-nourished. The treatment for this is rupture of the membranes; but it should not be practised without due caution, or it may produce tedious labour from the cause mentioned in the preceding paragraph.

In the *second stage*, the labour is often rendered tedious by the feeble and irregular action of the uterus; when this exists, the interval between the pains is long, and the pains themselves are feeble and short, and have little or no effect on the child. This state of things is not uncommon in delicate women, or, in the reverse; or it may be produced by mental depression, a deranged state of the digestive organs, or, it may arise from hereditary transmission.

In the treatment of these cases, it is above all things necessary to keep up the patient's spirits; all causes of irritation should be re-

moved, and she should be allowed to change her position. In some cases it may be right to administer an opiate, so as to recruit her by sleep, and in all cases a stimulating enema will be found of service, especially if the bowels are loaded and the delay depend on this cause. But the most effectual remedy in these cases, is the *ergot of rye*, a remedy which seems to possess a power of certain, direct, and speedy action on the uterus, causing it to contract almost unremittingly till its contents are expelled. Besides the power of strengthening feeble pains, Dr. Ramsbotham has shown that it is capable of *originating* uterine action.

It may be given either in substance, infusion, or tincture, in the dose of from fifteen to twenty grains of the powder, till a drachm is taken; half a fluid-drachm to one fluid-drachm of the tincture; or, the same quantity of powder as above directed, mixed in hot milk or coffee.

It is, however, to be given with caution, as results fatal both to mother and child have followed its injudicious administration.

The indications for giving it are, according to Dr. Churchill, 1st, feeble and inefficient pains without especial cause; 2d, if the os uteri be soft and dilatable; 3d, if there be no other obstacle to a natural delivery; 4th, if the head or breech present, and are sufficiently advanced; 5th, if there be no threatening head symptoms, nor excessive general irritability.

But, on the other hand, it should not be given, 1st, if the os uteri be hard and rigid; 2d, if the presentation be beyond reach; 3d, if there be a mal-presentation; 4th, if the pelvis be deformed; 5th, if there be any serious obstacle to delivery in the soft parts; and, 6th, if there be head symptoms, or much general irritation.

*Toughness of the membranes*, even after the os uteri is dilated, is sometimes a cause of tedious labour; but, when once ascertained, it admits of an easy remedy; if the pains are active, and the os uteri dilated, they may be ruptured without ceremony. The practitioner should cut a notch in his finger nail, and *saw* through the membranes, at the most dependent part, during a pain.

Sometimes they protrude unbroken, down to the os externum, and in some few cases, the child has been expelled with the bag of membranes and placenta *en masse*; under such circumstances it would certainly be drowned in its own liq. amnii if assistance were not at hand to rupture them, and enable the child to breathe.

*Rigidity of the soft parts* is a very common cause of delay in women who have borne children late in life, or who are of a plethoric condition, with a well-developed muscular system. In such, the head makes little or no progress, although the pains be strong and frequent. If this condition of things lasts long, the patient will fall into a state of exhaustion, or constitutional irritation; or inflamma-



tion and sloughing of the soft parts from long-continued pressure will ensue.

The indications in the treatment are, 1st, to *gain time*; 2d, to *counteract inflammation*. These will be fulfilled by a moderate bleeding, if the constitution will bear it; by a dose of opium, to moderate or suspend the uterine action; and by small doses of tartar emetic, with the hope of relaxing the system. To these means may be added, warm hip-baths, warm mucilaginous fomentations to the parts, and the introduction of unirritating unguents into the vagina.

If the rigidity be dependent upon the presence of *cicatrives* of the os uteri, vagina, or perineum, the result of laceration or sloughing in former tedious labours, or occasioned by the ill use of instruments, the same rules for treatment may be adopted.

The uterus may acquire an *inclination* one way or another, during pregnancy, from different causes, and this oblique position of the organ may be a cause of delay in the progress of the labour. In women who have borne many children it is often owing to relaxation of the abdominal muscles, which permits the uterus to fall forwards, and thus the child's head, instead of being propelled into the brim of the pelvis, is driven back against the upper part of the sacrum. The nature of the obliquity is detected by a per vaginam examination, which reveals the position of the os uteri; if it be *lateral*, place the patient on the *opposite* side; if *anterior*, let her lie on her back, and support and draw up the fundus uteri by means of a towel or napkin passed beneath the pendulous belly and fastened behind the back, until the head shall occupy the inferior strait.

There are various other causes that may render a labour tedious, such as an over-distended bladder, or a rectum filled with hardened fæces, a rheumatic condition of the uterus, tumours, and deformities of the pelvis, &c. In the first case, the remedy is found in the introduction of the catheter and drawing off the water; in the second, a stimulating injection should be given, or, if necessary, the hardened fæces removed with the handle of a spoon; in rheumatism of the uterus, the patient generally complains of feverishness and restlessness, the abdomen is tender, the urine scanty and high-coloured, for some time before labour sets in. The contractions of the uterus are rendered exceedingly painful, and at times inefficient. The treatment consists in bloodletting, warm fomentations, an aperient of mag. sulph. and sodæ carb., and alkaline drinks.

Tumours and deformities of the pelvis require instrumental aid, and render an otherwise natural labour, preternatural.

#### FACE PRESENTATIONS.

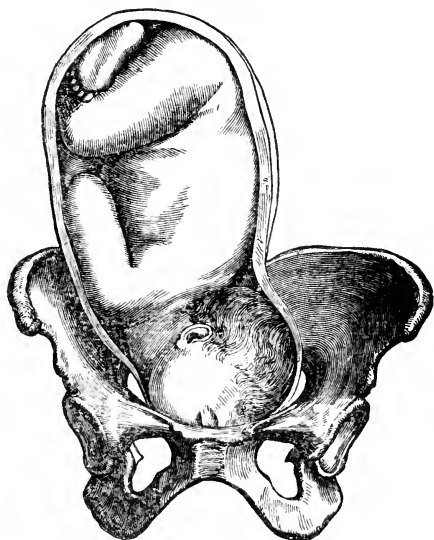
Face presentations are deviations from those of the vertex, and are not by any means as dangerous as they were formerly supposed to be. Madame Lachapelle has laid it down as a "fixed prin-

ciple, that this sort of labour is nearly as easy and as natural as that by the vertex, and affirmed, that out of seventy-two cases of this kind, forty-two were delivered by the unassisted efforts of the female, without danger either to mother or child. They are therefore included under the head of *Natural Labour*.

The *causes* of face presentations are obscure, and have been variously described by authors. Some suppose that they are caused by the inclination or obliquity of the fœtus itself, rather than of the organ which contains it. Madame Lachapelle attributes them to the circumstance that the anterior obliquity of the womb being very common, the weight of the occiput must in such cases prevent the chin from being applied to the breast; and must bring the mento-bregmatic diameter into parallelism with the sacro-pubic diameter, from the very commencement of the labour. Paul Dubois thinks they are primitive, and probably produced by the active movements of the fœtus itself, and the following is his explanation. "At any time during gestation, the chin may depart from the breast; if the fœtus retains this position till the end of pregnancy, it becomes permanently fixed in it at the commencement of labour, by the rupture of the membranes, and the contractions of the uterus."

By most authors, obliquity of the uterus has been looked upon as the principal cause of face presentations. If at the commencement

Fig. 18.



of labour the uterus is so oblique as to throw the fundus far over to the right side, the child presenting by the head and the vertex in the first position, the direction of the expulsive force operating on the infant, will propel its head against the edge or brim of the pelvis, and either cause it to glance upwards into the iliac fossa and let the shoulder come down, or it will be turned over, so as to let the face fall into the opening, and thus produce a face presentation, in which the chin will be directed to the right side,

and the forehead to the left of the pelvis. (Fig. 18.)

It will therefore be seen, from this explanation, that face presentations are deviations from those of the vertex. From this circumstance some authors make the same number of positions for them as for vertex presentations; others again make four, corresponding to the four *oblique* positions of the vertex, while some enumerate the same number, disposing them *transversely*, and from *front to rear*, admitting a *right mento-iliac* and a *left mento-iliac*, a *mento-pubic* and a *mento-sacral position*. These positions having all been established, it is proper that they should be mentioned. It seems advisable, however, to simplify as much as possible, and accordingly the number has been reduced very generally to two.

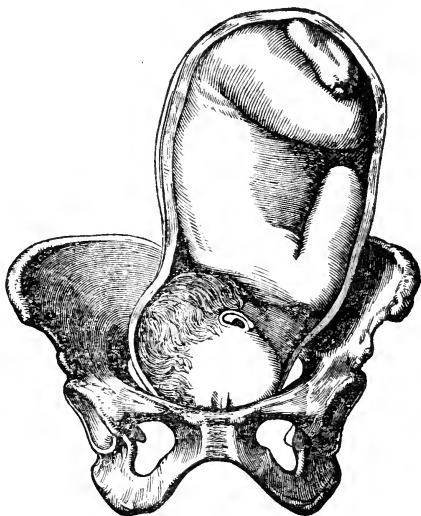
*First position*.—Forehead to the left ilium, or left acetabulum, and the chin to the right ilium, or right sacro-iliac junction, the bridge of the nose representing the line described by the sagittal suture in the first vertex position. (Fig. 18.)

The *second position*.—Forehead to the right acetabulum, or right ilium, and the chin to the left ilium, or left sacro-iliac junction. (Fig. 19.) The first position is a deviation from either the first or fifth position of the vertex; the second, from the second or fourth.

*Mechanism*.—In the first position the right side of the face is anterior, and therefore more depressed than the other on entering the brim, and the finger touches the right eye or zygoma first, on making an examination; if the labour is a long one, this part of the face is swollen and livid. The face comes down transversely, with the bi-malar, or rather the bi-temporal diameter, in coincidence

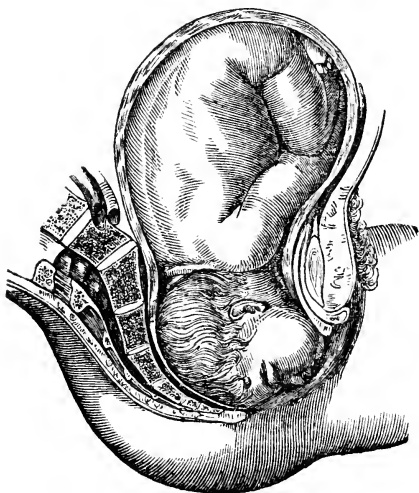
with the antero-posterior of the superior strait, and the fronto-mental with the transverse. As the head is forced down into the excavation, *extension* first becomes as great as possible, then the chin rotates upon the right anterior inclined plane until it gets under the arch of the pubes; while the anterior fontanelle glides in an opposite

Fig. 19.



direction upon the left posterior inclined plane, and falls into the hollow of the sacrum. As the chin emerges, it rises up towards the mons veneris, performing in this case the movement of *flexion*, instead of *extension*, as in vertex cases; the forehead, followed by the sagittal suture and occiput, passes gradually down the plane

Fig. 20.



presented to it by the anterior surface of the coccyx and perineum, in front of which all these parts are successively disengaged. (Fig. 20.)

The *second position* is merely the reverse of the *first*; the left side is now turned forwards, and the left eye and zygoma are lowest in the pelvis, and the ecchymosis is found on this side, if the labour is protracted. The chin rotates upon the left anterior inclined plane, and the anterior fontanelle on the right posterior one: the same diameters correspond,

and the labour is completed as in the first position. It is said that this position is more frequent than the former, and that rotation is more readily effected, as the rectum offers no impediment.

In all the various positions that have been described or alluded to, the object is to bring the chin to the pubis, and the mechanism is the same as in the two varieties above described. Should this fail, and the chin rotate into the hollow of the sacrum, it is impossible for this part to be born first (unless the fœtus be an abortion); for the thorax would then be in the pelvis at the same time as the head, and would require assistance to deliver it. These cases will be treated under *Preternatural Labour*.

*Diagnosis.*—Generally speaking, it is not difficult, although the face has been confounded with the breech. It is generally distinguished by the prominence and regularity of the features, by the nose, eyes, chin, and mouth; the latter is distinguished from the anus by the absence of the prominence of the coccyx, and by the sphincter ani; the best means of diagnosing face presentations is by the bridge of the nose, which from its *crossing* the os uteri

may be detected at a very early period of labour; it is better than the eye, which may not only be injured, but may mislead; it is better than the malar bones, for these may be mistaken for the tuber ischii, or even for the shoulder. The nose not only tells the presentation, but also the *position*. After the face has descended, the chin will confirm it.

*Treatment.*—Face presentations require more laborious effort for delivery than others, from the fact that the cephalic extremity is removed from the line of direction in which the uterus and accessory powers act. The second stage is also longer, because the bones of the face are incompressible, and there is not the same adaptation to the parts through which it is to pass.

In ordinary cases little is required beyond watching the case carefully, cheering and supporting the patient. If called early enough, endeavour to rectify the presentation; if not, to bring the chin to the pubis by the gentlest assistance. In most cases no interference is required; the general rules already given are sufficient. The features of a child born under a face presentation are generally much swollen, turgid, and livid. We must be prepared, therefore, to expect some disfigurement, which, however, will generally disappear in a day or two.

*Other deviations* from vertex presentations sometimes occur from the operation of the same or similar causes. The head may descend half turned over, so that the occipito-frontal, or occipito-mental diameter corresponds to those of the straits. In this case either the anterior fontanelle or forehead will be the presenting part. Sometimes the head is too much flexed, occasioning a part of the nucha to present with the occiput. Again, it frequently happens that one of the parietal bones, or the ear, or the temple, being nearly parallel with the plane of the superior strait, engages first. Such cases may either correct themselves, or become the cause of preternatural labour.

#### PELVIC PRESENTATIONS.

Under the head of pelvic presentations are included those of the knees and feet; it matters but little, so far as the mother is concerned, which end of the fœtal oval presents at the superior strait, since either can be born unassisted. These pelvic presentations are, however, more dangerous to the child than cephalic, either from the fact that the placenta is often detached from the uterine surface before the head is born, or from pressure upon the umbilical cord during the exit of the head, either case being attended by the same result, viz.: *asphyxiation of the child*. All practitioners agree that the child is oftener born dead in pelvic presentations, than in those in which the vertex descends first.

*Causes.*—Breech labours occur once in about every forty-five or fifty cases; why they occur this often, or why they happen at all,

appears to be inexplicable. Madame Lachapelle explains their occurrence as follows:—During a great part of gestation, and whilst the fœtus is still movable in the cavity of the uterus, its long diameter can be readily brought into coincidence with the transverse diameter of that organ; its position therefore is by no means fixed, and it can, by virtue of its active movements, present any part of its surface at the uterine orifice, but especially the cephalic or pelvic extremities. The latter part may occupy the superior strait at any period of gestation, in consequence of the movements of the fœtus, and may remain in that situation for an indefinite period. It happens then, if the fœtus in this time should have developed itself to any extent, it cannot turn, and it will be apt to retain the attitude it may then acquire till the end of pregnancy, as its length does not readily admit of its passing the transverse diameter of the uterus.\* Violent movements on the part of the female, it is thought, may also be a cause of pelvic presentations, but as before stated, they are in the great majority of cases, inexplicable. Some women, from original conformation or other causes, appear particularly obnoxious to this mischance, bringing all their children into the world by breech labours.

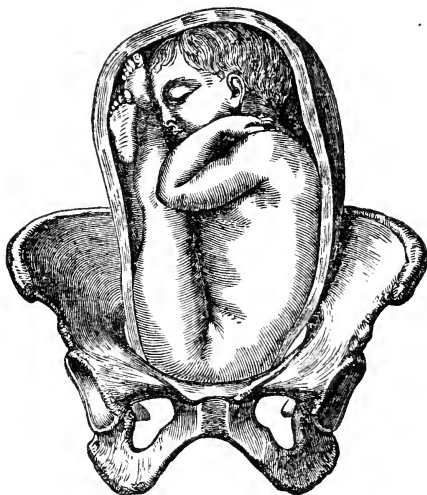
*Prognosis.*—Breech labours are generally more tedious than cephalic, inasmuch as the pelvic extremity is not so good a *dilatator* as the cephalic; it never presents the same evenness, the same resistance, or the same rounded form as the head to the openings of the pelvis; it consequently acts to much less advantage on the cervix to finish its dilatation. In vertex presentations the most voluminous part, that which is best calculated to bear all kinds of pressure, escapes first. In pelvic presentations, on the contrary, the point of the cone advances first, so that the fœtus progresses more slowly in proportion as the labour advances.

*Positions.*—The same difficulty occurs in enumerating the various positions of the breech that we have seen obtain in the other presentations, every author recording those which seemed to him best established. Thus some make as many as eight; among these is M. Flamant, who makes one for each extremity of the different diameters of the superior strait, viz.: two for the antero-posterior, two for the transverse, and two for each of the oblique, making eight in all. Others make six, corresponding to the different positions of the vertex, the sacrum taking the place of the vertex. We find again some reducing them to four, viz.: 1st, sacrum to the left acetabulum, 2d, to the right acetabulum, 3d, to the pubes, 4th, sacrum of the child to the promontory of sacrum of the mother. Thus the direct positions, either anterior or posterior, are possible, as well as the diagonal ones, and the breech *may* present in as many ways as the head.

\* Chailly, *Traité Pratique de l'Art des Accouchemens*, p. 604.

To simplify the matter, however, most of the recent writers reduce them to two, viz.: *sacro-anterior*, and *sacro-posterior*, that is, the back of the child towards the belly of the mother, and the back of the child towards the back of the mother. Not that the back of the child is *directly* anterior or posterior, but oblique, the transverse diameter of the child's hips corresponding to one or other of the oblique diameters of the superior strait. (Fig. 21.)

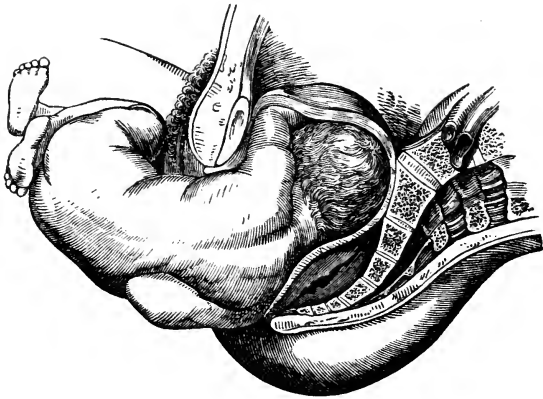
Fig. 21.



*Mechanism.* — The mechanism of the sacro-anterior positions is so much alike, that but one description will be given of them. Naegelé, on the mechanism of parturition, says, that “In every case, whether the nates have at first a completely transverse or oblique direction, they will be always found, on pressing lower into the superior aperture of the pelvis, to have taken an oblique position; and that ischium which is directed anteriorly, to stand lowest. In the most common position, where the sacrum of the child is towards the left acetabulum, as the breech descends into the pelvis, it is the left ischium that stands lowest, and is first touched by the finger. The child's left hip rotates forwards upon the right anterior inclined plane under the arch of the pubis, while the right hip slides backwards into the hollow of the sacrum along the left posterior inclined plane. As the shoulders are supposed to remain fixed in the uterus, flexion of the child's body takes place as it is being born, and restitution after the birth of the hips is effected. As the shoulders also engage obliquely, they undergo rotation, the left shoulder rotating on the right anterior inclined plane, and appearing under the pubis, while the right falls into the hollow of the sacrum (Fig. 22).

“But whilst the shoulders are descending in the above-mentioned oblique position, the head, with the chin resting upon the breast, presses into the superior strait in the direction of the right oblique diameter, that is, with the forehead at the right sacro-iliac junction, the occiput rotates upon the left anterior inclined plane, towards the

Fig. 22.



pubis, and the forehead on the right posterior, into the hollow of the sacrum, and the head is born in such a manner, that whilst the occiput rests against the os pubis, the point of the chin, followed by the rest of the face, sweeps over the perineum, as the head turns on its lateral axis from below upwards (Fig. 23).

Fig. 23.



“There is no essential difference in the mechanism of the labour, when the sacrum is at the right acetabulum, except that the rotation is reversed; the right hip and shoulder rotate on the left anterior in-



clined plane, and the left hip and shoulder on the right posterior inclined plane; the occiput on the right anterior, and the forehead on the left posterior inclined plane. As before mentioned, when the sacrum is to the pubes, as it descends it becomes oblique, and then the mechanism is precisely the same as above described. (Figs. 22, 23 describe these.)

“As in positions of the cranium, the swelling of the integuments is chiefly met with on that parietal bone which, during the passage of the head, is situated lowest, and on that spot with which it enters the external passage, so in this case, the livid-coloured swelling appears on that part which, directed forwards, was situated lowest during the passage of the nates, and with which the nates were born.”

In the second chief position, viz. : with the anterior surface of the child corresponding to the anterior abdominal parietes of the mother, or in other words, with the sacrum of the child to the sacrum of the mother, the same effect is produced by the expulsive action as before. The breech descends to the outlet of the pelvis; a slight turn is effected; one of the ilia (and it is generally the left) appears under the arch of the pelvis, the other traverses the perineum; the breech and legs escape, the shoulders pass the brim, and descend until they press upon the structures at the outlet; one escapes under the arch of the pubes, the other follows the curve of the sacrum, and the head is propelled into the cavity of the pelvis, with the face looking to one side, and the occiput to the other.

It might be supposed, from the position of the head at the commencement of labour, with the face looking forwards, that the *occiput* would fall into the hollow of the sacrum, and the *face* emerge under the pubes; but this is not the case; for when the shoulders are born, and the head is in the pelvis, the face is directed to one side or the other, exactly as in the sacro-anterior position; and a precisely similar turn is effected, the face falling into the hollow of the sacrum; so that the foetus in its exit makes a semicircular rotation, the face being placed forwards at the commencement of labour, and being expelled through the outlet over the sacrum and perineum. Dr. Ramsbotham, from whom the above description is taken, says farther, “I believe that in no instance, if the case were left entirely to nature—provided the child and pelvis were of the common size and form—would the face be expelled under the arch of the pubis.” Dr. Collins also confirms it. Dr. Naegelè mentions this last as a deviation from the ordinary mechanism of breech cases. He also describes another deviation, in which the chin departs from the breast, and the head enters the pelvis, after the birth of the body, with the occiput pressed against the nape of the neck, and the vertex corresponding to one or other ilium of the mother. As the head presses lower into the cavity, the vertex turns gradually more and

more backwards, so that when the trunk is born, the arch of the cranium is directed to the hollow of the sacrum, and the inferior surface of the lower jaw to the symphysis pubis. In the birth of the head, whilst the under jaw presses with its inferior surface against the os pubis, the point of the occiput, with the vertex, followed by the forehead sweeps *first* over the perineum; thus bringing the occipito-mental diameter into apposition with the antero-posterior of the outlet.

*The diagnosis* of breech presentations has already been given; it is not usually difficult. It may be confounded with the face, particularly where the labour has continued for some time, and the presenting part is tumid. It will be distinguished from the latter by the absence of the bridge of the nose, by the movable, *single* point of the coccyx, by the contractility of the sphincter ani, by the tubera ischii, by the cleft between the nates, by its roundness and softness, and by the organs of generation. Of these, however, the point of the coccyx and the sacrum are the best, as the others may be so altered by swelling as not to be recognisable. The presence of the meconium is not a certain sign, since it is occasionally met with in cephalic presentation, where the child is subjected to strong pressure, though in the latter case, Dr. Collins says it is more fluid, from being mixed with the discharges from the uterus and vagina.

*The shape of the bag of waters*, is another diagnostic sign, being less hemispherical and more cylindrical than in vertex presentations, and more resembling an intestine in shape.

*Auscultation*, though not a certain test, is a corroborative proof; the sound of the foetal heart will be heard higher in the abdominal region, if the head be at the fundus uteri, than if it be seated in its more natural position. The same is true of the *movements* of the foetus, they being generally felt *lower* in the abdomen in breech cases, than in those in which the vertex presents.

Presentations of the breech, although perfectly natural labours, are generally more tedious for the mother, and more dangerous for the child than those of the head, for reasons already stated, viz.: that when, in pelvic labours, the head enters the pelvis, if every thing be not favourable for its passing rapidly through it, the cord is so long compressed that the child is almost certainly lost.

*Treatment*.—Much more care and attention are required in the treatment of these labours, than in those before described; not only to protect the soft parts of the mother, but also to preserve the child's life, which is always placed in more or less danger. It is, therefore, of great importance that a correct diagnosis should be made early. Being satisfied that it is the breech which presents, the case requires no interference until the breech shall have been expelled through the external parts, further than to guard the soft parts of the mother, and carefully to support the perineum. Above all things, the atten-

dant should not draw down the feet, as the inexperienced are too apt to do, in the hope of facilitating the delivery by having something to pull upon; this practice always diminishing the size of the dilating part, and thus *prolonging* the labour. As the breech escapes, it should be supported and carried upwards in the axis of the pelvis, allowing it perfect liberty to change its position or make such turns as the mechanism may require. Mechanical assistance is rarely required in these cases, the child *adapting itself* to the passages of the mother.

When the umbilicus appears at the external organs, the cord should be seized and gently drawn down and pushed down to one side; this will prevent its being torn and pressed upon.

The *strength of the pulsations in the cord*, is the *best evidence we have of the necessity for any interference*.

When the thorax has emerged, if the arms have not escaped with it, they should be brought down by passing one or two fingers over the shoulders, as near as possible to the elbow, and then drawing the arm *across the face and chest* until the elbow arrives at the external orifice; having delivered one, the other is easily extracted. It is generally better to deliver the one at the perineum first.

The slower the pelvis and body pass out, the quicker will the head pass, and the greater will be the chance of saving the child's life.

The body being born, it should be wrapped in warm flannel, and raised upwards on the practitioner's arm, to a height sufficient to enable the longest diameter of the head to become parallel with the axis of the vagina, and the patient urged to bear down.

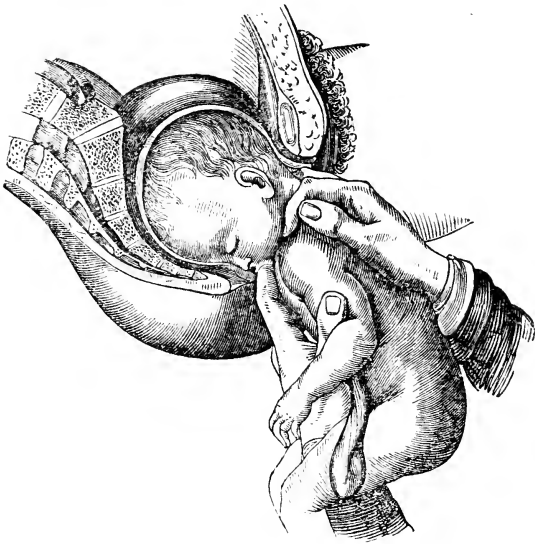
If the head be delayed while in the vagina there is danger of losing the child; the extent of this danger will be estimated by the pulsation in the cord. As in most cases the head will be found with the face in the hollow of the sacrum, the delivery may be hastened by introducing one or two fingers of the left hand into the mouth, and depressing the chin upon the breast, at the same time carrying forward the body of the child. (Fig. 24.)

If this fail, the perineum should be pressed back so as to allow the atmospheric air to enter to the respiratory organs. The child, in this way, may be saved till the expulsive efforts effect the delivery. Should these means fail, and the child be in danger, the forceps should be at hand, and the child be delivered by their assistance.

If it should happen that the body is expelled with the face anteriorly, and the chin should lodge upon the pubes, it should be carried *backwards*, and the chin drawn down by the finger introduced into the mouth. The remainder of the delivery and the after treatment, are the same as in vertex presentations.

*Presentations of the inferior extremities.*—What has been said in relation to the danger of breech presentations, applies with even more force to those of the lower extremities. In this latter case the

Fig. 24.

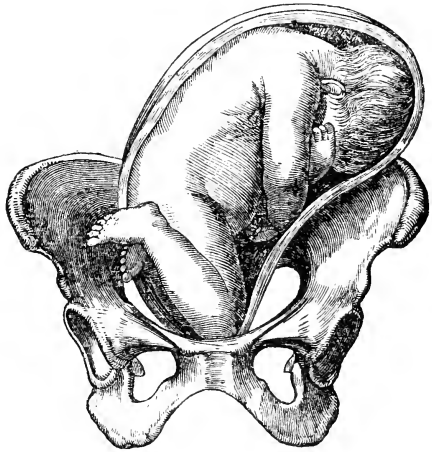


child may be compared to a *cone*, the apex of which presents itself first. Of course, under these circumstances, the pressure upon the child is constantly increasing as it descends, and the external parts not having been thoroughly dilated, when the body is born and the head engages, it is much more liable to prove fatal to the child in consequence of the detention that almost unavoidably ensues; the *prognosis*, therefore, in such cases is less favourable than in a *simple breech presentation*.—*Diagnosis*. Presentations of the feet may be readily distinguished. Before the membranes have ruptured, the bag of waters often protrudes in a more cylindrical form, or like the finger of a glove, and we discover that the presenting part is smaller than either the head or breech. At this stage we cannot readily distinguish whether it be the superior or inferior extremity that presents. After the membranes have ruptured, the *foot* will be recognised by its greater length, by the rounded instep, by the uniform length of the toes, by the absence of a thumb, and by the presence of the heel with the ankle bone on either side. The *knee* may be distinguished from the elbow, with which it is liable to be confounded, from the fact, that it is thicker, that it has two prominences, and a depression between them; while the elbow, which is thinner, presents between the two prominences, a projection, in which it seems to end. (Fig. 25.)

*Positions of the feet.*

—Most accoucheurs enumerate *four* positions for footling presentations, viz.: 1st. Heels behind the left acetabulum, loins in front and to the left. 2d. Heels behind right acetabulum, loins forward and to the right. 3d. Heels behind the pubis, loins directly in front. 4th. Heels to the promontory of the sacrum. There are others who enumerate six, corresponding with vertex positions, and others again as many as eight, corresponding with those of the sacrum mentioned in the beginning of this article.

Fig. 25.



Following the arrangement adopted in relation to breech presentations, we enumerate but *two*, viz.: a *calcaneo-anterior*, and a *calcaneo-posterior*. 1st. When the heel is directed forwards and the toes backwards. 2d. When the heel is backwards and the toes forwards. The former is the more frequent, and both correspond to the two classes of breech presentations. (Fig. 26.)

Fig. 26.



The *positions of the knees*, have also the same varieties, the *anterior* parts of the leg corresponding to the sacrum and the vertex; and as they are commonly converted into footling cases, they do not require a separate description. (Fig. 25.)

*Mechanism.*—The feet meeting with no resistance to fix them, are liable to change their position during their descent until the hips enter the brim, which they do precisely as in breech cases; the mechanism, therefore, is the same, and does not require a further description.

*Treatment.*—The same rules apply to the treatment of presentations of the inferior extremities that were laid down in breech cases, with the additional caution, *not to yield to the temptation to pull down the feet*; the dilating part is already too small for safety, and if it be diminished by this procedure, the child will almost certainly be lost by pressure upon the cord during the descent of the head.

#### PRETERNATURAL LABOUR.

*Preternatural labour*, or *dystocia*, signifies a faulty, or irregular labour, the course of which is unfavourable, and in which the assistance of the obstetrician becomes necessary. It will be remembered that this definition applies to all cases of labour, without reference either to presentation or position, in which manual assistance becomes necessary.

According to Velpeau, the causes that render labour difficult, depend either upon the mother or the child. Some of them are unforeseen, or do not occur till the moment of parturition; the title of *accidental* may be appropriated to them. Others exist beforehand, and render the labour necessarily difficult; they merit the denomination of *pre-existing* causes.

The *accidental* causes are: any serious disease, such as inflammation of the brain or its coverings, the lungs, pleura, peritoneum, or uterus, &c., which takes place during labour; any hemorrhage sufficiently abundant to endanger the life of the mother or her offspring; convulsions, syncope, laceration of the womb, the premature escape of the cord, hernia, aneurism, asthma, great debility, &c., and some positions which do not become bad until after the first pains.

The *pre-existing* causes are: deformities of the pelvis, malformation or disease of the organs of generation, calculus in the bladder, fibrous or other tumours in the excavation, deformities in respect to height, transverse positions, monstrous conformation and diseases of the fœtus.

As these different causes are in reality only complications of labour, it follows that *dystocia* comprises all cases of complicated labour, as *eutocia* comprehends all simple labours.

From the occurrence of any of the above-mentioned causes, one of the following operations may become necessary, to wit: *turning*, the *application of the forceps*, or *craniotomy*. The first of these most frequently becomes necessary in cases of transverse positions

of the child, as in presentations of the shoulders. As the mode of proceeding is the same whenever the operation becomes necessary, it will be described only in cases of *shoulder presentations*.

#### PRESENTATIONS OF THE SUPERIOR EXTREMITIES.

In almost all cases of this kind it is the shoulder which presents itself at the superior strait, but it may happen that instead of a shoulder, a hand or elbow may be prolapsed; still, when they are advanced to a certain degree, it is the shoulder which fills the strait and presents the obstruction. The descent of the arm or hand add nothing to the difficulty; indeed it is rather serviceable, since it assists us in our diagnosis, and does not at all interfere with the successful termination of the labour. In this respect it differs from breech presentations, in which the descent of the feet is altogether to be avoided.

In all cases of shoulder presentation the back of the child either looks forwards toward the abdomen of the mother, or backwards towards the spine; the former is twice as frequent as the latter.

It need hardly be said, that in the majority of such cases, the delivery is impracticable except by art, although there are cases reported of what is called *spontaneous evolution*, in which the child has *righted* itself, the arm and shoulders receding, and the breech descending in its place, the labour being completed by the unassisted efforts of the mother.

Although spontaneous evolution *may* take place, it is more conformable to the dictates of prudence and humanity to turn the child, and bring down the feet, or restore the head to its proper place.

*Causes.*—There have generally been enumerated but two great presentations, viz., the *cephalic* and *pelvic*, all others are but deviations from these. As footling and knee presentations are deviations from the breech, so are those of the shoulder from cephalic. Various causes have been enumerated; among them are particular positions of the mother's body, inclination of the womb or of the straits of the pelvis, sudden and irregular movements of the foetus, irregular early contractions of the womb, and irregular distension. Dr. Rigby concludes that the causes of arm or shoulder presentations are of two kinds, viz., when the uterus has been distended by an unusual quantity of liquor amnii, or when, from a faulty condition of the early pains of labour, its form has been altered, and with it the position of the child.

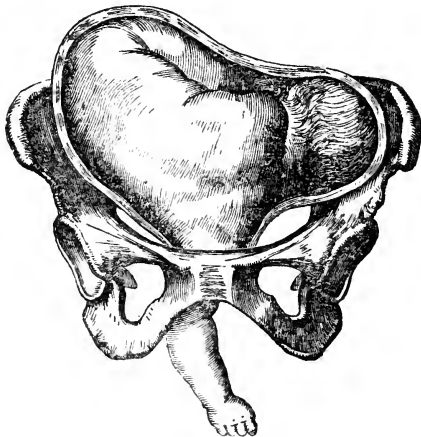
Dr. Meigs looks upon obliquity of the womb as the great cause. When the fundus falls over to either side, the action of the uterus is oblique, the head, instead of engaging in the superior strait, strikes against the brim of the pelvis, and glancing off from thence, is

turned upwards into the costa of the ilium, while the shoulder descends or engages in the superior strait.

*Diagnosis.*—It is only when the labour has commenced, and indeed made some progress, that a shoulder presentation can be positively detected. It may be *suspected*, if we are unable to reach the presenting part, if the os uteri, though flaccid, opens slowly, if the bag of waters is cylindrical, or like the finger of a glove, and if the uterus ceases to act after the membranes have been ruptured for some time. We can only *positively* detect the presentation by distinguishing the different parts of the child, as, for instance, the spinous process of the scapula, the clavicle, the round-shaped shoulder, the axilla, the ribs, the arm, and in some cases the hand when prolapsed, distinguished from the foot by the means already pointed out. The aspect of the palm of the hand will mark whether it be the right or left. The diagnosis between the *breech* and the *shoulder* will be easy, if the distinguishing marks of the former are remembered.

*Positions.*—There are two positions for the presentation of each shoulder, viz., a *first* and *second* for the *right shoulder*; and a *first* and *second* for the *left*. In *both* the first positions the head is on the left of the mother, and in both the second, on the right. As shoulder presentations are deviations from *vertex* presentations, the *first* positions are the most common. These positions are called the dorso-pubic and dorso-sacral of the right, and dorso-sacral and dorso-pubic of the left shoulder.

Fig. 27.





*Right shoulder.—First position.*—The head of the child is to the left of the mother, the back of the child is towards the front of the mother, (dorso-pubic,) and the face of the child with its toes and feet look towards her back. (Fig. 27.)

*Second position.*—The head of the child is to the right of the mother, the back of the child towards the back of the mother, (dorso-sacral,) and the face and front of the child look towards the front of the mother. (Fig. 28.)

Fig. 28.

*Left shoulder. First position.*—The head is on the left, the face and front of the child look forwards, and the back is to the back of the mother, (dorso-sacral of the left.)

*Second position.*—The head is to the right, the face and front of the child look backwards, and the back is towards the front of the mother, (dorso-pubic of the left.)

*Treatment.*—Having ascertained that

the case is a *shoulder presentation*, the indications are to deliver by the operation of *turning*, or *version*; by which is understood “the act of turning the child with the hand, and bringing one of the extremities of its great diameter to the superior strait.” (Velpéau.)

There are three varieties of this operation described by obstetrical writers: *First. Version by the head*, in which the presenting part is pushed away, and the head substituted for it; the remainder of the labour being left to nature. *Second. Version by the breech*.—Where the pelvic extremity of the child is substituted for the presenting part, and the case converted into a *breech labour*. *Third. Version by the feet*, in which the hand is introduced into the cavity of the uterus, one or both feet seized and brought down, causing the child to make a complete evolution, and extracting it footling. (Fig. 29.)

The first and second methods, although safest for the child, are rarely employed, in consequence of the difficulty of seizing and moving

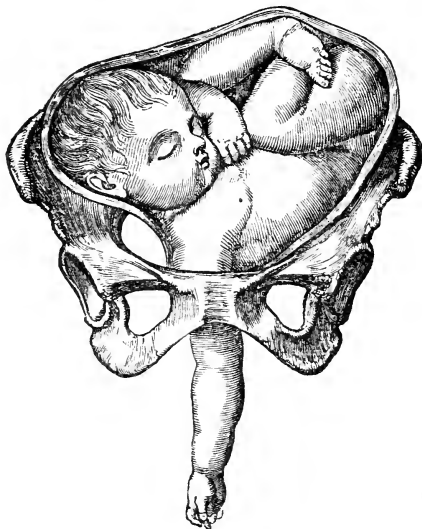
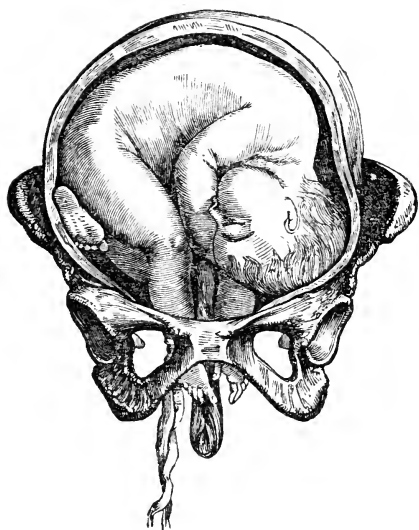


Fig. 29.



the parts mentioned into a more favourable condition. The third is the mode of practice generally adopted, and although more dangerous to the child, it is safest for the mother, since it gives the attendant more complete control of the case. It is the mode of delivery now almost universally adopted, both in this country and Europe.

*Method of procedure.*—The operation ought never to be attempted till the os uteri is *dilated*, or *dilatable*; the fittest moment is when the os uteri is *fully dilated* and the *membranes unruptured*. If the os uteri is

rigid and unyielding, the proper means of relaxing it should be first adopted; the rectum and bladder should also be thoroughly evacuated, and the *position* carefully ascertained.

The patient should be placed in the position most convenient to the operator; some recommend that on the back, with the hips on the edge of the bed, and the knees supported by assistants; some on the hands and knees; others prefer the ordinary position on the left side. The *choice of the hand* depends on the position: the rule is, *use that hand whose palm, when opened in the cavity of the womb, looks towards the abdomen of the child*. Some recommend the use of the right or left hand, according as either is most convenient. It should be well oiled on the outside, and introduced in a conical form, into the vagina, during a pain; it will then be ready to enter the os uteri as soon as the pain goes off. The presenting arm is never an impediment, and should not be removed.

When the membranes remain unruptured, the hand should be gently insinuated between them and the uterus, until the feet, (or *one foot*,) are found, always stopping and opening the hand on the accession of a pain.

Be certain that it is a foot that is seized. *Now* rupture the membranes and draw the feet, or foot, with a waving motion, slowly into the pelvis. By this method the liquor amnii is retained, the uterus

kept distended, and the child turned with as great facility as in a "bucket of water."

The act of turning should be accomplished during an *interval* of pain, thus the danger of rupturing the womb will be avoided. External pressure with the unoccupied hand favours the version very considerably, and should never be neglected. In turning the child, the feet should be brought over the *front* of the child, and not over the back, thus avoiding dislocation of the spine.

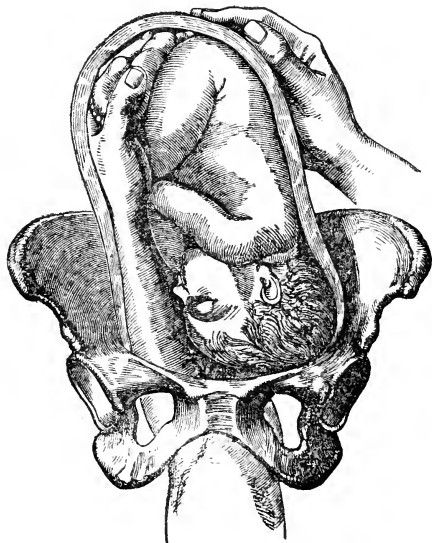
The *extraction* of the child should be accomplished *during* a pain, always remembering the axis of the pelvis, and being careful not to place the fœtus in a wrong position, but endeavouring to make the face fall into the hollow of the sacrum. The case is now a footling one. When the membranes are ruptured, and the waters drained off, additional care is necessary not to *force* the uterus, but to endeavour to promote relaxation by the proper means, and above all to use gentleness in overcoming the contractions.

It is considered advisable by some practitioners to turn by *one* foot only, inasmuch as the breech with the thigh turned up, is more bulky than the hips with the thigh extended; the passage will be better prepared to admit the quick transit of the child's head, upon which the safety of the infant depends. After the case has been converted into a footling, it should be treated as though it were so originally, that is, left as far as possible to the natural expulsive powers.

*Version in cephalic presentations*, is accomplished by the same method of proceeding: the same rules applying for the choice of the hand, &c., as in shoulder presentations. This operation sometimes becomes

necessary in hemorrhages before delivery, either accidental or unavoidable; convulsions; prolapsus of the cord; syncope, &c., thus converting, what would otherwise have been a natural, into a preternatural labour. (Fig. 30.)

Fig. 30.



When the operation of turning is entirely impossible, it may become necessary to deliver the mother either by *exvisceration*, or *decapitation*.

### THE FORCEPS.

It would be manifestly out of place, in a work of this kind, to enter into a detailed history of the forceps. Suffice it to say, that although hinted at by the ancients, we find no record of their discovery or application, till the beginning of the seventeenth century, when Dr. Hugh Chamberlayne published a translation of Mauriceau, in the preface of which he declares that his father, brother, and himself, "have by God's blessing and our industry, attained to, and long practised, a way to deliver women without any prejudice to them or their infants." "By this manual operation, a labour may be despatched (in the least difficulty), with fewer pains, and sooner, to the great advantage, and without danger, both of woman and child."

The merit of the discovery, therefore, seems to rest with Dr. Paul Chamberlayne, by whom and his sons it was kept a profound secret, till about the year 1715, when it was made public. Since that time, the instrument has undergone various modifications, always, however, retaining the general form originally given to it. The English generally prefer the short forceps, the French and Germans the long. In this country, the long forceps are most generally used.

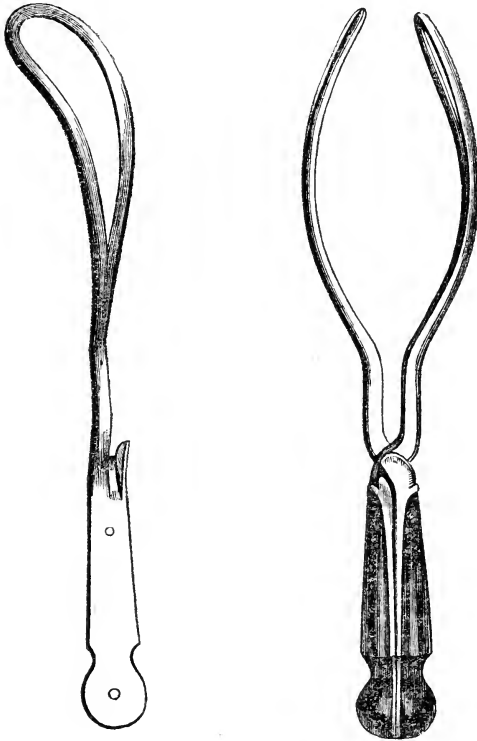
The forceps are intended for the extraction of the child's head, *and nothing else*. They possess the twofold power of, 1st, grasping and slightly compressing the child's head; 2d, that of acting as a lever of the first kind, and as an extractor. They are to be applied to no other part of the child's body than the head, and are not designed to be applied in cases of premature delivery, or where the head is larger than natural from abnormal growth.

This instrument consists of two branches or pieces, one intended to be used by the right hand, and the other by the left. The first is called the *right hand* blade; the second, the *left hand* blade, or branch. Each branch consists of three parts, viz.: the blade, or clam, the lock, and the handle; in some instruments, the handle terminates in a blunt hook. The clam or blade, ought, if possible, to be applied to the side of the child's head, and not to the face or vertex, and should extend from the vertex to the chin. It is provided with an open space called the *fenestra*, which not only renders the instrument lighter, but enables it to be more accurately applied to the sides of the head. The *lock* consists either in a *pivot* in one branch, which is called the male blade, and a notch in the other, called thence the female blade, which is the German lock; or a notch in the upper surface of the left, and in the lower surface of the right branch, which is the English lock.

The original forceps, (and at this day, many of the English

forceps,) were *straight* in the direction of their length; that is, they had only one curve, that which applied itself to the child's head. Drs. Smellie and Levret, both about the same time, gave to the blades a new curve on the edges, so as to adapt them to the axis of the pelvis. This modification is therefore often spoken of as the "*New curve.*" (Fig. 31.)

Fig. 31.

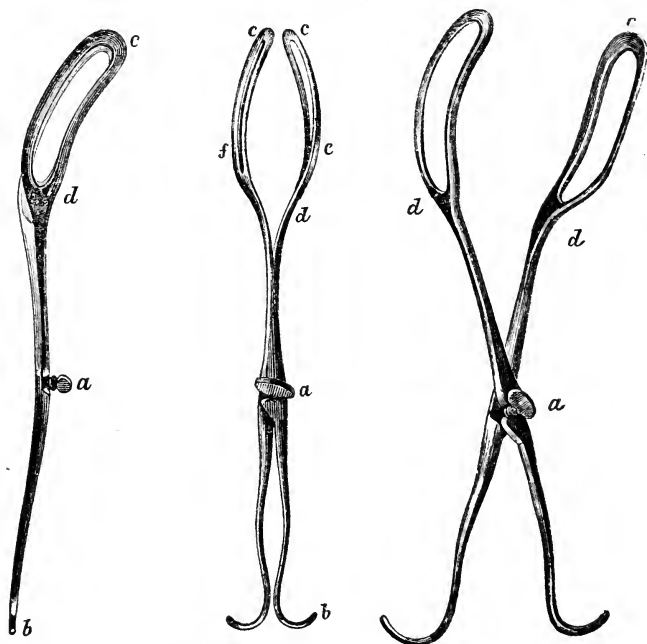


The "*eclectic forceps,*" as modified by Professor Hodge, of the University of Pennsylvania, combines the advantages of both the long and short forceps. Fig. 32 represents them: *a*, lock; *b*, blunt hook at end of handle; *c*, *d*, clam; *e*, *f*, the fenestræ.

*Indications for their Use.*—The forceps are indicated, 1st, where nature is unable to expel the child, either from a want of sufficient power, or when the labour is arrested by certain malpositions of the head at the brim, or in the cavity of the pelvis; 2d, whenever the

labour becomes dangerous for mother or child, and where the danger can only be removed by hastening the labour.

Fig. 32.



It is meant, when the *forceps* are used, to supply with them the insufficiency, or want of labour-pains; but, so long as the pains continue, there is reason to hope they will produce their effect, and therefore justify waiting.

*The first stage of labour must be completed*, that is, the os uteri must be dilated, and the membranes broken, before the attempt is made to apply the forceps. They are never to be used as *dilators*. Care must be taken, however, that, from an aversion to the employment of instruments, their use is not too long delayed, and thus the benefit to be derived from their application be entirely lost.

The most favourable case for their application is, where the head is at the inferior strait; the nearer the head is to the external organs, the more readily may the instrument be adjusted to it, especially if *rotation* have taken place. It is very rarely, if ever, necessary to apply them, where the head has not yet passed the superior strait. The forceps should always, *if possible*, be applied over the ears of the child; it is a good rule, therefore, always to find this part, before proceeding to apply them.

*Method of Application.*—Having determined to apply the forceps, the same general rules should be observed as in turning, viz.: evacuate the bladder and rectum; draw the patient to the edge, or side of the bed, having previously protected it from injury, and place her either on her back with the feet supported, or as the English practitioners prefer, on her left side. The necessity and nature of the operation should always be explained to the patient or her friends, before proceeding to its performance.

The instruments should always be warmed and well anointed before using them, and some mild unguent should also be applied to the external organs, and the patient protected from exposure, by a sheet or blanket thrown over her. The great importance of a *precise* knowledge of the *position of the head* should be impressed upon the mind of the practitioner, before commencing this operation.

*Which blade must be introduced first?*—In this country and on the continent, where the long curved forceps are used, very explicit directions are laid down for the choice of the blade. In England, where the short straight forceps are employed, it seems to be a matter of indifference which is applied first, the general directions being to apply that blade first, the lock of which looks forwards. The following directions, therefore, apply to the use of the *long curved forceps*. Let the student remember, in the first place, that the forceps are to be applied perpendicularly to the transverse, parallel with the occipito-mental diameter of the child's head. As a general rule, the *left hand*, or *male blade*, should always be introduced *first*.

*Occipito-anterior position*, where the vertex presents and rotation has taken place. The left hand, or male blade, is to be taken in the left hand as a writing pen is held, two or three fingers of the right hand are to be introduced between the left side of the vagina and the child's head, so that their extremities may touch the os uteri; the handle of the instrument is first raised up high in front of the woman's right groin, so as to bring the other extremity in the line of the axis of the vulva, into which it is next gently and slowly introduced *in the interval between the pains*; in proportion as it enters, the handle is by degrees brought from above downwards, and from right to left, towards the median line. The point of the instrument must be kept carefully in contact with the child's head, and *no force* used in the introduction. It is thus moved onwards, making it follow the left posterior inclined plane, gradually depressing the handle until the instrument has been placed by the side of the child's head in the direction of the occipito-mental diameter. The handle is then to be given in charge of an assistant, and the *right hand*, or *female blade*, to be taken in the right hand in the same manner as before, while the fingers of the left are to be introduced between the right side of the vagina and the child's head. Upon these, as the guide, the blade is to be introduced as before described, gradually depressing

the handle till it comes in contact with and crosses the blade first introduced; the two are then to be locked, and the adjustment is completed. Care should be taken that nothing be entangled in the lock of the forceps, by carrying the finger round it.

Should the handles of the forceps, when applied, come close together, probably the bulk of the head is not included between them, and therefore, when we acted with them, they would slip.

If the handles, when locked, are at a great distance from each other, they are not accurately applied, and will probably slip. Allowance should be made, however, in these estimates, for the different dimensions of the heads of children. When the instruments are thus adjusted, a slight compression, and traction should be made in order to be sure the soft parts of the mother are not included in the grasp, (which is known by her complaints,) and also to bring the instrument to its proper adjustment on the child's head.

As soon as a pain comes on begin the extraction by slowly moving the forceps from handle to handle, thus causing them to act as double levers, exerting at the same time sufficient extractive force to prevent the opposite blade from slipping deeper into the organs, while the handles are moved to the right, or to the left.

Great care should be taken to support the perineum as the vertex emerges, and at the same time to carry the handles of the forceps upwards, towards the abdomen of the mother, causing the head to execute the same movements, as though it were expelled by the natural pains.

The woman should be allowed intervals of rest between the extractive efforts, precisely as in a natural labour, unless there be some pressing exigency for her rapid delivery; at the same time the hold upon the forceps should be relaxed, so as to remove the pressure from the head.

When the head is born, the forceps should be removed, and the labour completed by the natural powers of the woman.

In the operation just described, that is, after rotation has taken place, when the forceps are adjusted, the lock looks upwards, and the concavity of the new curve is directed towards the symphysis pubis, while the convexity coincides with the hollow of the sacrum. In every application of this instrument, the general rule is that the *concave edges should look towards the pubes, and the convex towards the hollow of the sacrum.*

In the *first position, before the rotation has taken place*, the same general rules are to be observed in the introduction. When the blades are locked they are inclined towards the left thigh, and the lock looks upwards and to the left. The same rule of traction is to be observed as before; the rotation will take place as the head advances.

In the *second position* the adjustment is not so easy, because after



the introduction of the first blade, it occupies so much of the anterior commissure of the vulva as to leave insufficient space for the introduction of the second. To obviate this, after the first, or male blade is introduced, retract it a little till it is opposite the left ischium, then give it in charge of an assistant, and introduce the female blade to its proper position; now pass the male blade up to its position under the ramus of the left pubis, and lock as before; the handles will point towards the right thigh, and the lock will look upwards and to the right. Make traction as before.

In the *occipito-posterior* positions, the forceps ought to be introduced and fixed as in the former positions, only the handles must be much more depressed, and the perineum thrust back, so as to allow them to adapt themselves to the occipito-mental diameter.

If rotation has taken place into the hollow of the sacrum, as the vertex must escape first, the first movement in extraction should be to raise the handles up a little, so as to increase *flexion*; then as the vertex escapes over the perineum, (which is greatly distended in this operation, and should be carefully guarded,) they should be *depressed*, so that the head may extend itself backwards, as it always does in these labours. The rest of the process is completed as in natural labour.

In the *fourth* and *fifth* positions, where rotation has not taken place, the application is more difficult; the blades rather seize the head in its vertical diameter, and are brought into parallelism with the oblique as the extraction proceeds. The introduction must take place as in a first or second position, the fifth corresponding to the first, and the fourth to the second. In these positions the forceps ought to be so placed, that the concave edge may look forwards, and it is allowable to rotate the vertex into the hollow of the sacrum, provided all hope of bringing it to the pubis has failed.

There is one position of the child's head in which it is recommended to introduce the *right hand*, or *female blade* first, viz., the *left occipito-iliac*, according to Velpeau, where the head is transverse, the occiput at the left ilium, and forehead at the right; the right hand blade is to be introduced first, and conducted with care in front of the right sacro-iliac junction, as high up as the forehead; then by the assistance of the fingers of the left hand, placed under its convex edge, and in concert with the right hand, move it from behind forwards, and from right to left, until its concave edge is turned towards the left iliac fossa, and the blade has arrived upon the right parietal protuberance. The handle, strongly depressed, is then given to an assistant, who holds it against the woman's left thigh.

The left branch is held in the left hand, and passed up along the posterior part of the pelvis, until its point is above the superior strait, and the pivot even with the mortice that is in the other branch. After having joined them, and dislodged the head, if it be still in the

superior strait, and forced the occiput to descend into the excavation, provided it were not already there, the concave edges of the instrument are gradually brought to the front, and the remainder of the operation is conducted as in the occipito-pubic positions.

Dr. Meigs describes a similar operation, when the head is transverse, but lower in the pelvis, with the vertex resting on the left ischium, and the forehead on the right.

“When the instrument has grasped the head in this position, the handles will project very much towards the left thigh in abduction; but if we introduce the male blade first, inasmuch as its handle will project towards the left thigh, it will occupy all the space on that side, and prevent the insertion of the second branch, for there is no place in which to depress the handle. To avoid this difficulty, take the female blade in the right hand, and introduce it into the posterior and right side of the vagina, causing its point to sweep over the face to the right side of the head, behind the pubis, leaving the handle to project towards the left thigh. Next take the male blade into the right hand, and turning the concave edge of the new curve downwards, insert the point into the right side of the vagina, below the female branch. Let the fetal face of the clam apply itself to the convexity of the head, and slide it onwards, and in proportion as it enters, make it sweep round the crown of the head towards the back of the pelvis. In effecting this, the handle comes gradually down as the clam gets on the left side of the cranium, and at last the lock is found where it ought to be, viz.: under the upper or female blade, with which it is then locked.”

Having ascertained that the head is properly grasped, the attempt may be made to rotate it, and the latter stage of the operation will be the same as already described.

*Right occipito-iliac position.*—The only difference between this and the left occipito-iliac position is in the application of the forceps, in doing which the left blade is applied first.

The forceps are sometimes necessary in *face presentations*. In these cases they may be applied to the sides of the head, as in the preceding. In those examples in which the chin comes to the pubis, the method of application is the same as when the vertex is at this point; but in those in which the forehead is at the pubis, the handles must be very much depressed at first, as in the occipito-posterior positions; as the case proceeds they must be strongly elevated, so as to draw the chin down to the fourchette, over which it must slip. As soon as the chin is free the handles must be allowed to descend again, whilst the traction is continued until the head is born.

In cases of *locked or impacted head*, instead of applying the forceps to the sides of the head, one blade is passed over the face, and the other over the vertex, for this reason: it generally happens when the head is thus locked, it is in its transverse, or bi-parietal diameter,

one parietal protuberance being held at the pubis, and the other at the projection of the sacrum; there is not space enough, therefore, at these points to admit the blades, and if they are to be applied to the head, it can only be on those parts that are free from great pressure, as the face on one side, and the occiput on the other. After applying the forceps in these cases, they should be well pressed together, to prevent their slipping when the traction effort is made. The motion from handle to handle, assisted by the traction, will generally be sufficient to disengage the head, after which the forceps should be removed.

Lastly, in pelvic presentations, when the trunk is delivered, and the head detained, the method of proceeding is as follows: if the face is in the hollow of the sacrum, the body, wrapped in a napkin, should be raised upwards, and held in a position nearly perpendicular; then the left branch is introduced and applied to the head, from the chin to the vertex, afterwards the right is adjusted, following the same rules as when the head descends first.

If, however, the *occiput* is in the hollow of the sacrum, and it cannot be turned to the front of the pelvis by manual assistance, the child should be carried back over the perineum as far as can be done with safety to its neck, and the forceps introduced in front of its body, as before. In extracting the head, we should endeavour to act with such force as to cause the chin and forehead to emerge under the arch of the pubis.

In all cases the trunk is to be turned towards the direction in which the occiput looks, and the forceps introduced along the sides of the head, in such a way that the concavity of its edges may be towards the front, or brought there in the progress of the operation.

Under whatever circumstances the forceps are applied, the extraction should always be performed in the line of the axes, and always *with gentleness*.

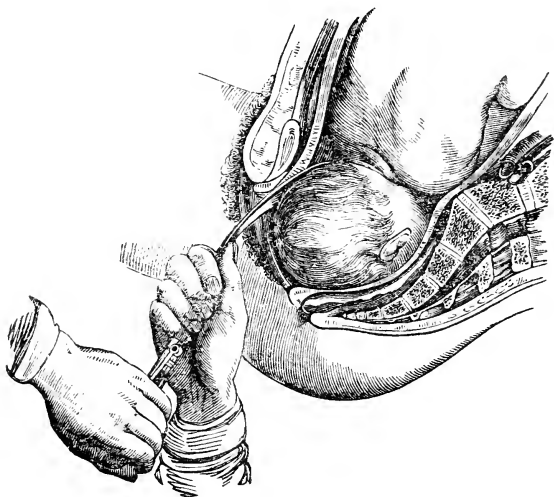
#### THE VECTIS, OR LEVER.

A just idea of this instrument will be had, by considering it as one blade of the *forceps*, a little lengthened and enlarged, with the handle placed in a direct line with the blade, that is, without any lateral curvature.

The general conditions and circumstances of labour before stated as requiring and allowing the use of the forceps, will hold equally good when the vectis is intended to be used. Three modes of using this instrument have been suggested; either as a lever of the first order, or as an antagonist to the left hand introduced into the pelvis, or as a simple tractor; the last is considered the only safe method. If used as a lever of the first kind at all, the fulcrum should be made by the hand of the accoucheur, and *not by the soft parts of the mother*.

In the second method it is evident that if there be sufficient room in the pelvis for the introduction of the fingers of the left hand, there can be but little necessity for instrumental assistance.

Fig. 33.



In the third method, that proposed by Dease, of Dublin, the instrument is introduced as a single blade of the forceps would be, the point is carried fully over the child's head, and the handle grasped tightly, and held firmly by one hand, while the shank of the instrument is embraced by the other, and a movement, that of steady traction downwards, should be given by that hand which embraces the shank, thus converting the instrument into a lever of the *third* order. (Fig. 33.)

The same posture and preparatory arrangement of the patient should be made, as in forceps cases; and in the same manner, the traction is to be made during a pain. This instrument may be used to correct malpositions, and to assist rotation and flexion.

#### THE FILLET OR NOOSE, AND BLUNT HOOK.

The first consists of a strip of strong cloth, silk, or leather, formed into a running noose, and intended to be introduced over the head in whatever way can be most easily accomplished; and this done, the loop is tightened, and extraction effected by main force. Its use is now discarded in head presentations. Some persons, however, still make

use of it to effect extractive force upon the ham, groin, or axilla ; but, as the *blunt hook* answers a better purpose, and is more easily applied, it is now rarely used, except to confine the hand in shoulder presentations, where turning is necessary.

The *blunt hook* is applied to the groin in breech cases, or to the axilla where the shoulders are delayed ; it is also sometimes used to produce flexion in breech cases, when the body is born and the head detained. In these cases it may be tried first in the mouth, if that fail, it may be fixed upon the lower edge of the orbit.

#### CRANIOTOMY.

This operation is demanded at times on account of either mother or child ; on account of the mother, in consequence of deformed pelvis ; on account of the child, in consequence of the disproportionate size of the head, tumours of the chest or abdomen ; or both these conditions may occur at the same time.

Uniform smallness of the pelvis, or contraction of its brim, or of any part of its cavity or outlet, are, of course, most serious obstacles to labour. Unless timely aid be given, not only may the child be destroyed, but the mother's vital powers may be exhausted, in ineffectual parturient efforts, and the most serious consequences result to the soft parts, from the long-continued pressure upon them, such as sloughing, apertures from the vagina into the bladder or rectum, and other accidents, rendering her miserable for life.

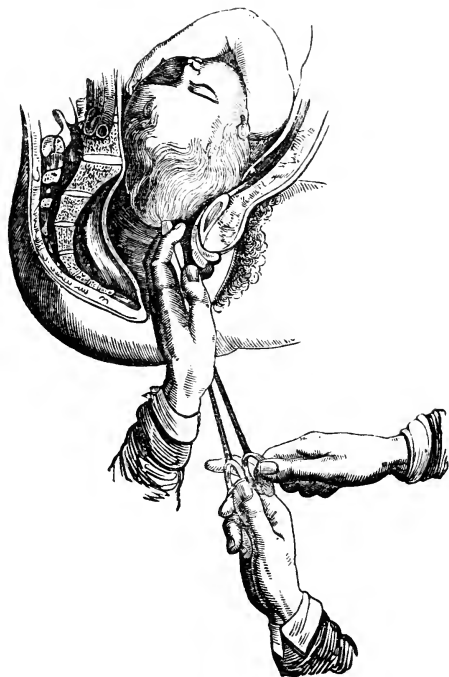
Care should be taken, therefore, never to delay assistance until the woman has become exhausted. Shivering, or vomiting, dry brown tongue, and a pulse above 100, show a necessity for active interference.

*The object of the operation of craniotomy* is to terminate the labour with safety to the mother in cases where, from the disproportion between the size of the foetal head and the pelvis, a living child can neither be expelled by the natural powers, nor extracted by the forceps ; it being always understood that *the distortion is not so great as to prevent the extraction of the child when mutilated.*

According to most authorities, whenever the bones of the pelvis approach much nearer to each other than three inches in the antero-posterior diameter, it is unequal to the transmission of the skull entire ; and unless there be at the superior strait an antero-posterior diameter of an inch and a half with a transverse of three, it would be useless to attempt to deliver *per vias naturales*, even after the head has been reduced in size.

In some cases, where the sutures are very loose, the evacuation of the brain is often sufficient, as the bones of the cranium collapse so much by the pressure of the womb, that the child may be expelled by the natural powers. But it is presumed in this case, that the pains are

Fig. 34.



strong and frequent. Should this not be the case, the brain must be evacuated and extracting force applied.

The instruments required are of two kinds,—the one to perforate the skull, and the other to extract, after the necessary diminution is effected. The first are called perforators; the second, crotchets, blunt hooks, craniotomy forceps, &c.

*Mode of operating.*

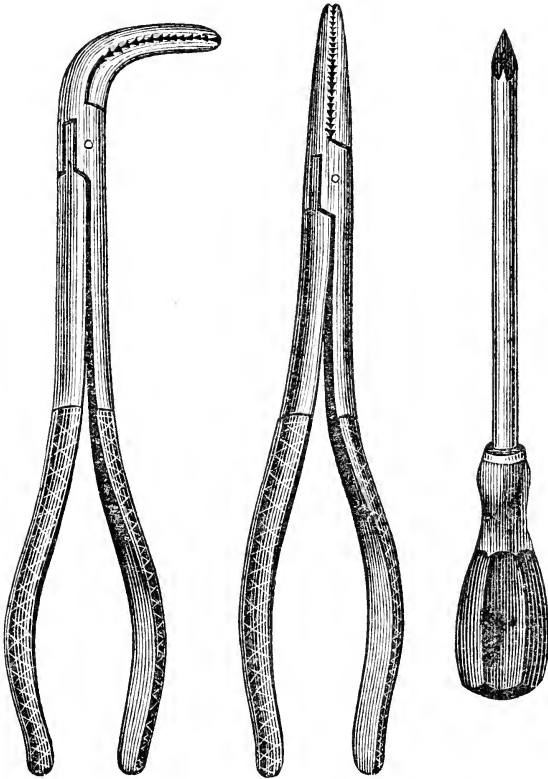
—It is not absolutely necessary for the success of this operation, that the os uteri should be *entirely* dilated, although the wider the orifice is, the less danger will there be of injuring that organ. The rectum and bladder having been previously emptied, the

woman is to be placed in the same position as in forceps operations. The perforator should then be carefully applied upon the groove between two fingers of the left hand, previously introduced and placed upon the part of the head which it is proposed to open. It must now be passed forwards with a semi-rotatory motion until it penetrates the bone; if the *scissors* are used, the handles should be separated as widely as possible. The cutting edges are then to be placed at right angles to the first incision, and again separated so as to make a crucial opening. The instrument should now be passed into the skull, and the brain broken up, after which it (the instrument) should be withdrawn. (Fig. 34.) Then the crotchet should be introduced in the same manner, and fixed upon the inside or outside of the head, and extraction practised, being very careful to guard the soft parts of the mother.

If the head cannot be delivered in this manner, recourse must be had to the craniotomy forceps, and the bones broken up and extracted in pieces. Sometimes the forceps may be used advanta-

geously, where the crotchet cannot. There are a variety of instruments recommended in the performance of this operation: in

Fig. 35.



the first stage, Smellie's scissors, and their modification by Holmes; an ordinary bistoury wrapped near to the point; the ordinary trocar; &c. In the second, the sharp crotchet; the blunt hook; the bone forceps of Dr. Davis; the cephalotribe of Baudelocque, jr.; the straight and curved forceps of Dr. Meigs, &c. (Fig. 35.)

*After treatment.*—The nervous shock will be best treated by quiet, small doses of opium, and moderate stimulation. The condition of the vagina and uterus should be carefully watched and occasionally injected with warm water. If symptoms of inflammation arise, they should be met promptly by venesection, leeching, calomel and opium. In other respects, the patient should be treated as after a natural labour.

## CÆSAREAN OPERATION.

When from any cause the antero-posterior diameter of the superior strait, or the transverse diameter of the lower, is not more than  $1\frac{1}{2}$  inches, there is no possibility of delivery "per vias naturales," and it becomes necessary to resort to the Cæsarean operation.

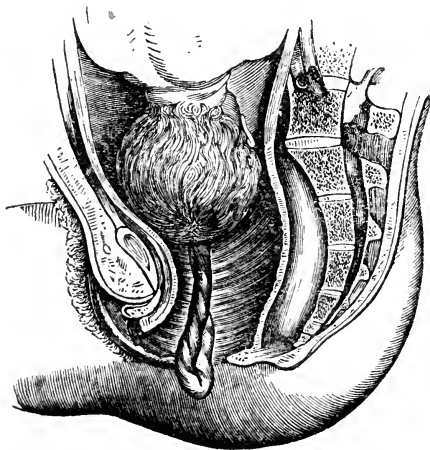
The conclusions that have been derived by Dr. Churchill from a careful examination of statistics are, "that in cases where we cannot deliver the patient by any other means, and when, consequently, both mother and child would inevitably die, we may afford each a chance by performing the *Cæsarean section*."

The best period for operating is at the commencement of the labour, provided there be no doubt as to the necessity. The strength of the woman is then unimpaired, she can bear the operation better, and runs less risk of inflammation. For the method of performing this operation, see *text books*.

## PROLAPSUS OF THE CORD,

Whenever it occurs, may become a cause of preternatural labour. It may be produced in various ways, as for instance, by transverse presentation; by over-distention of the uterus by a large quantity of liquor amnii; by sudden rupture of the membranes and a gush of the contained fluid; by presentations of the feet or knees, the lower portions of the uterus not contracting sufficiently around the child; and by excessive length of the cord. (Fig. 36.)

Fig. 36.



The *prognosis* is, of course, unfavourable, the child being very liable to perish from asphyxia produced by pressure upon the cord.

*Treatment*.—Various expedients have been resorted to, in order to replace the cord, none of which have been entirely successful. It has been proposed to push it up beyond the brim and hold it there till the head has engaged; or to hook it over the limbs of the child; or to enclose it in a little bag attached to a catheter or slender rod, then return it, withdraw

the rod, and leave the bag and cord in the uterus. If, however, the



head has descended, and the parts are in a favourable condition, it is better to use the *forceps*. If the woman has had children, the pelvis is roomy and the soft parts dilated, and the presenting part not descended too low, the child may be turned. Should the cord have ceased to pulsate, we need not interfere.

#### UTERINE HEMORRHAGE.

There are three varieties of hemorrhage treated of by obstetrical writers, viz.: *accidental*; *unavoidable*; and *hemorrhage after delivery*. The first generally occurs before or during labour, and arises from a partial and accidental separation of the placenta, which is generally in its usual position.

The *immediate cause* of the flooding is the separation of some portion of the placenta from the womb, and laceration of its vessels; the *remote cause* may be undue muscular exertion; blows; falls; mental excitement; straining at stool; general plethora, &c.

*Diagnosis*.—This variety of hemorrhage is distinguished from that which depends on implantation of the placenta over the cervix uteri by these circumstances: the os uteri may be felt on examination to contain nothing but the bag of waters; that the hemorrhage occurs during the interval of the pains, and is arrested by the uterine contractions; and that we can generally make out some definite cause for accidental hemorrhage, and its occurrence is irregular.

When the blood which is poured forth from the uterine vessels on the separation of the placenta, is at once discharged externally, the nature of the case is clear. But it may happen that the blood may be poured into the bag of membranes, or between the membranes and the womb, without appearing externally, and may thus prove fatal, without the practitioner being aware of the danger.

This condition of things may be suspected, if, towards the end of pregnancy, the patient is subjected to any of the above causes that may produce hemorrhage, and if she complain of dull aching pains in the back, tenderness of the womb, with, perhaps, obvious swelling at some part of it, together with faintness, and the constitutional signs of loss of blood.

*Treatment*.—If the patient has not arrived at her full time, the hemorrhage is not profuse, and the os uteri undilated, there is no immediate danger. She should be placed in a horizontal position on a hard mattress, and lightly covered; cold applications to the pubes, or cold enemata, should be used. Internally, the infusion of rose leaves and aromatic sulphuric acid, or acetate of lead and opium, should be administered.

Should these measures not succeed, recourse may be had to the *tampon*. It should be remembered, however, that this instrument should *never* be employed when the uterus is *empty*, as the blood might collect within the cavity till the woman perished from the loss.

Should these means fail, there still exists another, viz.: *rupturing*

*the membranes* and allowing the liquor amnii to escape. As soon as this is done, the uterus contracts, compresses the orifices of the bleeding vessels, and thus arrests the hemorrhage.

Should the contractions not come on, the organ may be stimulated by the administration of ergot, and friction over the abdomen. The os uteri is generally so relaxed by the hemorrhage as to be very dilatable. It has also been proposed, if all these fail, to introduce the hand, turn the child, and thus terminate the labour.

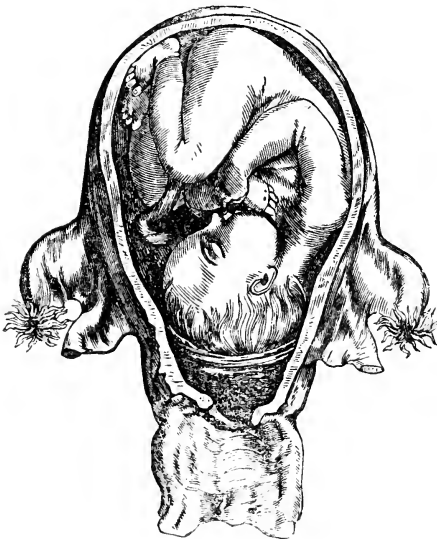
The placenta is usually expelled immediately after the child; if it be not, it is much better to extract it, and secure a firm contraction of the uterus, than to allow the hemorrhage to continue.

If the patient's strength is much exhausted, stimulants should be used, and nutritious articles of diet exhibited. It is generally considered advisable to keep down the reaction that succeeds excessive hemorrhages, by the administration of opium, combined, if necessary, with some stimulants. The patient should be kept in a strictly horizontal position till all danger of a recurrence is past.

#### UNAVOIDABLE HEMORRHAGE.

*Placenta prævia; placental presentation.* — The hemorrhage which results in this case is the necessary and unavoidable consequence of the dilatation of the os uteri, by which the connexion

Fig. 37.



between the placenta and uterus is separated; the greater the separation, the greater the hemorrhage, as the labour advances. The placenta may be situated partially, or entirely over the os uteri. (Fig. 37.) The *cause* of the hemorrhage is the separation of the placenta from the cervix uteri, and the consequent exposure of the mouths of the bleeding vessels.

*Symptoms.* — The first discharge generally occurs from about three to five weeks before labour commences; the amount varies, but is generally slight at first and unaccompanied by pain. It returns again

after a week or so, and without any apparent cause, and thus comes and goes till the end of gestation. With the first sensible contractions, the flooding occurs more profusely, and is seen to increase *during* each pain. An internal examination is necessary to discover whether the implantation be complete or not.

*Diagnosis.*—This variety of hemorrhage is distinguished by the fact, that it usually begins without evident cause, and that it is increased *during* a pain; a per vaginam examination also reveals the presence of the placenta, which is distinguished from a clot of blood by its being firmer and not breaking down under the finger. If it only partially covers the os uteri, its edge will be felt continuous with the membranes, and through the latter the presentation may perhaps be felt.

*Treatment.*—If the hemorrhage is slight and the term of gestation not completed, palliative measures should be tried as before described. If so profuse as to demand interference, there is no hope of a natural termination, unless the pains be so violent as to force away the placenta before the child. This, however, is so rare as not to justify waiting. The only alternative is to turn and deliver as quickly as possible. It fortunately happens that the continued bleeding so softens the os uteri as to render it speedily dilatable.

The hand is to be introduced in the usual manner, and insinuated between the os uteri and the placenta, on that side on which the placenta is believed to be thinnest; the membranes should then be ruptured as high up as possible, and the feet seized and brought down. When the body of the child is in the pelvis it will act as a tourniquet, and compress the bleeding vessels. Nevertheless, the labour should be terminated as early as possible.

Some authors recommend that the hand should be pushed *through* the placenta—a thing much more difficult to effect. The placenta should always be delivered as quickly after the child as possible, and every care taken to prevent a recurrence of the hemorrhage.

Some authors recommend that if the os uteri be undilated when the hemorrhage comes on, the *tampon* should be used till dilatation takes place. This has been objected to, on the ground, that it prevents the attendant from knowing when the os uteri is dilated or dilatable, and thus valuable time is lost.

If the feet present, it is more favourable, as the operation of turning is rendered easier. If the placenta is only attached to the edge of the os uteri, and the pains are active, it should be treated as a case of accidental hemorrhage, by rupturing the membranes. The pressure of the head whilst dilating the os uteri will close the mouths of the bleeding vessels with the placenta, and so arrest the flooding till the child is expelled.

Drs. Simpson of Edinburgh, and Radford, of Manchester, recom-

mend that instead of *turning* in these cases, the whole placenta should be *detached* and *extracted* if possible, before the child. The following are Dr. Simpson's conclusions, based on the examination of a large number of cases.

1st. That the complete separation and removal of the placenta before the child, is very seldom followed by any great hemorrhage.

2d. That on the other hand, the previously existing hemorrhage almost always ceases from the moment the placenta is *perfectly* and completely detached from its connexions with the uterus.

3d. That the cessation of the hemorrhage is explicable, not on the idea that the descending head of the child acts as a plug or compress upon the exposed orifices of the uterine sinuses, but on the mutual vascular economy of the uterus and placenta, and the circumstance that the hemorrhage principally comes from the partially detached surface of the latter. The practice has been condemned by other eminent authorities, and it is recommended, even if it be adopted, to seize and bring down a foot if it can be readily found; if it be determined not to turn, it is also recommended to give a scruple of ergot at the moment of separating the placenta, so as to bring on early uterine contractions.

*Hemorrhage after delivery.*—The discharge in this case also proceeds from the mouths of the vessels exposed by the separation (either partial or complete) of the placenta. A certain amount is lost after the birth of the child; it is only when it becomes so profuse as to threaten serious consequences, that interference becomes necessary. It may occur after the escape of the head, while the body is retained; immediately after delivery; or at an interval of ten or twelve days after.

The hemorrhage may arise from *inaction* of the womb; from an absence of that contraction which is the only safeguard. The uterus is felt large and flabby in the abdomen; the pulse becomes weak and tremulous; the patient restless; there are constant and deep sighings and groanings, and frequent syncope, dimness of sight, and ringing in the ears, and even convulsions. These symptoms, together with the escape of the blood, will be sufficient to establish the diagnosis.

*Treatment.*—In every case, the indication is to *make the womb contract*. This may be done in various ways, viz., by friction to the abdomen; by the application of cold to the genitals, or abdomen; by grasping the womb through the abdominal parietes; at the same time ergot should be administered to the same end. If these means fail, the hand should be introduced into the cavity of the organ, with the hope of exciting contraction. It has also been recommended to introduce ice into the uterus; or a freshly cut lemon, and then to squeeze out the juice upon the internal surface.

Among the internal remedies are, acetate of lead and opium;

alum; and monesia. Pressure upon the abdominal aorta, and ligatures upon the limbs, are highly praised by some authors. Velpeau recommends the application of a sinapism between the shoulders as a revellent. Dr. Radford recommends galvanism as a powerful excitant of the uterine muscular fibres.

The hemorrhage may, however, be attended with partial adhesion of the placenta to the uterus, with an irregular spasmodic or *hour-glass* contraction of the latter organ. In this case, having placed the left hand on the abdomen, so as to grasp and steady the womb, introduce the right hand, in a conical form, gently through the constricted portion of the womb; separate the placenta, and then the contractions of the uterus will probably expel the hand and placenta together.

The operation of transfusion has been recommended and practised by Dr. Blundell in cases of extreme danger from loss of blood, and has proved successful in fourteen cases, although it has failed in an equal number.

The patient should be kept in a strictly horizontal position, and if syncope occurs, the head should be lowered and the feet elevated, so as to allow the blood to flow to the brain. Stimulants should also be administered, and the room kept cool and well ventilated. The after treatment is the same as in the cases already described.

#### PUERPERAL CONVULSIONS.

There are three varieties spoken of by obstetrical writers, viz., the *hysterical*, the *epileptic*, and the *apoplectic*. The first occurs generally during the early months of gestation, and in females of a nervous or hysterical constitution. It is distinguished by the absence of insensibility, and frothing of the mouth, and the convulsive movements of the lower jaw. There is no stertorous breathing, and but slight contortion of the body; although in many cases, the muscles of the back are violently contracted, a symptom which is looked upon by Dr. Dewees, as pathognomonic of this form. The paroxysms often terminate in screams and tears, and the discharge of a large quantity of limpid urine.

*Treatment.*—If there be a quick, full pulse, or headache, venesection may be practised, or a few leeches applied to the temple. In general, the attack is relieved by antispasmodics, such as musk, camphor, valerian, or assafoetida. Cold water poured from a height upon the head will often break up the paroxysm. When it has ceased, a small dose of opium should be administered.

*Epileptic convulsions.*—The symptoms resemble those of an ordinary epileptic attack, and the patient often has premonitions of what is coming, from the presence of pain in the head, ringing in the ears, obscure or partial vision, loss of sensation, rigors, nausea, &c. The *aura epileptica* is seldom felt.

The *attendant symptoms* are, a turgid purple condition of the face; convulsive movements of the face and whole body; foaming at the mouth; repeated and sudden closure of the under jaw, by which the tongue is often dreadfully bitten; the respiration is at first irregular, and being forced through the closed teeth, and the foam at the mouth has a peculiar hissing sound which, once heard, can never be mistaken; the pulse is quick, full, and hard at the beginning, but afterwards becomes small and scarcely perceptible; the urine and fæces are often discharged involuntarily.

This fit lasts for a time varying from five minutes to half an hour, and then gradually subsides; the pulse often becoming calm, and the patient conscious; or she may remain in a state of complete coma with sibilant or stertorous breathing; the more profound the coma, the greater the danger.

The calm is generally short in duration, being often followed by a recurrence of repeated paroxysms and intervals.

Puerperal convulsions may come on either before, during, or after labour. When they occur before labour, uterine contraction is very apt to come on synchronously with the fit, and the child is born dead. When they occur during labour, the latter runs nearly its natural course, and the fits are synchronous with the pains though not recurring with each. When they occur after labour, they generally take place from two to four hours after the child is born, and are attributable to some injury received by the brain and nervous system during the parturient effort.

The *causes* are generally a loaded state of the stomach or bowels; intemperance in eating or drinking; fright; and in most cases, an accumulation of blood in the brain during the violent expulsive efforts. Primiparæ are more frequently attacked than multiparæ.

*Treatment.*—The first indication is to protect the brain from the effects of an accumulation of blood. This should be done by taking away blood, in a full stream, from the arm, or temporal artery, and repeating it if the paroxysm continue. This may be followed by cups or leeches to the temples and back of the neck; there is great tolerance of bloodletting in this disease.

A strong purgative should next be given, (such as calomel and jalap,) and its operation assisted by stimulating enemata. It has also been recommended to combine tartar emetic with the purge, or to give it alone, in divided doses, after the bowels are moved. The head should be shaved, and cold applications made to it.

In regard to the *use of opium*, most practitioners are in favour of it when judiciously used. If it be given in the commencement of the attack, when the patient should be bled, it can only hasten the fatal result. But if the fits continue, *especially after delivery*, with signs of great irritation and exhaustion, it may be given with the hope of deriving benefit, remembering that depletion should always be premised.

*Should the process of labour or parturition be interfered with?*

If the convulsions occur during gestation, the uterus should not be interfered with. Should they occur at the commencement of labour, the propriety of interference may be questioned; the safest plan is merely to rupture the membranes, (provided the os uteri is dilated or dilatable,) which sometimes hastens the progress of the labour. *Version* has been condemned. When the head has descended into the pelvis, and there is sufficient space, the *forceps* should be used. The attempt should be made during an interval of the paroxysm; should the fit recur at this time, the blade should be withdrawn, for fear of injuring the mother.

Should the head of the child be fixed in the pelvis, so as to be immovable with the forceps, it may be necessary to open the head. Before this is done, however, all the attendant circumstances should be carefully weighed; the child may be alive; the labour, if left to itself, may terminate naturally; and lastly, even if terminated by art, the fits may not necessarily cease.

*Apoplectic convulsions.*—Generally speaking, in this form there is little or no convulsions, no distortion of the face, and no frothing at the mouth; the muscles are flaccid and powerless; the respiration is stertorous, the patient is insensible, and there is generally no repetition of the paroxysm.

The attack is generally preceded by headache, ringing in the ears, total or partial blindness, and flushing of the face. The pulse is full, slow, and laboured during the attack, and the pupils insensible to light. This form almost always occurs during labour, and is caused by the violent strain upon the cerebral vessels during the expulsive efforts.

*Treatment.*—Bloodletting in a full and copious stream, either from the arm, jugular vein, or temporal artery. This should be repeated, if needful, or followed by local depletion, in the form of cups or leeches. If the patient is benefited by it, the head should then be shaved and ice applied, and the bowels freely evacuated.

If this variety occur during labour, and the uterine action be suspended, the patient should be delivered as speedily as possible, in order to save the child; for this purpose, if the head be within reach, the forceps should be applied. The after treatment of all these cases requires the greatest watchfulness and quiet. Should the patient become maniacal, all sources of irritation, within and without, should be removed, the patient kept quiet in a dark room, and under the influence of tartar emetic.

#### PUERPERAL FEVER.

This malady has received various names, such as *childbed fever*, *puerperal fever*, *peritoneal fever*, *puerperal peritonitis*, *low fever of childbed*, &c.; by some it has been considered as a fever dependent on local inflammation, by others as a blood disease. Each author

who has written upon the subject, has adopted a classification in accordance with his own views and experience; it would be impossible, therefore, in a work of this kind, to give a synopsis of *all*. "The student is liable to be deceived, if he grounds his ideas of this malady solely on the observations of one or two writers, especially those who have witnessed epidemics as they have appeared in hospital practice, however graphic the representations may be; because scarcely any two have resembled each other; and because the symptoms in all cases are much modified by the temperature and other qualities of the atmosphere, the season of the year, the localities in which the disease appears, and several external circumstances, independently of the constitution of the patient herself."\*

There may be said to be *four* principal varieties of this disease. The *first* and most common variety, is characterized by pain and tenderness in the abdomen, preceded by a chill, and accompanied by a hot skin, rapid pulse, and sometimes profuse perspiration. In this form the uterus and its appendages, or the peritoneum, receive the greatest force of the blow.

The *second form* assumes the character of a mild typhus, accompanied by intestinal irritation. It is ushered in by rigors, followed by a hot fit; and succeeded by nausea and vomiting, or diarrhoea, with most offensive evacuations. The tongue, at first loaded and white, soon becomes preternaturally red, as in those affected by chronic dysentery. The skin is dry and hot, and of a dusky yellow hue; the mind is unsettled, without being absolutely delirious; the debility is extreme, and the limbs tremulous. In some cases these symptoms are followed by acute inflammation of some important organ, or of the joints, softening of the womb, suppuration of its lymphatics, or veins. There is usually suppression of the milk, and sometimes of the lochia.

In the *third variety* the main mischief seems to be expended on the nervous system; there is great delirium, agitation, and sense of impending death. This form is liable to be followed by fatal syncope and coma, and may supervene on either of the others.

The *fourth* and worst form of puerperal fever affords the most extensive evidence of the diffusion of a poison over the system through the blood, and presents the most perfect analogy with scarlatina maligna. Shivering, and abdominal pain, are followed by rapid exhaustion, quick pulse, glassy eye, and dusky skin. There are often pain in the chest, husky cough, laborious breathing, and other evidence of inflammation of the lungs, which after death may be found gangrenous. Abscesses of the joints, and cellular tissue; phlebitis, and gangrene of the intestines, are among the ravages of this most fatal malady.

\* Ramsbotham, p. 415.



There are a few *general symptoms* which may be added to those mentioned above as characterizing the different forms. The pulse is always accelerated, ranging from 110 to 140, or 160; in the inflammatory form it is full and hard; in the adynamic, weak and small; pain is not uniformly present, though most generally; there is great tympanitis, and generally constipation. The lochia and milk are usually suspended; the urine is suppressed, or voided with great pain; tormina and tenesmus are present; and there is often a vomiting of yellow or green bitter matter, and in the last stage, a discharge resembling *black vomit*. The intellect is often undisturbed to the last, though the patient often takes a great aversion to her infant.

Numerous *causes* have been laid down as productive of this disease: among the predisposing, are atmospheric vicissitudes, depressing passions, unhealthy residences, dissipation, bad diet, &c. Among the exciting are, epidemic influences, intestinal irritation, retained placenta, difficult labour, suppression of lochiæ and lacteal secretion, and *contagion*.

There are many who look upon this as a *blood disease*, who believe that puerperal fever originates in a vitiation of the fluids; and that the causes which are capable of vitiating the fluids are particularly rife after childbirth; and that the various forms of puerperal fever depend on this one cause, and are deducible from it. Others, on the contrary, believe that the primary impression is made upon the nervous system.

The *treatment* must vary according to the form of disease we have to contend with. In the first, or inflammatory form, instant recourse must be had to bloodletting, which must be pushed to the extent of syncope if necessary. The abdomen should then be covered with leeches, which are to be followed by hot fomentations. The bowels should also be freely opened with a purgative, after which calomel and opium should be administered, with the view of producing its constitutional effects.

In the *second form*, bleeding, except in the early stage, will be generally improper, and even then should be restricted to plethoric patients. The principal reliance must be placed on purgative medicines, as salines and mercurials. A full dose of calomel should be exhibited, and followed by a purgative; after free evacuation, calomel and opium should be administered. After the bowels are unloaded, purgation should cease, as it rather causes depression; mercurials and salines, or tonic stimulants and carminatives, should be used, according as the disease shows marks of excitement or depression. In the low form, bark, camphor, or ammonia appear to be particularly indicated.

In the *third* or nervous form, warm purgatives should be administered, or laxative enemata, after which a few doses of opium should be exhibited. Bloodletting is generally uncalled for.

In the *fourth* variety, the two indications are: *First*. To attend to the local lesions. *Second*. Never to forget that these are not the disease, but merely the effect of a more diffusive, though concealed cause, to act on which our remedies should be directed. The rationale of the treatment, therefore, consists in the exhibition of such remedies as will act on the cause, and such as will alleviate or remove the local affections; taking care that in our attempt to effect the latter end, we do not so act on the constitution as to give additional energy to the more deadly power of the concealed cause. (Ferguson.) In the early stage, leeches, blisters, calomel and opium, &c., should be used as required: and in the latter stage, stimulants and tonics.

#### MILK FEVER.

The milk fever generally begins on the third day after delivery, sometimes on the first or second, or not until the fourth, fifth, or sixth. It is ushered in with chills, headache, pains in the back and limbs; the pulse, at first small and hard, soon becomes developed, and the skin hot; the breasts grow hard, swelled, and painful in a few hours, so as to prevent the motion of the arms. This condition of things is followed by a sweat, and the fever abates in the course of twelve or twenty-four hours, and the secretion of milk is established; the breasts, however, remain tumid and painful much beyond this period, especially in women who do not give suck. The lochia, too, are often suspended or diminished during this time.

*Treatment*.—The bowels should be freely moved by the administration of a saline cathartic, or oil. If the fever runs high, a small bleeding should be practised. If the breasts are painful to the touch, they should be covered with warm emollient poultices, and if not relieved by this, a few leeches should be applied to them.

These means are important to prevent the formation of a mammary abscess. The breast should not be allowed to fill with milk, but should be drawn either by the child, or artificially, as often as it becomes distended. Should suppuration unfortunately take place, the pus should be evacuated as soon as possible, and a warm poultice applied. If sinuses remain from the burrowing of pus, compression should be made upon the gland by means of adhesive straps. If a milk fistula should be the result, the orifice should be filled with a tent, and the wound allowed to granulate from the bottom.

#### INVERSION OF THE WOMB.

The inversion may be either partial or complete. *Partial inversion* may be known by the absence of the fundus behind the pubes, and the presence of a large solid tumour in the vagina, accompanied by profuse hemorrhage, intense pain in the pelvis, violent tenesmus,

vomiting, fainting, cold, clammy sweat, and feeble or imperceptible pulse.

*Complete inversion* is recognised by the presence of a reddish, livid tumour, filling the vagina, and protruding beyond it, resembling in shape the uterus after delivery. The os uteri may be felt at the superior extremity of the tumour, forming a kind of circular thickening at its apex, and the uterus is wholly wanting in the hypogastric region.

*Causes.*—It may occur spontaneously in atony of the uterus, or from irregular contractions. Violence in extracting the placenta, shortness of the cord, delivery in the upright position, tumours of the uterus unconnected with parturition, have all been mentioned as causes of this accident.

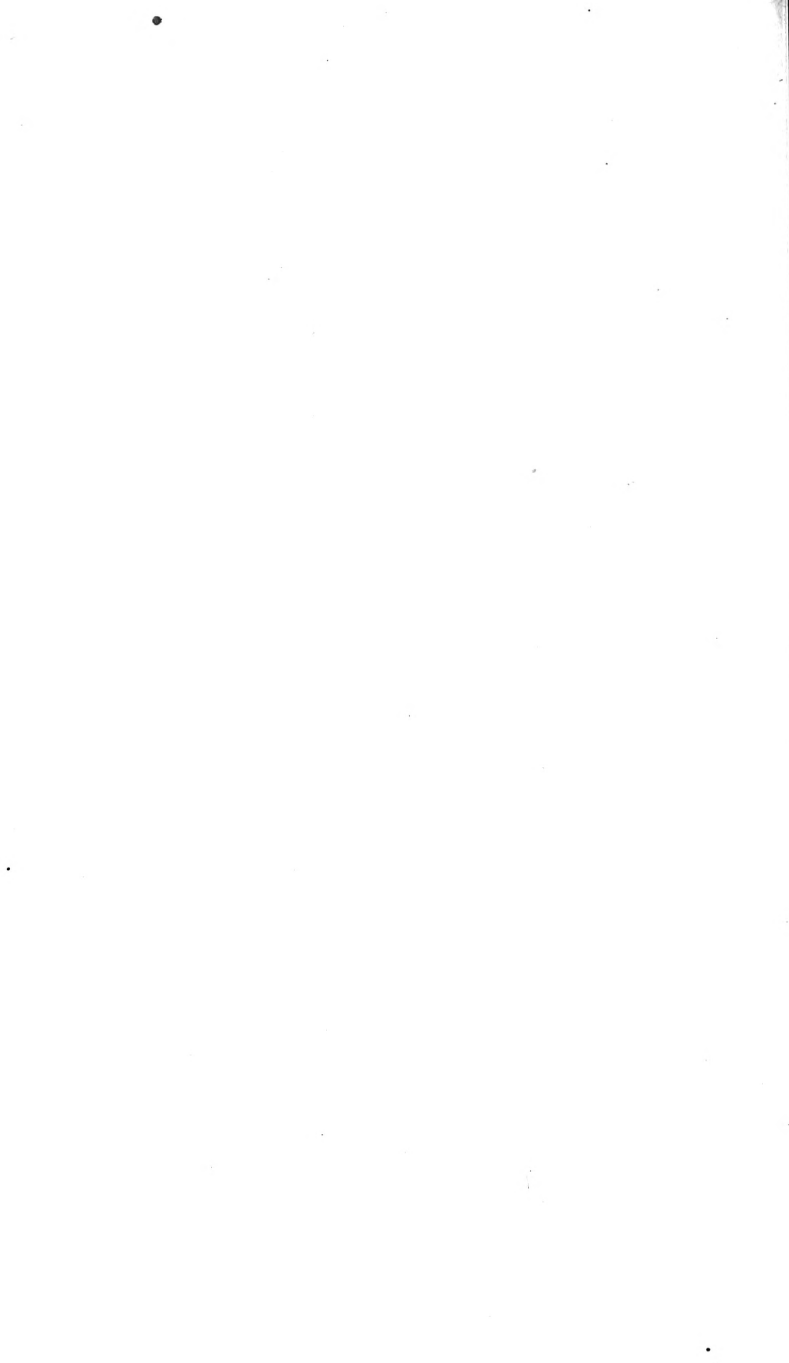
*Treatment.*—By some it is recommended to compress the tumour and pass it in through the vaginal orifice, followed by the hand, which, when in the vagina, should be formed into a cone, and made to press mainly upon the fundus uteri; after a while it will be found to recede, and on being farther pressed, it suddenly starts from the hand, and the organ is returned to its natural condition.

Others advise that no compression be made; the womb should not be handled, but watching it carefully, at the moment when free from contraction, the fundus should be pressed with one finger and indented like the bottom of a bottle; when that much is effected, the reposition is sure, provided continual pressure be made: the fundus will be pushed up again through the os uteri and vagina, until the hand is found high up in the cavity of the uterus.

If the placenta be adherent, some recommend that it be reduced with the fundus; others, and the majority, that it be first removed, and then that reduction take place, as this procedure will facilitate the operation.







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PHILADELPHIA:  
LEA AND BLANCHARD.

1848.

Entered, according to Act of Congress, in the year 1848,  
BY LEA & BLANCHARD,  
In the Clerk's Office of the District Court for the Eastern District of  
Pennsylvania.

C. SHERMAN, PRINTER,  
19 St. James Street.

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# MATERIA MEDICA.

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**MEDICINES** are substances which have the power of so modifying the actual state of the organs, as to render them applicable to the cure of disease. They differ from *remedies*, which are of a more generic nature; and include all the various means employed to alleviate or cure disease: thus heat, cold, electricity, a surgical operation, &c., are all remedies, but cannot be called medicines.

**MATERIA MEDICA** is the science which treats of medicinal substances; **THERAPEUTICS**—the application of remedies to the treatment of disease. **PHARMACY** is the art of compounding or preparing medicines for use.

A complete knowledge of medicines includes an acquaintance with their *physical characters*, such as of colour, taste, odour, general appearance; their *chemical properties*; their *natural and botanical history*; their *modes of growth, collection, preservation, &c.*; their *therapeutical applications*; their *physiological properties*, or their method of affecting the healthy system; and their *toxicological properties*, or their poisonous effects. It is hence obvious that a correct knowledge of *Materia Medica* presupposes some acquaintance with Natural History, Botany, and Chemistry; and that of Therapeutics requires some familiarity with Anatomy and Physiology, and also with the principles of Mental and Moral Philosophy, as well as of the general powers or forces of nature, such as light, heat, electricity, and magnetism.

Along with medicines proper, it is usual to consider a set of substances called *aliments*, which are often very useful as therapeutic agents, though they cannot be considered as *medicinal* in their action. They possess nutritive qualities, and when swallowed, they are digested and converted into chyle. Medicines, on the contrary, produce their effects upon the system, not by undergoing change through the digestive process, but either by being absorbed into the circulation, and thus influencing the blood and the various secretions by virtue of some chemical influence, or by means of nervous communication between distant parts and the part to which the remedy is immediately applied.

Some few medicines appear to act upon the system *mechanically*, as some of the anthelmintics which expel worms from the bowels, simply by the mechanical irritation they produce; bran is thought

to act as a laxative in the same manner; and metallic mercury has been employed to overcome intromission of the bowels, by virtue of its gravity.

As regards the *absorption* of medicines into the blood, there is abundant proof of the fact, since they have been detected, after being swallowed, in the different secretions, in the solid tissues of the body, and in the blood itself. Thus rhubarb and turpentine have been found in the urine; garlic in the exhalation from the lungs; sulphur and mercury in the perspiration; garlic, various purgatives, narcotics, and other remedies in the milk; and so on.

As regards the *method* by which medicines gain admission into the blood, there can be but two avenues—the lacteals or absorbents, and the veins. From various experiments made upon the lacteals, it is highly probable that their chief, if not exclusive function, is to take up *alimentary* substances—such as can be converted into chyle: medicinal substances were very seldom found in them. On the other hand, experiments are equally strong in proving, that the *veins* are chiefly concerned in the absorption of medicinal substances; thus Magendie found that if the lacteals be tied, nux vomica will affect an animal in six minutes, while, if the veins be tied, no effect is produced. The mode by which absorption is effected is probably, to a great extent, physical, or by *endosmose*. The *rapidity* of absorption is influenced by a variety of circumstances, as the part or tissue to which the medicine is applied, the nature of the medicine itself, the condition of the system, &c. It is said to be the greatest from the bronchial mucous membrane.

There are various circumstances which modify the action of medicines upon the system; these may depend upon the medicine itself, as respects its dose, mode of combination, &c.; or upon the condition of the organism at the time of its administration. Under the latter head, the most important circumstances are:—

1. *Age*.—The young are much more susceptible to the action of medicines than the middle aged. Old persons are less able to bear an overdose than middle-aged. It is difficult to lay down any precise rule upon the subject: that of Dr. Young is often adopted; it is “to diminish the dose of most medicines, for children under 12 years, in the proportion of the age to the age increased by 12;” thus at 2 years it would be  $\frac{2}{2+12} = \frac{1}{7}$ , &c. At 21, the full dose may be given. There are certain medicines, however, which cannot be given to young children according to the above rule; thus calomel and castor oil require to be given in larger proportionate doses; whilst the narcotics, and some of the metallic preparations, must be administered in much smaller proportionate quantities.

2. *Sex*.—Females, as a general rule, require smaller doses than males. The peculiarities of their system, at the different periods of menstruation, pregnancy and lactation, must also be borne in mind.



3. *Habit*.—The effect of habit, in accustoming to the action of a medicine, is well known. The influence of acrid or irritating substances is but little diminished by repetition.

4. *Diseased condition of the body*.—This is well seen in the power of the system to bear very large doses of opium in tetanus and mania-à-potu, and of the different effects of calomel in different conditions of the system.

5. *Temperament and Idiosyncrasy* will also modify the action of medicines. These should always be ascertained in the administration of our remedies.

6. *Tissue, or organ*.—The stomach is much more susceptible than the skin: carbonic acid, when inhaled into the lungs, acts as a poison; when swallowed into the stomach, it merely proves a grateful stimulant.

#### ADMINISTRATION OF MEDICINES.

Under this head may be included the parts to which medicines are applied, with the mode of their application,—and the forms in which they are employed.

The parts of the body to which medicines are most usually applied, are the stomach, rectum, skin, mucous membrane of the lungs, and nostrils.

The *stomach* is most frequently resorted to, both on account of the facility of administration through it, its great susceptibility, and its intimate relation with other parts.

The *rectum* is employed, where the patient cannot swallow the medicine, or where there is some objection for giving it by the mouth, or when a local impression is desirable. Medicines thus employed are called *enemata*, or *clysters*, or *injections*. If introduced in the solid state, they are named *suppositories*. The quantity of the medicine, as a general rule, is three times that given by the stomach.

The *skin* is frequently made use of as a means of affecting the system by remedies. These may be applied either *epidermically*, or *endermically*,—that is, to the sound skin, or to the skin deprived of its cuticle. The endermic method is by far the most prompt and powerful. The cuticle is best removed by means of a small blister: and the proper parts for the application are the epigastrium, and the insides of the limbs. The usual dose is three times the quantity given by the mouth; and the powdered substance should be properly diluted, before being sprinkled upon the denuded surface. The circumstances which may demand the endermic method of administration are inability, or indisposition of the patient to swallow, or of the stomach to retain the medicine; inflammation of the gastric mucous membrane, or a want of susceptibility of this part to the action of the medicine, from frequent repetition; the necessity, in urgent cases,

of introducing medicines in all possible modes; the indication that may exist to produce revulsion from internal parts; and the necessity for procuring the local effects of the remedy.

When the cuticle is not removed, the medicines may be applied in various manners: thus, where their local effects alone are wanted—by lotions, fomentations, cataplasms, &c.; where their general impression is desired—by inunction, baths, and vapour. The most simple form of administering a vapour bath, is to elevate the patient's knees under the bedclothes, and to place at his feet hot bricks enveloped in wet flannels; the vapour which is given off, has thus free access to the body. Another method is to place the patient in a tub of warm water, enveloping him in a blanket, after which a number of hot bricks are to be placed in the tub, until the requisite amount of steam is generated. If the vapour of a solid substance, as sulphur, is required, the patient is to be placed in a properly contrived apparatus, and the solid body sprinkled in powder on a hot iron at his feet.

The *mucous membrane of the bronchi* may also be employed for the introduction of medicines. They are applied here usually in the form of vapour, by means of an inhaler; or, when this cannot be had, by means of a teapot or basin, with an inverted funnel. It is not recommended to blow fine powders into the lungs.

Occasionally, medicines are introduced through the nasal or pituitary membrane; they are however employed, in this manner, generally with a view to their local impression. When they produce a discharge, they are called *errhines*; when sneezing, *sternutatories*.

The practice of introducing medicinal substances through the veins has been occasionally resorted to; but it is not recommended, in consequence of the danger of the introduction of air, which is attended with fatal consequences.

#### FORMS OF MEDICINES.

Medicines are used in the solid or fluid state, each of which comprises several forms.

1. *Solid forms.* These include *pills, powders, confections, troches,* and *electuaries.*

*Pills.*—Small globular masses, intended to be swallowed without chewing; they should not consist of substances requiring to be given in large doses, nor of salts which are deliquescent or efflorescent, although the latter may be rendered fit, by first driving off the water of crystallization by heat. Some substances require only the addition of water; others, the intervention of some viscid body, as gum or sugar. The heavy metallic powders may be mixed with soft extracts or confections; the light vegetable powders, with syrup, honey, or mucilage. When the requisite consistence has been given to the mass, it is to be properly rolled out by means of a spatula, and then

divided into the requisite number of pills. Sometimes they are covered with gelatine, to conceal their disagreeable taste.

*Powders.*—Such medicines are given in the form of powder as are not very bulky, nor of very disagreeable taste, and have no corrosive property. Deliquescent substances, and those containing much fixed oil, are unfit to be used in powder; as also such crystalline salts as contain water of crystallization, unless this be previously expelled by heat. The substance may be reduced to the state of powder by means of a mortar and pestle, made either of metal, glass, or wedgewood. The coarser particles are separated by sieves made of various materials. Some require to be submitted to the processes of *levigation* and *elutriation*. By the former of these terms is meant the rubbing of the substance, previously moistened, between two smooth pieces of hard flat stone; the latter term signifies the agitation of the matter in water, allowing the coarser particles to settle, pouring off the liquor for the finer ones to subside, and lastly, decanting and drying the powder.

The lighter powders may be administered suspended in water, or any other convenient vehicle: the heavy insoluble ones, in syrup, molasses, or honey.

*Troches.*—Small solid masses, in which the medicinal substance is incorporated with the sugar and gum,—intended to be held in the mouth and allowed slowly to dissolve. They are used chiefly in affections of the throat.

*Confections.*—Soft solids, made by incorporating medical substances with sugar: they comprise also *conserves*.

*Electuaries.*—Usually extemporaneous prescriptions, made by mixing medicines (generally powders) with honey or molasses.

2. *Liquid forms.*—These include *decoctions*, *infusions*, *mixtures*, *tinctures*, *wines*, *syrups*, *vinegars*, *oxymels*, and *honeys*.

*Decoctions.*—Preparations in which the active properties of vegetables are extracted by boiling. The boiling should take place in a covered vessel. Certain vegetables are unfit for decoction, as those which possess a volatile oil, or such as contain much inert, starchy, or mucilaginous matter.

*Infusions.*—These differ from decoctions in not being boiled. They may be made either with cold or boiling water. Cold water is preferred where the active principle is volatile, or easily injured by heat, or where it is desirable to avoid the solution of some principle which is insoluble at a low temperature. Both infusions and decoctions usually require to be *filtered*; this process may be performed either by using unsized paper in a common funnel, or by *percolation* or *displacement*.

*Mixtures.*—These consist generally of one or more insoluble substances, suspended in water by means of gum, sugar, or yolk of egg. When an oil is suspended in this way, the mixture is called

an *emulsion*. A good deal of care and dexterity are requisite in making a uniform mixture.

*Tinctures*.—Solutions of medicated substances in alcohol, or diluted alcohol. They are usually macerated, at ordinary temperatures, in well-stopped bottles, frequently agitating. Undiluted (official) alcohol is employed where the substance to be dissolved is insoluble in water,—as resins, essential oils, &c.; but *diluted* alcohol is preferred when the substance is soluble both in alcohol and water.

*Syrups*.—Preparations in which the medical substance is preserved in a concentrated solution of sugar. *Simple syrup* consists of two and a-half pounds of white sugar dissolved in a pint of water. *Medicated* syrups are made either by adding the proper amount of sugar to vegetable infusions, decoctions, juices, &c., or by adding the tincture of the substance to simple syrup, and afterwards driving off the alcohol by the heat of a sand bath.

*Honeys*.—These are analogous to syrups, the difference being that honey is employed to preserve the medical substance, instead of a solution of sugar. They are said to be less apt to become candied.

*Oxymels* are preparations in which honey and vinegar are combined.

*Vinegars*.—Liquids in which distilled vinegar is employed as the solvent.

Besides the above forms of medicines, which are employed for internal administration, there are several others which are used exclusively as external applications; these are *liniments*, *ointments*, *cerates*, *plasters*, and *cataplasms*.

*Liniments*.—Oily compounds intended to be applied to the surface by bathing, or by saturating cloths with them.

*Ointments*.—Soft solids which melt at the temperature of the body.

*Cerates* are rather harder than ointments: they do not melt at the temperature of the body. *Simple cerate* consists of fresh lard and white wax.

*Plasters*.—These are solid at ordinary temperatures, and require to be heated before they can be spread. They are usually kept in rolls, and when wanted for use are spread upon sheepskin, linen, muslin, or even paper; a small margin being left at the edges uncovered.

*Cataplasms* or *poultices*.—These are soft moist preparations, intended to relax and soften the parts to which they are applied. They are usually made from bread and milk, flaxseed meal, &c.

The *weights* and *measures* recognised by the pharmacopœia in the compounding and dispensing of medicines are the *Apothecaries' weight*, and the *Apothecaries' or wine measure*, though medicines are purchased and sold by the wholesale dealer by the *Avoirdupois weight*. The imperial pint of the British pharmacopœia (not re-

cognised by the U. S. Pharmacopœia) contains *twenty* fluid ounces. The common pint contains only *sixteen* ounces.

The following are the denominations, together with their symbols, which are employed in prescription:—

Pound, ℔; ounce, ℥; drachm, ℥; scruple, ℥; grain, gr.; gallon, cong. (congerius); pint, O. (octarius); fluid ounce, f℥; fluid drachm, f℥; minim, ℥.

A *drop* is not always equivalent to a minim, since it varies in size according to the nature of the fluid, and the shape and size of the vessel from which it is dropped. In the case of water, the minim and drop are the same; in alcohol there are two drops in each minim; in ether, there is a still greater difference.

Besides the above weights and measures, it is frequently found convenient to employ *approximative* measurements, in prescribing medicines. The following are the most common:

A *teacup*,—estimated to hold about four fluidounces, (f℥iv.) or a gill.  
 A *wineglass* “ “ two fluid ounces, - - (f℥ij.)  
 A *tablespoon* (cochlear magnum,) - - - - (f℥ss.) half a fluidounce.  
 A *teaspoon*, (cochlear parvum,) - - - - (f℥j.) a fluid-drachm.

#### CLASSIFICATION OF MEDICINES.

The great diversity of the effects of different medicines, renders an attempt at their classification very desirable. Classifications of medicines may be divided into *empirical* and *rational* ones. As an example of an empirical classification, the *alphabetical* order may be cited, since this method is founded on names which are arbitrary, and have no relation to the bodies which they are intended to represent. All its supposed advantages—as, for example, that of facility of reference—may be obtained from a well-constructed index.

The *rational* arrangements are such as have an actual relation with the bodies for which they are used, being founded on the properties of the medicines themselves, or on their mode of affecting the economy. Thus medicines may be grouped, according to (1) their *sensible* properties, as colour, taste, and smell; (2) their *chemical* properties; (3) their *natural-historical* properties; (4) their *therapeutical* properties; (5) their *physiological* properties.

Valid objections may be urged against all of the above systems of arrangement, with the exception of the *physiological* system, which is here adopted, as being the safest guide both to the student and practitioner.

By the *physiological classification* is meant one founded on the relation which medicines bear to the system in a state of health. Medicines may be arranged *physiologically*, on two principles: according to the parts or organs which they affect, or according to the nature or quality of the action which they set up. It would be almost impossible to base an arrangement exclusively upon either

of these methods ; but some authors form their principal divisions or *classes* of medicines from the parts acted on, and their *orders* from the nature or quality of the effect, or *vice versâ*. The following system of classification is founded upon the *physiological* method.

Medicines may exert their influence over the system at large, or they may evince an affinity for some one especial organ, as the lungs, kidneys, skin, &c. The former may be denominated *General Remedies*, the latter *Local Remedies*.

*General Remedies* include the following classes :

I. *Cerebro-Spinants*, or such as act primarily upon the cerebro-spinal system. These comprise several subdivisions, as (1) *Paralysers* and *benumbers*, or such as produce paralysis of voluntary motion, or cause topical numbness, as *aconite* and *conea*. (2) *Convulsives* or *tetanics*,—agents which increase the irritability of the muscular fibre, and in large doses, occasion convulsions, as *strychnia*, *brucia*, &c. (3) *Stupefacients*, or *intoxicants*,—producing, at first, excitement both of the arterial and nervous systems, but subsequently, stupor and depression. This variety includes *opium*, *alcohol*, *ether*, &c. (4) *Sedative stupefacients*, or such as occasion weakness of muscles and confusion of intellect, along with nausea and convulsions, as *digitalis*, *tobacco*, &c. (5) *Delirifacients*, or such as produce delirium, preceded by dilatation of pupil, dysphagia and aphonia, and terminating in stupor. Examples of this subdivision are seen in *belladonna*, *stramonium*, and *hyoscyamus*.

II. The second class comprises the *Stimulants*.—This class of remedies might very easily be made to include very many of the preceding division, as for instance ether, alcohol, and opium ; but only those are here spoken of, whose most obvious quality is to produce an exaltation of the vital energies of the system. Stimulants may be divided into *nervous* and *arterial* ; the former including the *antispasmodics*, and the latter the *volatile oils*, *ammonia*, *capsicum*, &c.

III. *Tonics*.—This order comprises such medicines as possess strengthening or invigorating properties. They are closely allied to stimulants, and might, in fact, be classified under the head of *permanent stimulants*. Tonics are divided into vegetable and mineral tonics.

IV. *Astringents*.—These include medicines which produce contraction of the organic fibre. By some they are considered as only a subdivision of tonics. Astringents are naturally divided into *vegetable* and *mineral*.

V. *Refrigerants*, or *arterial sedatives*.—By this term is meant medicines which reduce the temperature of the body, and thereby diminish febrile heat. The most decided remedy of this class is *cold*, directly applied ; but there are also certain medicines which produce a similar effect, as the vegetable acids, the preparations of antimony, and saline substances.

The second general division, comprising *Local Remedies*, includes the following orders :

I. *Diaphoretics*, or such as act specifically on the skin, producing perspiration.

II. *Diuretics*, or such as act upon the kidneys, increasing the secretion of urine.

III. *Emetics*, or such as produce vomiting.

IV. *Cathartics*, or such as produce purging.

V. *Expectorants*, or such as produce a local impression on the lungs, increasing expectoration.

VI. *Emmenagogues*, or such as stimulate the uterine secretion, promoting menstruation.

VII. *Sialogogues*, or such as stimulate the salivary glands.

VIII. *Errhines*, or medicines which produce an increased discharge of mucus from the nose.

IX. *Ecbolics*, or medicines which produce contraction of the uterus, so as to expel its contents.

X. *Epispastics*, or such, as when applied to the surface, produce vesication, or blistering.

XI. *Rubefacients*, or such as occasion redness and inflammation of the surface.

XII. *Escharotics*, or caustics,—which destroy the life of the part to which they are applied.

XIII. *Emollients*, or substances which soften and relax the skin.

XIV. *Demulcents*,—which act by protecting the surfaces, to which they are applied, from irritation.

XV. *Diluents*, or such as act by diluting the fluids of the body.

Besides the foregoing, the Local Medicines may also include *antacids*, or such as neutralize acid ; and *anthelmintics*, or such as destroy and expel worms from the bowels.

There yet remain three very important medicines to dispose of, viz. *mercury*, *iodine*, and *arsenic*,—which it is found extremely difficult to arrange under any of the preceding classes, on account of the peculiarity of their *modus operandi*. Perhaps it will be best to adopt the plan of some authors, and treat of them as a distinct class.

The following table will present a synopsis of the foregoing arrangement :

#### GENERAL REMEDIES.

I. Cerebro-spinants.	}	ORDER 1. Paralyzers.
		“ 2. Convulsives.
		“ 3. Stupefacients.
		“ 4. Sedative stupefacients.
		“ 5. Delirifacients.
II. Stimulants. . .	}	ORDER 1. Antispasmodics, or Nervous stimulants.
		“ 2. Arterial stimulants.
III. Tonics.		
IV. Astringents.		

## LOCAL REMEDIES.

- V. Refrigerants.
- VI. Diaphoretics.
- VII. Diuretics.
- VIII. Emetics.
- IX. Cathartics.
- X. Expectorants.
- XI. Emmenagogues.
- XII. Sialogogues.
- XIII. Errhines.
- XIV. Ecboics.
- XV. Epispastics.
- XVI. Rubefacients.
- XVII. Escharotics or Caustics.
- XVIII. Emollients.
- XIX. Demulcents.
- XX. Diluents.
- XXI. Antacids.
- XXII. Anthelmintics.

*Medicines not Classified.*

Mercury.  
Iodine.  
Arsenic.

## CLASS I.—CEREBRO-SPINANTS.

## ORDER I.—PARALYSERS.

## ACONITE.—(ACONITUM, U. S.)

Leaves and root of the *Aconitum napellus*, or monkshood, a perennial herbaceous plant, growing in the mountainous parts of Europe. The root is tapering; leaves deeply divided; flowers of a dark blue colour. All parts are possessed of acrid properties, and when fresh emit a faint narcotic odour. *Taste* of the leaves and root, at first bitterish and acrid, and followed by a peculiar tingling sensation, often amounting to numbness, which extends to the soft palate.

*Effects.*—Those of a sedative narcotic, or rather of a *benumber*, since it diminishes sensation, causes a feeling of numbness and tingling along the extremities, muscular debility, contraction of the pupil, but no delirium or stupor. Poisonous doses cause excessive burning and numbness of the mouth, throat, and stomach, with violent vomiting, prostration, great loss of sensibility, but neither coma nor convulsions. It differs from tobacco and digitalis in not producing stupor or giddiness, as a general rule. It yields its virtues to alcohol. Its peculiar properties depend upon an alkaline principle termed *aconitia*; there is also a volatile acrid principle, besides some extractive, &c.

*Aconitia* is a white solid substance, existing in combination with



an acid. It possesses all the powerful properties of the plant in a highly concentrated degree. In fact, when pure, it is as subtle a poison as prussic acid; though much of the aconite sold in the shops is worthless. Its very high price forms an objection to its use. The *alcoholic extract* of aconite, when well prepared, forms an excellent substitute for the aconitia. The common extract of the pharmacopœia is not good.

*Uses.*—Internally in chronic rheumatism, gout, cancer, &c.; but it is more valuable as an external application, particularly in neuralgia, when applied in the form of tincture.

Dose, of the purest aconitia  $\frac{1}{30}$ th of a grain (Pereira); but is very seldom used; of the *tincture*, 5 drops three times a day; of the *alcoholic extract*,  $\frac{1}{6}$ th of a grain. The ointment is made by adding the aconitia to fresh lard; it is used in neuralgia.

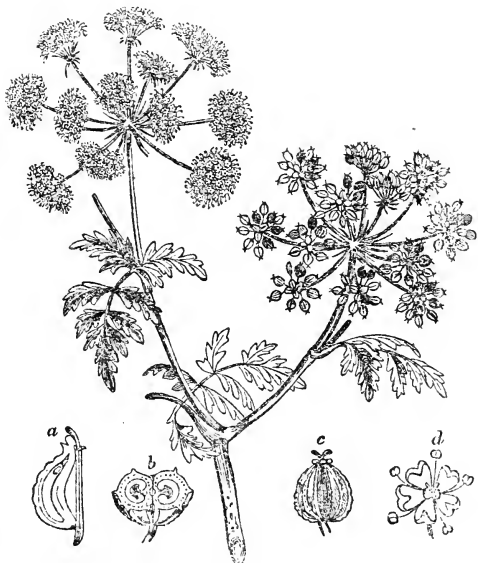
#### HEMLOCK.—(CONIUM, U. S.)

Leaves and seeds of the *Conium maculatum*, a biennial umbelliferous plant, a native of Europe, but naturalized in the U. S. It has a spindle-shaped root, and a smooth branching stem marked with purple-coloured spots. The leaves are compound-tripennate and bipennate. Believed to be the same plant as the *κωνιον* of the Greeks, and the *cicuta* of the Romans.

The leaves should be collected from plants growing in sunny situations, and preserved in close vessels. When well preserved they retain their green colour and narcotic odour. *Taste* bitter and nauseous.

Imparts its virtues to alcohol and ether. The *seeds* are small, and have a slight odour and taste, but retain all the active properties of the plant. The active principle is an alkali named *conieia*, of a

Fig. 1.



highly acrid nature, sparingly soluble in water, forming salts with the acids.

*Effects on System.*—Said by Christison, who has experimented upon it, to act as a direct sedative to the cerebro-spinal system, occasioning paralysis of the voluntary muscles, and subsequently of the muscles of respiration, together with vertigo and general debility. Its influence appears to be exerted more over the nerves of motion than over those of sensibility, producing a paralyzing effect upon the muscles supplied by the former.

*Uses.*—Employed by the ancients as a discutient or resolvent, in enlargements and indurations of the glands and viscera; also in scrofula, bronchocele, leprosy, syphilis, and ulcers of a cancerous character. Its chief reputation has been in cancer, for which it was introduced into practice by Störk of Vienna; but it is highly probable that its alleged virtues in this disease are solely due to its narcotic powers.

Hemlock is used in *powder*—dose, 3 or 4 grains two or three times a day; *tincture*—dose, f3ss. to f3j; *extract*—an inspissated juice of the leaves,—3 grs. two or three times a day.

#### ORDER II.—CONVULSIVES.

This division of the cerebro-spinalants includes such as produce *convulsions* among their more prominent effects. There is a difference, however, in the circumstances attending these convulsions: some being connected with an increased irritability of the muscular fibre, and resembling the spasms of tetanus, while others are attended with great depression, both of sensation and muscular power, as in the cases produced by hydrocyanic acid; while a third set may be followed by delirium and stupor, as when caused by camphor.

#### NUX VOMICA.—U. S.

Seeds of the *Strychnos nux vomica*, a middling sized tree, growing in the East Indies. The fruit is a berry about the size of an orange, containing many seeds imbedded in a juicy pulp. These are rather less than an inch in diameter, circular and flattened, slightly concavo-convex. Externally they are covered with a whitish silky down. The interior is hard, of a horny consistence; difficult to powder. They have no odour, but an intensely bitter taste; they yield their active principle to dilute alcohol more readily than to water.

Nux vomica owes its virtues to two alkaline principles which it contains, called *strychnia* and *brucia*, which exist in combination with *igasuric acid*.

*Strychnia* may be procured either from nux vomica, or from *St. Ignatius' bean*, which contains it in large quantities. As found in the shops it is usually granular, but it may be made to crystallize. Colour white; no odour; taste, intensely bitter; almost insoluble in

water; soluble in alcohol; slightly so in ether; unites with acids to form salts. *Brucia* is found in *false Angustura bark*; its properties are similar to those of strychnia, though feebler.

*Effects on System.*—Given in very small doses it acts as a tonic to the digestive organs; in rather larger quantities, its influence seems to be directed chiefly to the muscular system, through the medium, however, of the spinal marrow. There is, at the same time, an increased sensibility to external impressions, trembling of the limbs, and slight convulsive motions, which subsequently extend to the involuntary muscles, producing, in poisonous doses, the most violent tetanic spasms; the individual perishes apparently from asphyxia, brought on by the spasm of the respiratory muscles. There is no narcotism, nor is the pulse much affected.

There is strong reason for believing that the peculiar impression of the medicine is exerted entirely through the medium of the spinal marrow, and not through the medium of the brain.

*Uses.*—The cases which would seem most obviously to be met by nux vomica, or strychnia, are those attended with deficient nervous energy, as indicated by a torpid or paralytic condition of the muscles. The cases of paralysis to which it is applicable are such as are not attended with organic lesion of the brain. It is said to be more advantageous in paraplegia than in hemiplegia; also in local palsies, and in incontinence of urine, depending on a loss of power of the muscles of the bladder. The first obvious sign of its influence on the system, in cases of paralysis, is a tingling sensation experienced in the part affected.

Dose of the *powder*—5 grs. three or four times a day, gradually increased until a sensible effect is produced. A better form is the *alcoholic extract*, the dose of which is from half a grain to two grains.

Dose of strychnia— $\frac{1}{12}$ th to  $\frac{1}{6}$ th of a grain, three times a day.

Strychnia may be applied *endermically* in cases of amaurosis, when not of an organic character,—half a grain being sprinkled upon a blistered surface on the temple.

#### HYDROCYANIC ACID.—(ACIDUM HYDROCYANICUM, U. S.)

This acid is a compound of hydrogen and cyanogen, and is of vegetable origin, being found in the bitter almond, cherry laurel, and in most of the species of the *prunus* and *amygdalææ*. Usually obtained, however, by decomposing the bicyanide of mercury, by hydrochloric, or hydrosulphuric acid. The concentrated, or purest acid is a limpid fluid of a sp. gr. of 0.697; having a strong peculiar odour, which, however, differs from that of the oil of bitter almonds, extremely volatile; boils at 79°; has a great tendency to undergo decomposition, and is extremely poisonous. It is never employed in the undiluted form.

The *medicinal* or *dilute* hydrocyanic acid is procured by the re-

action of hydrochloric acid on cyanide of silver in water. Its properties are similar to those of the concentrated acid, only in a less degree; it contains from 2 to 3 parts of real acid in 100 of water. It is very liable to decomposition, especially when exposed to the light; hence it should be kept in a dark place.

*Effects on System.*—In very small doses repeated, it causes a bitterish taste, nausea, vertigo, faintness, but no very certain alteration of the circulation. The more violent effects are great and sudden prostration, giddiness, and faintness, tetanic convulsions, and insensibility, difficult and spasmodic respiration, and death. The peculiar odour of the acid is usually very distinct. The post-mortem appearances are not very definite. The best *antidotes* are chlorine, ammonia, the cold affusion, and artificial respiration.

*Uses.*—Internally, as a remedy in certain nervous affections, particularly *gastrodynia*; also in whooping cough, asthma, epilepsy, hypertrophy and palpitation of the heart, and in the cough of phthisis. Externally, it is employed as a wash in certain forms of skin disease,—the proportions being ʒij of the dilute acid to Oss. distilled water. Dose of the officinal acid, 1 to 3 drops, repeated till some obvious effect is produced.

As a substitute for hydrocyanic acid, the cyanide of potassium may be used, since it is not, like the former, apt to undergo decomposition when kept. It may be given in the dose of  $\frac{1}{4}$  gr., gradually increased. When swallowed it becomes converted into hydrocyanic acid, by the acid of the stomach. Another good substitute is the *oil of bitter almonds*—in the dose of  $\frac{1}{4}$  of a drop, to be repeated.

### ORDER III.—STUPEFACIENTS OR INTOXICANTS.

These are agents which produce a peculiar disorder of the intellect, termed *intoxication*, impair volition, and when used in excess, occasion paralysis of the voluntary muscles, and stupor. They are all decided excitants to the circulation as well as to the cerebro-nervous system; and their influence seems to be more decidedly directed to the brain than to the spinal marrow. This order includes many of the agents denominated *stimulant narcotics*. They differ very much in their energy over the system, and are, by some, supposed to produce their different effects on different parts of the brain. As medicines, their chief employment is in reference to their narcotic, anodyne, and stimulant properties.

#### ALCOHOL.

The product of a peculiar change in a saccharine liquid, known as the *vinous fermentation*. The conditions necessary for this change are a solution of sugar, the presence of some ferment, and a certain temperature. The chemical change which occurs is the conversion of sugar into alcohol and carbonic acid. The juices of various fruits

contain all the elements for due fermentation. Thus the juice of the grape undergoes spontaneous fermentation, yielding *wine*; the juice of apples yields *cider*; the infusion of barley *malt liquor*, &c. All such liquors—the result of fermentation—are named *fermented liquors*, and vary very much both as to flavour and also as to the quantity of alcohol which they contain; thus the stronger wines contain about 20 per cent. of alcohol; the weaker wines about 10 or 12 per cent.; the malt liquors, as porter, ale, and beer, about 4 per cent. All the fermented liquors when submitted to distillation afford much stronger products, called *distilled liquors*, *ardent spirits*, or *spirituous liquors*. Brandy, gin, rum, &c., are examples. These contain about 50 per cent. of alcohol. When the quantity is exactly 50 per cent., or one half, the liquor is termed *proof-spirit*.

Any of the distilled liquors when submitted to distillation, will yield the *alcohol* of the Pharmacopœia, called also *rectified spirits of wine*,—having a sp. gr. of .835. The alcohol thus procured contains as much as 15 per cent. of water, from which it cannot be entirely separated by any number of distillations. The *absolute alcohol* of chemists is never used in medicine.

The *alcohol dilutum* of the Pharmacopœias consists of equal measures of officinal alcohol and water: it is used in making certain tinctures; its strength is about that of the distilled liquors.

The various alcoholic liquors are used in medicine chiefly as stimulants in low states of the system. The *fermented* liquors, as wine, or the malt liquors, are usually preferred, unless a very decided stimulus is required, in which case *brandy* is employed.

*Wine- whey* is one of the best forms of administering wine; it is made by adding half a pint of wine, (Madeira, Sherry, or Teneriffe,) to a pint of boiling milk, separating the curd from the whey, and diluting the latter, if necessary, with rennet whey, and properly flavouring with sugar and spices.

The *malt liquors* may be employed as stimulants more freely than wine; they possess also tonic and nutritive properties: the best are porter and ale; beer is apt to prove acescent.

Alcohol is frequently employed externally, particularly in the form of ardent spirits, as a rubefacient: the effect is increased by mixing with red pepper.

An evidence of the favourable influence of alcohol in disease, is when, under its use, the pulse becomes fuller, and at the same time slower; the skin moist, with an abatement of delirium.

#### SULPHURIC ETHER.—(ÆTHER SULPHURICUS, U. S.)

Chemically, the *oxide of ethyl*. Prepared by distilling together  $2\frac{1}{2}$  lbs. alcohol and  $1\frac{1}{2}$  lbs. sulphuric acid. The ether, as first procured, is contaminated with sulphurous acid, oil of wine, and some alcohol. It is purified from the acid by a redistillation with potassa;

and from the alcohol by agitation with water. When thus purified it is named *rectified sulphuric ether*.

*Prop.*—A colourless limpid liquid, of a strong agreeable and peculiar odour; a hot pungent taste; sp. gr.  $\cdot 7$ , or a little less. Water takes up one part in ten; very soluble in alcohol; very volatile and inflammable.

Its effects on the system resemble those of alcohol, only more rapid and transient. It will affect the brain, producing intoxication; and, like alcohol, its effects are diminished by frequent repetition; Its impression is very speedily produced on the system by *inhalation*; by this means, a very powerful narcotic influence may be obtained.

As a medicine, ether is used chiefly as a powerful diffusive stimulant in cases of sudden and alarming prostration, as in metastatic gout, spasmodic asthma, angina pectoris, &c. It is best given in *emulsion*, made by rubbing it up with water by means of spermaceti. Externally applied, it produces cold, if allowed to evaporate; or a rubefacient effect, if confined to the skin.

The spirit of sulphuric ether (*Spiritus ætheris sulphurici*, U. S.) is a solution of ether in alcohol: it is not much used.

Hoffman's Anodyne (*Spiritus ætheris sulphurici compositus*, U. S.) is much more employed. It contains some *oil of wine*, to which it owes its peculiar fragrant odour, and which causes it to impart a milkiness to water; this is a test of its genuineness. It is much used to allay nervous irritations: it acts as an antispasmodic. Dose of ether, fʒss. to fʒj;—of Hoffman's Anodyne, about the same.

### OPIUM.

The concrete juice of the *Papaver somniferum*, which is probably a native of Persia, but is now cultivated in various parts of the world. It is an annual plant, attaining the height of 2 to 4 feet. The flower consists of four large petals (Fig. 2). There are two varieties of the papaver somniferum, named the *white* and *black* poppy.

The *capsules* (poppy-heads) are about one and a half to two inches in diameter, of a yellowish-brown colour, and filled with small seeds, which contain much fixed oil of a bland character, but no narcotic principle. The capsules themselves are slightly narcotic, and are sometimes employed in the form of decoction and syrup.

Opium is procured by making incisions in the half-ripe capsules, and collecting the juice which exudes, and properly drying it. It is obtained in large quantities in India, Persia, and Asia Minor; the chief supply of commerce being afforded from the latter country.

The different varieties of opium are the *India*, *Persia*, *Turkey*, and *Egyptian*.—The India variety is almost exclusively consumed in India and China. The Persian very seldom comes to this country.

There are two kinds of Turkey opium found in the markets,—*Smyrna* and the *Constantinople* opium.

*Smyrna opium* is, on the whole, the best; it comes in irregular rounded, or flattened cakes, covered with the capsules of some species of *rumex*, and enveloped in leaves; has a reddish-brown colour; a softish consistence in the centre; becomes darker and harder on exposure; has a strong narcotic odour.

*Constantinople opium* is seldom seen in our markets;—occurs in irregular flattened cakes, presenting the remains of a leaf on the exterior.

*Egyptian opium* comes in flat cakes about three inches in diameter, free from capsules; of a darker colour, and more mucilaginous than the *Smyrna* variety.

*Marks of good opium* are a strong narcotic odour, a bitter acrid taste, when long chewed, exciting irritation of the fauces and mouth; a reddish-brown colour; when drawn across white paper should leave an interrupted stain.

Opium is inflammable; it imparts its virtues to water and alcohol. *Chemical composition* very complex; most important ingredient is *morphia*;—contains also *narcotina* and *codeia*, which are alkaline principles, and *narceine*, which is neutral; also, *meconin*, *meconic acid*, *thebain* or *paramorphia*, *gum*, *extractive*, and a volatile principle.

*Physiological Effects*.—Those of a stimulant narcotic; it excites the circulatory and nervous systems, and in full doses affects the brain.

Its first impression is to stimulate the heart and arteries, as evidenced by an increased frequency of the pulse, and greater heat of skin. This is soon followed by diminished sensibility, calmness, and sleep, with abatement of pain, and suspension of mucous secretions, except that of the skin. This is succeeded by a degree of prostration, evidenced by a feeble pulse, cool, moist skin, languor, and depression. In large doses it is a narcotic poison, the symptoms being stertorous breathing, a slow full pulse, great insensibility, and a livid countenance; followed by a feeble and threadlike pulse, re-

Fig. 2.



laxation of the muscles, and death. The *treatment* consists in an immediate evacuation of the stomach, either by the stomach pump, or by a prompt emetic (zinci sulph. et ipecac.), counteracting the tendency to sleep by external irritation; arousing the sensibility by dashing cold water upon the face and chest; and supporting the system, when it begins to sink, with diffusible stimulants.

*Therapeutical Applications.*—Opium is employed in a great number of diseases; it is perhaps the very best *anodyne*, and is used for this purpose to relieve the pain of neuralgia, cancer, colic, &c. As a *hypnotic* or *soporific*, it is used in cases of morbid vigilance, except when dependent on inflammation of the brain. As a *stimulant* it is valuable in low forms of fever. As an *antispasmodic*, it controls spasm more effectually than most other remedies; in tetanus very large doses are required. As a *diaphoretic* it is useful in bowel affections, typhoid pneumonia, rheumatism, &c. It is also employed to arrest morbid discharges. On certain constitutions it produces peculiar effects, as obstinate wakefulness, nausea, delirium, and a tingling of the skin, attended with a miliary eruption.

The average dose of opium is one grain; but in mania-à-potu and tetanus, enormous doses are required. It may be applied *endermically* with advantage, in cases where the local effects are required; also by enema.

The following preparations are officinal in the United States Pharmacopœia:

*Tinctura Opii—Laudanum—Thebaic tincture.*—Prepared by macerating opium, ℥ijss. in diluted alcohol, Oij. It is a saturated tincture, and should always be of uniform strength. When long kept its strength is increased by the evaporation of the alcohol, in which case danger might result from administering it to infants. The dose equivalent to a grain of opium is ℞xiii. or 25 drops. Laudanum is frequently used as an external application.

*Tinctura Opii Camphorata—Paregoric Elixir.*—Prepared by the action of dilute alcohol on opium, benzoic acid, camphor, oil of anise, and honey. It contains two grains of opium in every fluid-ounce. It is much used in diarrhœa and coughs;—dose, about f3j.

*Tinctura Opii Acetata—Acetated Tincture of Opium.*—Prepared by macerating opium in alcohol and vinegar combined;—dose, ℞x.

*Acetum Opii—Black Drop.*—Prepared by macerating opium, nutmeg, and saffron in distilled vinegar. It is a strong preparation;—dose, 7 to 10 drops.

*Vinum Opii—Wine of Opium.*—Made by macerating opium and some of the aromatics in wine;—dose, ℞x.

*Morphia Sulphas—Sulphate of Morphia.*—Prepared by acting on a strong watery infusion of opium, with ammonia, which combines with the meconic acid, precipitating the morphia in a crystalline state; purified by boiling alcohol, and separated from the narcotina



by means of ether. By these means the morphia is obtained in a crystalline state; it is next neutralized with sulphuric acid. It occurs in fine needle-shaped crystals, freely soluble in water. The solution is officinal, (Liquor morphiæ sulphatis, U. S.) It contains one grain to f3j of water;—dose, f3j.

The *hydrochlorate* and *acetate* of morphia are also used: their properties are similar to those of the sulphate. The best *tests* for the presence of morphia are the *sesquichloride of iron*, which causes a blue colour; and nitric acid, which strikes a blood-red tint.

The salts of morphia are much employed *endermically*; they possess all the valuable properties of opium.

### LACTUCARIUM.

The inspissated juice of the *Lactuca sativa*, or *garden lettuce*, which abounds in a milky juice, especially at the period of flowering. It is prepared by pressing out the juice with water, and evaporating to a proper consistence. It is of the consistence of a dry extract, of a brown colour, and strongly resembles opium in its effects, except that it does not produce constipation. Its dose is from two to five grains.

### CAMPHOR.—(CAMPHORA, U. S.)

Product of the *Camphora officinarum*, or the *Laurus camphora* of Linnæus, an evergreen tree of considerable height, growing in China and Japan. All parts of the tree abound in the odour and taste of camphor, but this is yielded in greatest abundance by the roots and young branches, when they are cut up, boiled in water, and sublimed into inverted straw cones. Thus obtained, it constitutes the *crude camphor* of commerce. It is purified by resublimation, along with quicklime, when it becomes *refined camphor*.

It is solid, colourless and translucent, with a crystalline texture, tough and difficult to pulverize; has a strong penetrating odour, with a bitter pungent taste, followed by a sense of coolness; rather lighter than water; very volatile and inflammable; but slightly soluble in water; very soluble in alcohol, ether, the fixed and volatile oils.

Borneo camphor is in white crystalline fragments; it occurs in solid masses in the cavity of the wood of the *Dryobalanops camphora*.

*Effects on System.*—In moderate doses, it produces a gentle ex-

Fig. 3.



citement, heat of skin, and fulness of pulse, with a tendency to diaphoresis. Large doses prove narcotic. Sometimes it seems to act as sedative. It is applicable in typhoid cases, accompanied with nervous derangement. It is sometimes usefully combined with opium, in rheumatism, &c.

Dose, in substance, from 5 to 10 grains. The *emulsion* is made by rubbing up the camphor with gum, sugar, myrrh, and water.

*Aqua Camphoræ*—*Camphor Water*—is made by adding a few drops of alcohol to camphor, and then rubbing up with carbonate of magnesia and water: it contains 3 grains to every fluidounce.

*Tinctura Camphoræ*, often called *Spirits of Camphor*, contains two ounces of camphor to the pint of alcohol;—chiefly employed as an embrocation to sprains and bruises; used internally in colic and cholera;—dose, 5 drops to ℥ʒj.

*Linimentum Camphoræ*—*Camphor Liniment*, consists of camphor dissolved in olive-oil; used as a mild embrocation.

*Tinctura Saponis Camphorata*, improperly called *Soap Liniment*,—made by mixing together camphor, Castile soap, oil of rosemary, and alcohol. It is a yellowish oleaginous liquid, much used as a stimulant anodyne lotion in sprains, rheumatism, &c.

*Linimentum Saponis Camphoratum*, commonly known as *Opodeldoc*,—made like the last-mentioned preparation, except that an animal soap is used instead of a vegetable one, in consequence of which it coagulates on cooling, and yields a soft solid, which liquefies at the temperature of the body;—uses, the same as the others.

#### HOPS.—(HUMULUS, U. S.)

The *Humulus lupulus* (Fig. 4), is a native of Europe and North America. It has a perennial root, which sends up annually several rough, flexible, twining stems. The male and female flowers grow on different plants. The part used is the flowers, or rather strobiles, which are collected when ripe, dried, and packed in bales. They have a greenish-yellow colour; a bitter, astringent, and somewhat aromatic taste; impart their virtues to water and alcohol. A reddish powder is found at the base of the scales, termed *lupulin*, which contains all the virtues of the hops. These virtues depend upon a peculiar principle called *lupulina*, which resides both in the hops and in the powder.

*Effects on System*.—Stomachic, tonic, and slightly narcotic. The odorous emanations from hops are hypnotic; for this purpose the *hop-pillow* is employed, made by previously moistening the hops with spirits, to increase the effect, as well as to prevent a rustling noise. Hops are extensively employed in making malt liquors. They are best given in the form of infusion, made in the proportion of ℥ss. to Oj water. The decoction and extract are objectionable. Lupulin may be given in the dose, 6 to 12 grains, made into a pill.

Fig. 4.



The tincture of lupulin (*Tinc. Lupulinæ*) is officinal, as well as the tincture of hops. They are excellent remedies in the dyspepsia of drunkards, and in mild mania-à-potu;—dose, f3ss. to f3j. Hops are sometimes applied externally, in the form of poultice; it has an anodyne effect.

#### BITTERSWEET.—(*DULCAMARA*, U. S.)

It is doubtful whether this medicine should have a place among the narcotics, since its influence over the cerebral functions is very feeble. The plant yielding it is the *Solanum dulcamara* or *woody nightshade*; the parts employed are the stem and twigs, which should be collected in the autumn. They are about the thickness of a common quill, of a light brownish-gray colour, without odour, and have a bitter taste followed by sweetness.

*Uses.*—Their chief employment is as an alterative in chronic skin

diseases, given in the form of strong decoction. It may also be used in the same cases advantageously as a wash. Its virtues depend on an alkaline principle named *solania*, which is also found in the *Solanum tuberosum*, or common potato.

Dulcamara has been supposed by some to be antispasmodic, and for this purpose has been employed in the cases of the insane.

#### ORDER IV.—SEDATIVE STUPEFACIENTS.

These are medicines which occasion great depression of the system, attended often with nausea, sometimes with vomiting and purging, weakness and irregularity of pulse, syncope, giddiness, confused vision, and occasionally convulsions, delirium, and stupor. They are named by some writers *sedative narcotics* or *nervous sedatives*. The most important of this group are foxglove and tobacco.

##### FOXGLOVE.—(DIGITALIS, U. S.)

The *Digitalis purpurea* is a biennial plant with long radical leaves, from the midst of which an erect stem arises the second year, terminated by a raceme of beautiful purple flowers. The parts used in medicine are the leaves, which require to be selected and dried with great care, and preserved so as to exclude the light. When dried they should have a fine green colour, a slight odour, with the strong bitterness of the recent plant. They contain a peculiar principle termed *digitalin*, on which their activity depends.

*Effects on System.*—Those of a sedative narcotic; causes tightness and dull pain in the forehead, vertigo, dimness of vision, confusion of intellect, great reduction of the heart's action—in some cases as much as 30 pulsations a minute. It is also powerfully diuretic. Poisonous doses produce nausea and vomiting, great prostration, cold sweats, hiccup, convulsions, and death. It is cumulative in its action, and therefore its effects require to be carefully watched.

Digitalis is chiefly used to diminish the action of the heart in hypertrophy and dilatation of that organ, also in certain forms of nervous palpitations, in aneurism of the aorta; in inflammation as an adjuvant to the lancet; in scarlatina, pertussis, epilepsy, and some forms of hemorrhage; also as a diuretic. Dose in substance gr. j, two or three times a day; of the *infusion*, made by adding ℥ij to Oj of water, f℥ss.; of the *tincture*, ℥x to ℥xxx.

##### TOBACCO.—(TABACUM, U. S.)

Leaves of the *Nicotiana tabacum*, an annual plant, native of tropical America. It has an erect, hairy stem, long sessile leaves, viscid and hairy. As found in the shops it is of a yellowish-brown colour, strong, narcotic, penetrating odour, bitter, acrid and nauseous taste. Alcohol and water extract its virtues. Its active principle, named *nicotina*, is a volatile, alkaline oily liquid, without colour, with

a very acrid taste, and an odour resembling that of tobacco: it is extremely poisonous. Tobacco contains another principle named *nicotianin*, a fatty substance, seeming to owe its properties to containing a little nicotina. An *empyreumatic oil* is yielded by the destructive distillation of tobacco: it gives the peculiar odour to old tobacco-pipes: it is very poisonous.

*Effects on System.*—In very small quantities, it is a sedative to the system at large; in larger doses, acts on the brain, producing vertigo, and stupor, together with nausea and vomiting, extreme depression, coldness of the skin, syncope, and sometimes convulsions. Small doses repeated are more dangerous than a large one, in consequence of the latter being rejected from the stomach. In its effects, it resembles digitalis, surpassing it, however, in its depressing influence over the muscular system, but being inferior to it in its influence over the circulation.

*Uses.*—Chiefly to relax the muscular system, as in strangulated hernia, obstinate constipation from spasm of the bowels, or retention of urine from spasm of urethra. Not much given by the stomach on account of the excessive nausea it produces; chiefly by *enema*, (infusion, made in proportion of ʒj tobacco to Oj of water,—one half to be used at once.) Dangerous and even fatal symptoms have resulted from the tobacco injection. It may also be used in the form of cataplasm, in cases of spasmodic croup, lead colic, tetanus, and rheumatic affections.

Tobacco ointment (*Unguentum Tabaci*, U. S.) is made by boiling fresh tobacco in lard: it is used in cutaneous diseases, especially *tinea capitis*. The ointment is sometimes made from the oil.

#### INDIAN TOBACCO.—(LOBELIA, U. S.)

The *Lobelia inflata* is a native of America, where it was employed as a medicine by the aborigines. It is an annual plant, growing a foot or more in height, with an erect stem; the fruit is an inflated capsule. The whole shrub is used in medicine. It contains a volatile, acrid, peculiar principle, named *lobelina*, analogous to *nicotina*.

*Effects.*—Narcotic, acrid, emetic, and antispasmodic, strongly resembling those of tobacco. It is chiefly used as an antispasmodic in asthma, either by giving it in full doses so as to excite vomiting, or in small quantities frequently repeated till nausea comes on. Its infusion may be used in the form of enema in strangulated hernia. Used internally chiefly in the form of *tincture*,—dose fʒj. Fatal effects have followed the empirical administration of lobelia.

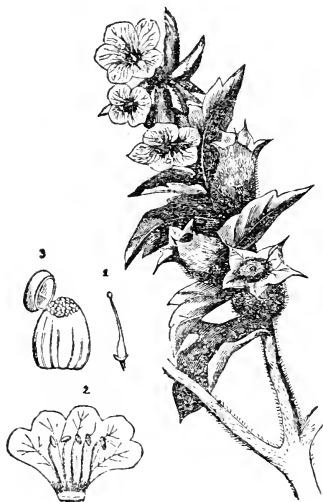
#### ORDER V.—DELIRIFACIENTS.

This division includes Hyoscyamus, Belladonna, and Stramonium—medicines, which, along with other narcotic properties, have a tendency to produce delirium.

## HENBANE.—(HYOSCYAMUS, U. S.)

Leaves and seeds of the *Hyoscyamus niger*, a biennial plant (Fig. 5), native of England, growing from one to three feet high; thickly furnished with sessile leaves, of a pale green colour. All parts abound in narcotic properties, but the leaves and seeds alone are officinal. The leaves of the second year, and of plants grown in sunny situations, are said to be the strongest. They ought to have a mucilaginous, slightly bitter taste, and should retain some of the narcotic odour of the plant. They depend for their virtues upon a peculiar crystalline alkaline principle, named *hyoscyamin*; this is yielded to water and alcohol.

Fig. 5.



*Effects*.—Very slightly, if at all, excitant; narcotic, anodyne, and soporific; resembles opium in moderate doses, except that it does not constipate. Large doses occasion dizziness, dilatation of the pupil, and slight delirium. It may

be used in cases requiring the exhibition of a gentle anodyne and calming remedy. It is given in *powder*,—dose, 5 to 10 grains; in *extract*, (inspissated juice)—dose, 3 to 10 grains; in *tincture*,—dose, fʒj. The preparations of *hyoscyamus*, as found in the shops, are very variable.

## THORNAPPLE.—(STRAMONIUM, U. S.)

The *Datura stramonium* (Fig. 6) is an annual, very common in different parts of the world, growing from 3 to 6 feet high. All parts are acrid and narcotic, but the leaves and seeds only are used in medicine. These owe their efficacy to a very poisonous peculiar principle called *daturia*.

*Effects*.—A strong acrid narcotic; diminishes sensibility, causes cerebral disturbance, as manifested by giddiness, headache, dilatation of the pupil, and obscurity of vision; also, calmative and antispasmodic; occasionally will produce diaphoresis and diuresis.

*Used*,—in neuralgia, rheumatism, epilepsy, and mania; also in spasmodic asthma, where it is employed by smoking the dried leaves or root in a common pipe; caution is required in the case of the

Fig. 6.



aged or plethoric. Given in *powder*—dose, 2 or 3 grains; in *seed*—dose, one grain twice a day; *extract of the leaves*—dose, one grain twice a day; *extract of the seeds*—dose,  $\frac{1}{4}$  to  $\frac{1}{2}$  a grain.

The extract is used by American oculists to dilate the pupil of the eye previous to the operation for the cataract.

The ointment (*Unguentum stramonii, U. S.*) is made by boiling the fresh leaves in lard: it has a light green colour, and may be employed in the same cases as the belladonna ointment.

#### DEADLY NIGHTSHADE.—(BELLADONNA, U. S.)

The *Atropa belladonna* (Fig. 7) is an herbaceous perennial plant, a native of Europe. It has a thick fleshy root, several downy, erect stems; ovate, entire leaves; and pendant, bell-shaped, purplish flowers. All parts are possessed of narcotic properties, though only the leaves are officinal. The dried leaves have a dull greenish colour, a slight narcotic odour, and a bitter nauseous taste. Active principle, *atropia*, a violent poison.

*Effects, &c.*—Anodyne, antispasmodic, and rather sedative; one of its earliest impressions is a dryness and stricture of the fauces; it often causes dilatation of the pupil, giddiness, dimness of vision; in large doses, great thirst, dysphagia, violent delirium, blindness, and occasionally convulsions, coma, and death. Its fatal effects are usually accompanied with marks of gastro-intestinal inflammation.

*Uses.*—As an anodyne, to relieve the pain of neuralgia; as a solvent or discutient, in chronic indurations; as an antispasmodic in

Fig. 7.



the latter stages of hooping cough; by some supposed to be a prophylactic in scarlatina. Externally applied, it produces a local anodyne impression; and if applied to the eyes, it causes dilatation of the pupil, for which purpose it is frequently used by the oculist. It is employed in substance, infusion and extract. Dose of powder, one grain twice a day; of the infusion—made with  $\mathfrak{Dj}$  to  $\mathfrak{f3x}$  water— $\mathfrak{f3j}$ , or  $\mathfrak{f3ij}$ ; of the extract—an inspissated juice— $\frac{1}{4}$  of a grain to one grain. The dose, in each case, is to be increased until dryness of the throat is produced.

*Emplastrum belladonnæ*—made by

mixing the extract with lead plaster—is used to relieve neuralgic pains; also in dysmenorrhœa.

*Unguentum belladonnæ*.—Used to painful or sprained joints, and sometimes applied to the rigid os uteri in cases of protracted labour: used also for dilating the pupil for the operation of cataract.

## CLASS II.—STIMULANTS.

“Agents which increase the vital activity of an organ.” Sometimes termed *incitants*, or *excitants*. Those, which, by exciting the nervous and vascular systems, affect all the organs or functions, are termed *General stimulants*; while those whose effects are more confined are named *Local stimulants*; and those which excite the parts to which they are applied are termed *Irritants*. Generally speaking, every excitement of the system is followed by a depression, which corresponds, in amount, with the previous state of exaltation. As remedies, they are applicable in cases of sudden or great prostration



of the system; and some of them have a particular tendency to the spinal system of nerves, and prove powerful means in controlling spasm, from which cause they are frequently denominated *Anti-spasmodics*. Many substances spoken of under other heads often produce stimulant effects, as alcohol, ether; opium, &c.; only such are treated of under the present head as cause stimulation, either of the circulation, or of the nervous system, as their *principal* effect. Those which produce a powerful and rapid, but transient action, are called *diffusible stimulants*.

#### ORDER I.—ARTERIAL STIMULANTS.

##### CARBONATE OF AMMONIA.—(AMMONIÆ CARBONAS, U. S.)

Chemically a *sesquicarbonate*; improperly termed *volatile alkali*. Prepared by subliming together carbonate of lime and sal ammoniac. When first made it is a solid, white, transparent cake; odour strong and pungent; taste, acrid and alkaline; soluble in water and alcohol; efflorescent on exposure, losing its stimulant properties.

*Effects*.—A powerful diffusible stimulant, acting chiefly upon the circulation; has a local tendency to the lungs and skin.

*Uses*.—Much employed in the sinking stages of fever, or of acute diseases; also in atonic gout, and dyspepsia attended with acidity of stomach; externally, to bites of poisonous insects. Dose, 5 grains every hour or two, given in solution with gum and sugar, to obtund its acrimony.

The *aromatic spirit of ammonia* consists of alcohol impregnated with gaseous ammonia, and some of the volatile oils;—dose, fʒss. to fʒj.

##### OIL OF TURPENTINE.—(OLEUM TEREBINTHINÆ, U. S.)

Procured from common turpentine, which consists of the volatile oil and resin, by distillation. Called improperly *spirits of turpentine*.

*Prop*.—A colourless limpid fluid; odour, strong and peculiar; taste, hot and peculiar; rather lighter than water, with which it is slightly soluble; its proper solvent is boiling alcohol. Chemically, a *hydrocarbon*; but when exposed to the air, absorbs oxygen, which converts part of it into resin.

*Effects*.—Small doses produce a warming, stimulating effect upon the stomach and the system generally, increasing the action of the heart and arteries. It is absorbed into the circulation, as proved by its being exhaled from the secretions. Apt to act upon the kidneys, sometimes with violence. Large doses act as a cathartic, and anthelmintic.

*Uses*.—A valuable stimulant, particularly in low forms of fever; more especially in *typhoid fever*, attended with dry tongue, delirium, tympanitis and subsultus. It is believed by some to produce an

alterative impression upon the mucous membrane. Also in chronic catarrh, chronic nephritis, chronic gout and rheumatism; also in hemorrhages from the lungs and bladder. Dose, from 5 to 20 drops, given in emulsion, or dropped on sugar, and frequently repeated.

PHOSPHORUS is one of the most powerful of the stimulants, but is rarely employed. It should never be used in substance, but in ethereal solution. Dose, one-twelfth of a grain.

#### AROMATICS.

The aromatics are by some classified among the tonics; but they may very properly be considered under the present head, since they all have stimulant properties, though in different degrees. They include the *spices*, which, on account of their agreeable odour and taste, are much employed as condiments, and also for flavouring or disguising less pleasant medicines.

Most of the aromatics have an agreeable odour and taste, which depend upon a volatile oil, procured by distillation. As medicines, they act as grateful stimuli; creating warmth of stomach, obviating nausea, expelling flatulence, and relieving slight colic.

Among the spices is frequently included a substance differing from them somewhat in properties, termed

#### CAYENNE, OR RED PEPPER.—(CAPSICUM, U. S.)

The fruit of the *Capsicum annuum*, a native of the East and West Indies, but cultivated in our gardens. The fruit is in pods 2 or 3 inches long, of a conical shape; colour when ripe, bright red, which becomes darker by drying; colour of powder red. The odour and taste of capsicum are peculiar, and depend on a fixed alkaline principle, named *capsicin*. Alcohol and water extract its active properties.

*Effects.*—A powerful stimulant, especially irritant to the part to which it is applied.

*Used.*—When a powerful local impression is required, as in rousing the action of the stomach; peculiarly applicable in malignant scarlet fever attended with putrid sore throat. A preparation consisting of two table-spoonsful of powdered capsicum, one teaspoonful of common salt, half a pint of boiling vinegar, and half a pint of boiling water, is much used for this purpose in the West Indies. A saturated infusion may also be applied locally to the throat in gangrenous cases, with great benefit.

Dose of powder, 5 to 10 grains; of infusion—made with ℥ij to Oss. water—f℥ss.; of the tincture, f℥j to f℥ij. The strength of the gargle should be proportioned to the severity of the case. The other species most employed are *Nutmegs*, *Cloves*, *Mace*, *Black Pepper*, *Cubeb*, *Allspice*, and *Cinnamon*.

NUTMEGS. (*Myristica*, U. S.)—Fruit of the *Myristica moschata*, a native of the Malaccas, but grown in Cayenne. They are the

kernels of the nut, which is surrounded by a membrane, called *mace*. Nutmegs contain a volatile oil, procured by distillation, and a fixed oil, called *oil of mace*, obtained by expression. Nutmegs are aromatic, and in large doses, narcotic. Used chiefly as a condiment, and to flavour farinaceous drinks. Mace is employed for the same purpose.

**CLOVES.** (*Caryophyllus*, U. S.)—Unexpanded flowers of the *Eugenia caryophyllata*, an evergreen, native of the Malaccas. They ought to have a deep brown colour, and an oily aspect.

Cloves are one of the most stimulant aromatics; depend for their virtue upon a volatile oil, which is rather heavier than water. Dose of powder, 5 to 10 grains; of infusion, made with ℥ij to the pint, f℥ij; of the volatile oil, 2 or 3 drops.

**BLACK PEPPER.** (*Piper*, U. S.)—Dried berries of the *Piper nigrum*, a vine, native of the East Indies. The fruit when first ripe is red, but becomes black by drying. When deprived of its outer coating it constitutes *white pepper*. It contains a peculiar crystalline principle—*piperin*—which, however, is not the active principle; this resides in the volatile oil. Piperine has been used with advantage as an *anti-intermittent*.

Black pepper is chiefly employed as a condiment, it is a decided stimulant in large doses. Its excessive use is injurious to the stomach.

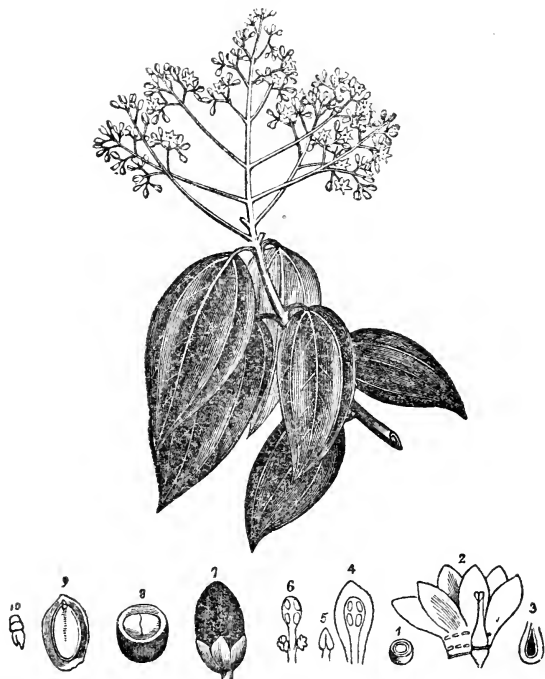
**CUBEBS.** (*Cubeba*, U. S.)—Dried fruit of the *Piper cubeba*, a vine much resembling the last. The cubeb berries are distinguished by being reticulated, and having a short footstalk attached to them. They have an aromatic odour, and a warm camphorous taste; depend for their virtues on a volatile oil, procured by distillation. They have a tendency to act on the kidneys, and in larger quantities to affect the head. As a medicine, its chief use is in affections of the urino-genital organs, particularly gonorrhœa. Dose of powder, ʒss. to ʒj; of the volatile oil, 10 to 20 drops.

**ALLSPICE.** (*Pimenta*, U. S.)—Called also *Jamaica pepper*. Grows in Jamaica; fruit of the *Myrtus pimenta*; called *allspice* from its combining the flavour of several other spices. Its virtues depend on a volatile oil. Used only as a condiment.

**CINNAMON** (*Cinnamomum*, U. S.)—Bark of the *Cinnamomum zeylanicum*, (Fig. 8,) a native of Ceylon. The bark is stripped from trees of six or seven years old. When dried, it curls up laterally, so as to form quills, which are inserted one within another. The variety called *Cassia* is believed to be the product of the *C. aromaticum*, a native of China, and is sent from Canton.

True cinnamon is known by its colour, the thinness of its bark, the congeries of quills in which it always comes, its splintery fracture, and its sweetish aromatic taste, more pleasant than that of cassia bark, though the best specimens of the latter may be considered nearly as good. There is a volatile oil of cinnamon, and also

Fig. 8.



one of cassia. Cinnamon contains some tannic acid, which is the cause of its astringency.

Cinnamon Water—*Aqua Cinnamomi*—is made by rubbing up the oil of cinnamon with carbonate of magnesia, and then adding water: it is used as a vehicle for other medicines. The *compound tincture* is used in the dose of ℥ʒj to ℥ʒij.

ORANGE PEEL—*Aurantii cortex*—is a mild aromatic, occasionally employed for flavouring.

The *Aromatic seeds* most used are the CARDAMOM—*Cardamomum*,—fruit of the *Alpinia cardamomum*, a native of Malabar.

FENNEL SEED—*Feniculum*,—fruit of the *Anethum fœniculum*, a native of Europe.

ANISE—*Anisum*,—fruit of the *Anisum pimpinella*.

CORIANDER—*Coriandrum*,—fruit of the *Coriandrum sativum*.

CARAWAY—*Carum*,—fruit of the *Carum carui*.—These all contain a volatile oil, and are used chiefly for imparting an agreeable flavour to other substances. The *Compound tincture of cardamom* is one of the best stomachic aromatics which we possess.

The following aromatic herbs are often used: *Lavender*,—the flowering tops of the *Lavandula vera*. Lavender water consists of the volatile oil dissolved in alcohol: it is used as a perfume.

*Lavender Compound*—*Tinc. Lavandulae Composita*—is used for the same purposes as the compound tincture of cardamom.

*Rosemary*—flowering tops of the *Rosmarinus officinalis*. It contains a very stimulant volatile oil, used as an ingredient in opodeldoc.

*Peppermint*—*Mentha piperita*—abounds in a volatile oil much used; dissolved in alcohol, it forms the *essence of peppermint*, employed for relieving nausea and slight colic.

*Peppermint water* is made by rubbing up the oil with the carbonate of magnesia, and then adding water. The herb, when fresh bruised and applied to the stomach, will frequently relieve nausea and pain.

*Spearmint*—*Mentha viridis*—is analogous in properties.

*Pennyroyal*,—*Hedeoma*—is very similar to the mints in properties, but rather more powerful.

*Balm*—*Melissa*, and *Marjoram*—*Origanum*, are also strongly allied in properties to the foregoing.

*Partridge-berry*—*Gaultheria*—contains a very heavy volatile oil, which is an ingredient in the compound syrup of sarsaparilla.

#### GINGER.—(ZINGIBER, U. S.)

Root of the *Zingiber officinale*, a perennial, herbaceous plant, growing in the East and West Indies. Several varieties are found in the shops. Sometimes the recent root, in a state of vegetation, is sent to the market, constituting *green ginger*; sometimes the root is dug up, scalded to prevent germination, and then dried, constituting common *black ginger*; again, the best pieces are selected, the outer skin removed, so as to give it a white appearance, and imported as *white ginger*. The latter comes from the West Indies.

Colour of the powder, light yellowish-white; odour, powerful and peculiar; taste, strong, aromatic, and biting. It contains a volatile oil and an acrid resin.

It is a grateful stimulant and carminative; used to expel flatus from the bowels; employed also as an adjuvant to the bitter tonics, in cases of dyspepsia. It is apt to be much deteriorated by age.

Given in powder, infusion, tincture and syrup. Dose of powder, 10 to 30 grs.; of the infusion, made with ℥ss. to the pint, ℥ʒij; of the tincture, ℥ʒj to ℥ʒij. The *syrup* is used generally for flavouring. Externally applied, it acts as a rubefacient.

#### SWEET FLAG.—(CALAMUS, U. S.)

Root of the *Acorus calamus*, a plant growing in marshes. Its effects on the system, and uses are very similar to those of ginger.

## ORDER II.—NERVOUS STIMULANTS, OR ANTISPASMODICS.

## MUSK.—(MOSCHUS, U. S.)

Product of the *Moschus moschiferus*, an animal somewhat resembling a deer, inhabiting the mountainous districts of Asia. The musk resides in an oval pod, about two and a half inches in length, and one and a half in breadth, situated between the prepuce and umbilicus. Musk is a secretion of the lining membrane of this pouch, and is found only in the male, and most abundantly in the adult animal. It is in the form of reddish-brown coarse granules, and, from its very high price, is extremely liable to adulteration. Its chemical composition is very complex: it is inflammable.

*Uses.*—Musk, when genuine, is one of the most powerful of the antispasmodics. Given in full doses, it excites the circulation, as well as the cerebro-spinal system, producing an exhilarating effect, with occasional vertigo and headache; also slightly hypnotic. It is employed with advantage in retrocedent gout, obstinate singultus, infantile spasms not accompanied with inflammation, &c. Advantageously given to children in enema. Dose, 5 to 15 grs. Given in form of emulsion,—dose, fʒi to fʒij.

## CASTOR.—(CASTOREUM, U. S.)

A substance strongly resembling musk in its medicinal properties and therapeutical applications. It is the product of the *Castor Fiber*, or beaver, and is contained in two follicles situated near the anus of the animal.

## ASSAFŒTIDA, U. S.

A gum-resin—the product of the *Ferula assafætida*, and possibly of some others. The *F. assafætida*, is an umbelliferous plant, growing in Persia and Affghanistan, having a long, tapering, perennial root, and very long leaves. Assafætida is obtained by slicing off the top of the root, and collecting the juice as it exudes, which is then kneaded into masses, and packed for market.

At first it is rather soft, but hardens by exposure, which also renders it darker. Colour externally, reddish-brown; internally, rather lighter, mottled with white tears, and shining; taste, bitter, acrid, and alliaceous; odour, very strong and alliaceous, but more powerful in the fresh juice. It softens by heat, and is inflammable. Chemically, it is a gum-resin, united to some volatile oil. Water dissolves the gum, which forms an emulsion with the resin; alcohol forms a clear, golden tincture.

*Uses.*—One of the most valuable of the antispasmodics; also stimulant, expectorant, and emmenagogue. Employed with advantage in hysteria, infantile convulsions, hooping-cough, chronic cough of a nervous character; also as a carminative, along with

rhubarb and aloes, in the constipation of old persons, and as an emmenagogue. Advantageously given to children by enema, in which case it will often prove laxative.

Dose of substance, gr. v to ℥j, given in form of pill; of the emulsion, (*Lac assafœtidæ*), f ʒss. to f ʒj; of the tincture, f ʒj.

Assafœtida is sometimes used in the form of a plaster, in chronic swellings.

#### VALERIAN.—(VALERIANA, U. S.)

Root of the *Valeriana officinalis*, a perennial plant, indigenous in Europe, growing about two or three feet high. The root consists of a short tuberculated rhizome, from which issue numerous round, tapering fibres, of a yellowish-brown colour externally, and whitish internally. Taste, bitter and acrid; odour, when dry, strong, peculiar, and somewhat aromatic. It depends for its virtues on a yellow volatile oil, separable by distillation, and an acid, named *valerianic acid*.

*Uses*.—A mild antispasmodic and stimulant. Useful in hemiplegia, combined with cinchona; also in slight nervous derangements. Best given in form of *infusion*, made with half an ounce of the root to a pint of boiling water; dose f ʒi to f ʒij. Dose of the *oil of valerian*, 3 to 5 drops.

**GARLIC**—(*Allium*, U. S.), is decidedly antispasmodic, especially in cases of children, to whom it may be advantageously applied in the form of cataplasms to the feet, to quiet the nervous irritation to which they are frequently liable in the course of disease. Sometimes employed as a counter-irritant to the spine, in cases of hooping-cough. It is likewise expectorant.

### CLASS III.—TONICS.

Tonics are medicines possessing the power of gradually increasing the tone of the muscular fibre, when relaxed, and the vigour of the body when weakened by disease. Though resembling astringents in some of their effects, they do not produce corrugation, except when combined with the astringent principle. They resemble the stimulants in the fact of acting on the system through the medium of the nervous system; but they differ from these in the slowness, as well as the permanency of their effects. Carried to excess, they are productive of debility; and if used in a state of health, they act injuriously, causing an excitation, followed by a proportionate degree of debility. Tonics are particularly indicated in functional disorders of the digestive organs, as dyspepsia, and in the convalescence from acute disorders. *Bitterness* was at one time supposed to be an essential condition to constitute any remedy a tonic; and although it is true that nearly, if not quite all, the vegetable tonics have a bitter taste, still the fact that the mineral tonics

are not bitter, would serve to prove that bitterness is not absolutely indispensable in a tonic medicine.

Tonics may be conveniently arrayed under the two orders of Vegetable and Mineral tonics.

### VEGETABLE TONICS.

These may be divided into 1, the Simple Bitters; 2, Bitters of Modified Properties. This modification may be caused by some property inherent in the bitter principle, as in the Peruvian bark; or it may be caused by the presence of some stimulating volatile oil, as in serpentaria; or of a sedative principle, as in the case of wild cherry bark.

#### I. SIMPLE BITTERS.

##### QUASSIA, U. S.

Wood of the *Quassia amara*, and *Q. excelsa*, trees growing in South America, and Jamaica. Imported in billets, which are nearly white, very light in texture, no odour, and a pure, intensely bitter taste. Kept in the shops in the form of chips or raspings. Contains a peculiar bitter principle called *quassin*.

*Uses*.—A pure bitter tonic; does not excite the system; applicable in simple dyspepsia, and in convalescence from acute disorders. Used in South America in the treatment of remittent fever.

Dose of powder, 20 grains to ʒj; of the infusion, made with ʒij to Oj of cold water, f ʒij; of the extract, (very powerful) gr. ij to gr. v; of the tincture, f ʒj to f ʒij.

The bark of the *Quassia Simaruba* possesses properties similar to those of quassia, and may be substituted for it.

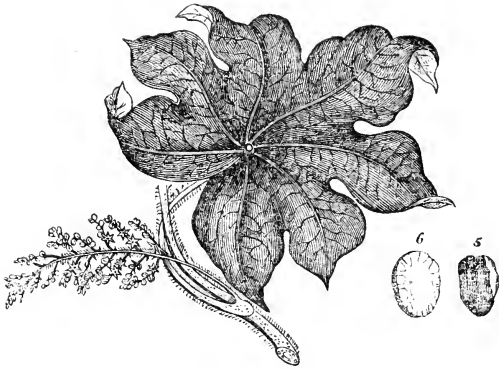
##### COLUMBO.—(COLOMBA, U. S.)

Root of the *Cocculus palmatus* (Fig. 9), a climbing plant, growing in Mozambique. The root is perennial, consisting of a main body and numerous offsets. The root, when dug up by the natives is sliced transversely, and dried. Found in the shops in circular or oval disks, from half an inch to two inches in diameter, and from a quarter to three quarters of an inch in thickness. The epidermis is wrinkled, and of a brownish colour; beneath this is a yellow cutical portion, and within this the shrunken, whitish, medullary part. It is liable to be attacked by worms, from the starch which it contains. Odour, slightly aromatic; taste, bitter and mucilaginous. Should not be kept in the state of powder, from its liability to attract moisture. Water and alcohol attract its active properties, which depend on a peculiar principle called *columbin*.

*Prop.*—A mild and excellent tonic; a good remedy in simple



Fig. 9.



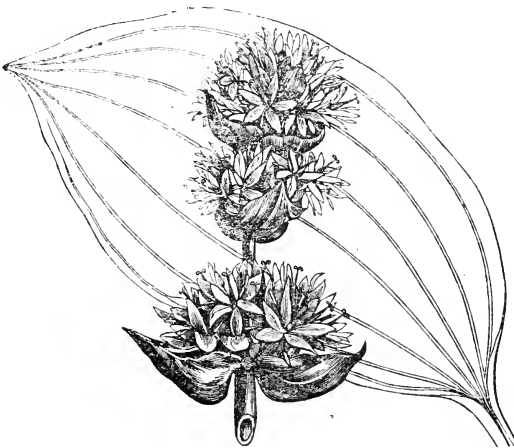
dyspepsia, and in convalescence; also in the declining stages of dysentery and diarrhœa. Often given with purgatives and aromatics.

Dose of powder, 10 to 30 grains; of the infusion, made with ℥ss. to Oj of water, f℥j to f℥ij; of the tincture, f℥j to f℥ij.

GENTIAN.—(GENTIANA, U. S.)

Root of the *Gentiana lutea*, a perennial plant, growing in the mountainous regions of Europe. It comes in pieces of considerable

Fig. 10.



length, sometimes sliced longitudinally, twisted and much wrinkled externally, and of a reddish-brown colour; yellowish within; of a

spongy texture; odour feeble; taste very bitter and sweetish; colour of powder yellowish. Water and alcohol extract its virtues, which depend chiefly on a peculiar crystalline bitter principle called *gentianin*.

*Prop.*—A pure simple bitter, much employed in dyspepsia, particularly in the form of infusion, made with senna, or rhubarb, and ginger. Gentian is slightly stimulant.

Dose of powder, 10 to 40 grains; of the infusion, made with ℥j to Oj of cold or hot water, f℥ij. The *compound infusion* contains orange peel and coriander seeds. The *tincture* contains cardamom seed and orange peel, and is one of the best of the bitter tinctures; dose f℥j to f℥ij. The *extract* is used in the dose of 5 to 30 grains.

#### GOLD THREAD.—(COPTIS, U. S.)

Root of the *Coptis trifolia*, a small, evergreen, herbaceous plant, growing in New England. The plant much resembles a strawberry vine, and has a thin interlaced root of a golden-yellow colour. In its general properties it strongly resembles quassia; its virtue depends on a bitter extractive. Best given in infusion, made with ℥ss. to Oj of water; used sometimes as a wash in aphthous sore mouths.

The *Sabbatia angularis* is another excellent indigenous tonic, having properties resembling those of the above-named simple bitters. It is generally used in the form of infusion.

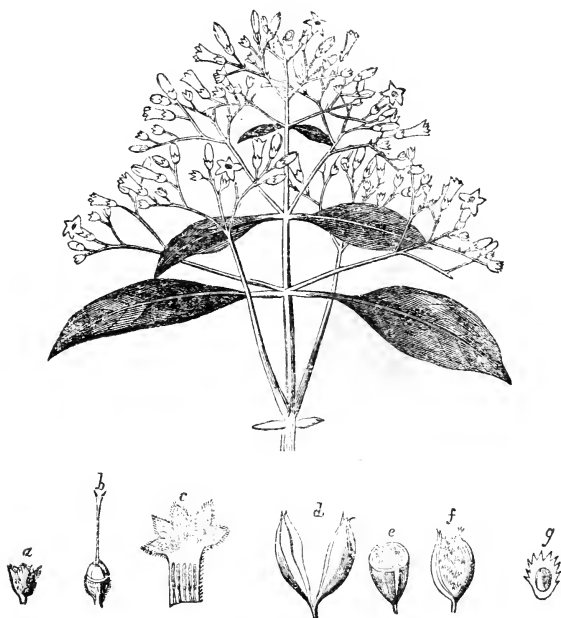
### II.—BITTERS OF MODIFIED PROPERTIES.

#### PERUVIAN BARK.—(CINCHONA, U. S.)

The genus *Cinchona* of the former botanists, comprised as many as fifty distinct species; Professor Lindley mentions twenty-six species, most of which are well known. Of these the most important, as affording most of the bark of commerce, are the *C. Condaminea*, *C. micrantha*, *C. cordifolia*, *C. magnifolia*, *C. lancifolia*, and *C. oblongifolia*. The genuine cinchona trees are exclusively found within the geographical limits of La Paz, about 20° of south latitude, and Santa Martha, about 11° of north latitude. They inhabit the mountainous regions of the Andes, usually about 6000 feet above the level of the sea. The name *cinchona* was given to the genus from the circumstance that the Countess of Cinchon was cured of intermittent fever by the use of the bark. It was also named *Jesuits' bark* and *Jesuits' powder*, from its having been used by the Jesuits as a secret remedy. All the different species of the cinchona have their own peculiar botanical characteristics: they resemble each other, however, in their general features: thus they all have opposite leaves, set upon short petioles; the flowers are at the

extremities of the branches, and of a white or rose colour. Fig. 11 represents a branch of the *C. Condaminea*.

Fig. 11.



There are only three varieties of genuine Peruvian bark recognised by the pharmacopœias: these are the *pale*, the *yellow*, and the *red*.

*Pale Bark.* (*Cinchona pallida*.)—Called also *Loxa* or *Crown bark*, and by the French, *gray bark*. It includes the commercial varieties of *Loxa* and *Lima* barks; and is the product of the *C. Condaminea*, and the *C. micrantha*. It comes only in quills, which are from half a foot to a foot long, from two lines to an inch in diameter; the epidermis is marked by numerous transverse cracks; colour of epidermis, gray, though often diversified; internal colour, cinnamon; fracture, smooth; colour of powder, lighter than the others; taste, bitter and astringent.

*Yellow Bark* (*Cinchona flava*.)—Called also *royal yellow* and *Calisaya* bark. The species which yields it, is not certainly known. It comes in quills and flat pieces; the former are from three inches to a foot in length, and from a quarter of an inch to two inches in diameter; epidermis, brownish, marked by longitudinal wrinkles and

transverse fissures; epidermis often wanting; texture fibrous; fracture splintery, exhibiting minute spiculæ; colour of bark, yellow-orange; taste, bitter and nauseous; odour, slight; relative value superior to the others, as it abounds most in quinia.

*Red Bark (cinchona rubra).*—Supposed to be derived from the larger branches and trunk of the same tree which yields the pale bark; size of quills, half an inch to two inches in diameter, and two to twelve inches long; flat pieces are large and thick; external colour reddish-brown, with a very rough epidermis, which occasionally exhibits warts upon it; colour of powder reddish; taste, very bitter.

The *pale bark* contains most cinchonina, the *yellow* most quinia, and the *red* about an equal portion of both alkalies.

The varieties of bark called *Carthagena barks* are much inferior to those just described. They are all shipped from the northern or Atlantic ports of South America.

Cinchona yields its virtues to water and alcohol. Its active principles are two alkalies named *quinia* and *cinchonina*, which exist combined with *kinic acid*.

*Quinia* is prepared by macerating Calisaya bark in water, acidulated with sulphuric acid; this acid forms the soluble supersulphate of quinia; filter, and add lime, which throws down the sulphate of lime, along with the quinia; next add boiling alcohol, which takes up the quinia, which may then be decolorized by animal charcoal, and separated by evaporation. It occurs in a white flocculent powder; nearly insoluble in water; very soluble in boiling alcohol, ether, and volatile oils; unites with acids to form salts, of which the most important is the officinal *sulphate*. Cinchonina is a white crystalline substance, with general properties resembling those of quinia.

*Incompatibles.*—The alkalies, alkaline earths, and tannic acid.

*Physiological effects.*—A tonic in small doses, and also anti-periodic; the latter is peculiar, and is not dependent upon its tonic properties. In full doses, apt to occasion oppression of stomach, nausea, and purging; also acts upon the cerebro-spinal system, as evinced by the tension of the head, ringing of the ears, and occasional deafness.

*Uses.*—As a mere tonic, it is inferior to the simple bitters in dyspepsia, but applicable in exhausting stages of disease, particularly in suppurations. Its most important use is in intermittent diseases, especially intermittent and remittent fever; believed to do good in these affections through the agency of the nervous system.

Cinchona is given in powder, infusion, decoction, tincture, and extract. Most powerful in substance, but apt to disagree with the stomach, and offensive on account of its bulk; dose ℥j, repeated so as to give ℥j to ℥ij in the intermission; its efficacy is increased by combining it with serpentaria. Powdered bark sometimes used externally, in the form of quilted jackets—applied to children. Dose

of the *infusion* (ʒj to Oj boiling water) fʒij. Dose of the *decoction*, the same. The cold infusion is preferable, made with cold water, acidulated with sulphuric acid, which more completely exhausts the virtues of the bark, and gives a clear infusion. Dose of *tincture*, fʒj to fʒiv. *Huxam's tincture* (compound) contains also *serpentaria* and other ingredients; dose, the same. Dose of extract, 10 to 30 grs.

*Sulphate of Quinia*.—Chemically a *disulphate*; made by adding dilute sulphuric acid to quinia, and crystallizing. Occurs in light, feathery, white crystals, without odour; taste bitter; soluble in boiling water and alcohol, and the dilute acids; cold water freely dissolves it by the aid of sulphuric acid; colour of the solution, opalescent.

*Effects on System*.—Generally similar to those of the bark, but sometimes fails to cure intermittents, when the bark will succeed. Dose, 10 to 14 grs., equivalent to ʒj of good bark; ordinary dose, one to three grains; may be often given by enema; also endermically.

Dose of the *impure sulphate of quinia* (made by evaporating the mother waters), double that of the sulphate. Dose of *sulphate of cinchonia*, the same as that of sulphate of quinia.

The best substitutes for Peruvian bark are the *salix*, or willow, which contains a bitter principle, called *salicin*; the barks of the *swietera febrifuga*, the *horsechestnut* and the *dogwood*: the latter contains a peculiar bitter principle, named *cornine*.

#### WILD CHERRY BARK.—(PRUNUS VIRGINIANA, U. S.)

Bark of the *P. Virginiana*, an indigenous tree. The bark is taken both from the stem and root; comes in pieces several inches long, slightly curved, usually deprived of the epidermis; has a cinnamon colour; taste, bitter and aromatic, with the flavour of the bitter almond; odour, similar; active properties to water and alcohol; injured by heat. Active principles, hydrocyanic acid and a volatile oil; these do not pre-exist in the plant, but are the result of a reaction between the *amygdaline* and *emulsine* with water.

*Effects*.—A tonic to the digestive organs, and at the same time sedative to the system. Useful in convalescence, attended with irritability of the stomach; also in the hectic of phthisis.

Best given in cold effusion, made by macerating half an ounce in a pint of cold water 24 hours; dose, fʒij three times a day. There is also a syrup, which is an excellent preparation; dose, fʒj.

#### VIRGINIA SNAKE ROOT.—(SERPENTARIA, U. S.)

Root of the *Aristolochia serpentaria*, an indigenous herbaceous plant, growing in rich woods. The root is perennial, consisting of numerous long slender fibres, proceeding from a common caudex. As found in the shops, it is in tufts of a brownish colour; has a strong camphorous odour, and a very bitter, acrid, camphorous taste.

Yields its virtues to alcohol and water; active ingredients, a volatile oil and a bitter principle.

*Effects*.—A stimulant tonic; used in low forms of disease; also, stimulates the secretions; employed sometimes as an adjuvant to Peruvian bark.

Dose of powder, 10 to 30 grs.; of the infusion—made with ℥ss. to Oj water—f℥j to f℥ij; of the tincture, f℥j to f℥ij. The decoction and extract are objectionable.

#### CHAMOMILE.—(ANTHEMIS, U. S.)

Flowers of the *Anthemis nobilis*, a small, herbaceous, perennial, indigenous to Europe, but introduced into the United States. The flowers are both double and single; the latter said to be the strongest. Imported usually from England; about half an inch in diameter, nearly spherical, of a yellowish-white colour; odour, fragrant and aromatic; taste, warm, aromatic and bitter; virtues depend on a volatile oil and bitter extractive, which are imparted to water and alcohol.

*Prop.*—A mild, stimulant tonic; useful in convalescence and some forms of dyspepsia; the warm infusion acts as a diaphoretic and emetic. Dose of *cold infusion*, (℥ss. to Oj,) as a tonic, f℥ij.

There are several other herbaceous plants, which are mildly stimulant and tonic to the system, as Wormwood (*Absinthium*), Tansey (*Tunacetum*), Horehound (*Marrubium*). These all contain a volatile oil and a bitter principle.

#### THOROUGHWORT—BONESET.—(EUPATORIUM, U. S.)

The herb *Eupatorium perfoliatum*,—an indigenous perennial, growing in moist places, distinguished by the perfoliate character of its leaves, each pair of which are at right angles to those immediately above and below. It has a faint odour, and a strong, bitter taste. Hot water extracts its virtues, which are believed to reside in a bitter principle. The cold infusion acts as a mild, pleasant tonic; the hot infusion as a diaphoretic, or even as an emetic.

#### CASCARILLA BARK.—(CASCARILLA, U. S.)

Bark of the *Croton Eleutheria*, and of the *Croton cascarrilla*, trees growing in the West Indies; chiefly imported from Eleutheria, one of the Bahamas; comes in small-sized quills, and in small chips; epidermis is partially detached. Odour aromatic; when thrown upon hot coals it exhales an agreeable odour like musk; taste, bitter and aromatic. Used chiefly as an adjuvant to other tonics; active ingredients, a volatile oil, and bitter extractive. Dose of powder, 20 to 30 grs.; of the infusion, (℥j to Oj) f℥ij.

#### CANELLA, U. S.

Bark of the *Canella alba*, a tree growing in the West Indies;

comes in imperfect quills, of a yellowish-white colour, and a bitter aromatic taste. Its properties are those of a stimulant tonic and aromatic. Not much employed alone; an ingredient in the *hiera picra*, or *pulvis aloes et canelle*.

#### ANGUSTURA, U. S.

Bark of the *Galipea officinalis*, a small tree growing in South America; comes in pieces slightly curved, about a line in thickness, and bevelled at the edges. Colour, yellowish-gray; taste, bitter and aromatic. Virtues depend upon a volatile oil and bitter extractive. A stimulant tonic, not much employed at present; should be carefully distinguished from the *false Angustura bark*, which is derived from the *nux vomica*, and is very poisonous.

#### MYRRH.—(MYRRHA, U. S.)

An exudation from the *Balsamodendron myrrha*, a shrub, or small tree, growing in Arabia and Abyssinia. The juice exudes spontaneously, or by incision. Two commercial varieties—*India* and *Turkey* myrrh: the latter is the finest; comes in masses and tears;

Fig. 12.



of a pale reddish-yellow colour, semi-transparent and brittle; of an aromatic peculiar odour. India myrrh is much inferior,—darker, softer, and much mixed with a substance called *bdellium*. Myrrh is usually imported from Bombay. It is a gum-resin, associated with a volatile oil; forms a clear tincture with alcohol, and with water a yellow opaque emulsion.

The alkalies have the property of uniting with myrrh, and ren-

dering it more soluble in water. Its active properties reside chiefly in the resin.

*Effects.*—A stimulant tonic, with a tendency at the same time to the lungs and uterus. Most employed in chronic pectoral affections, and in amenorrhœa. Dose of powder, 10 to 30 grains; of the tincture, f3ss. to f3j. The tincture is most used as an external application to spongy gums, and to indolent ulcers.

## MINERAL TONICS.

### IRON.—(FERRUM, U. S.)

The most important of all the mineral tonics; a constituent of many organized beings, and found in the red globules of the blood. The preparations of iron, called *chalybeates*, combine tonic with astringent properties; they increase the appetite, promote digestion, and exalt the general functions of life. Under its use, the red corpuscles of the blood become much increased, giving rise to a tendency to plethora. Its influence over the nervous system appears to be rather secondary. The chalybeates prove most useful in dyspepsia, with constipation, not accompanied by inflammation of the stomach; also in chronic debility of females associated with amenorrhœa; in some nervous affections; and especially in anemia.

Metallic iron is probably inert upon the system; but when swallowed in that state, it is apt to become converted into an oxide or salt in the stomach and bowels, and to disengage hydrogen gas, which causes unpleasant eructations. Iron filings, (*ramenta ferri*,) which are sometimes used, should be previously purified by means of a magnet.

*Squamæ Ferri*—*Scales of Iron.*—Obtained by hammering red-hot iron; consist chemically of the protoxide and peroxide. Dose, 5 to 20 grains.

*Rubigo Ferri*—*Rust of Iron.*—Formerly called prepared carbonate of iron; prepared by exposing fine iron wire to air and moisture, then reducing to a fine powder by levigation and elutriation. It consists of the protocarbonate and the sesquioxide. Colour, red; taste, styptic; insoluble in water.

*Ferri Subcarbonas*—*Subcarbonate of Iron.*—Formerly named *Precipitated Carbonate*; made by mixing together the solution of the carbonate of soda, and sulphate of iron. When first prepared the colour is greenish-black, which soon changes into a brownish-red, from the absorption of oxygen; it then consists chiefly of the sesquioxide. It has a styptic taste; no odour; is insoluble in pure water. It is one of the best chalybeates; is well borne by the stomach, and no danger from an overdose; much used in neuralgia. Dose, 5 to 30 grains.

*Pillulæ Ferri Carbonatis*—*Vallet's Ferruginous Pills.*—Pre-



pared as the subcarbonate, with the addition of honey, which prevents the absorption of oxygen; colour bluish. Dose, 5 to 10 grains, three times a day.

*Mistura Ferri Composita*, made to imitate *Griffith's Antihectic Mixture*. Prepared by mixing together solutions of carbonate of potash and sulphate of iron, with myrrh and spirits of lavender. Used chiefly in amenorrhœa with dyspepsia.

*Ferri Sulphas*—*Sulphate of Iron*—*Green Vitriol*, or *Copperas*.—Prepared by action of dilute sulphuric acid on pure iron wire. Colour, pale green; crystals, efflorescent, soluble; taste, styptic; fuses when heated. *Incompatibles*—alkalies, alkaline earths and earths, with their carbonates, and those soluble salts whose acids form soluble salts with iron, and whose bases form insoluble sulphates; also tannin. It is the most astringent of the chalybeates, also the most irritant. Applicable when small doses are required, best in pill of the effloresced salt. Dose of the crystallized, 1 to 5 grains; of the dried, gr. ss. to grs. ij.

*Tinctura Ferri Chloridi*—*Muriated Tincture of Iron*.—Made by the action of muriatic acid on the subcarbonate, and then adding alcohol. Colour, reddish brown; odour, ethereal; taste, sour and styptic. Used in affections of the urino-genital organs. An excellent chalybeate. Dose, 10 to 30℥. Used externally as a stimulant.

Other preparations of iron, less used, are the *phosphate*, *tartrate of iron and potassa*, *citrate*, *lactate*, *iodide*, *ferrocyanide*, and *ammoniated iron*.

#### COPPER.—(CUPRUM, U. S.)

Though probably inert in the metallic state, yet being easily acted upon by the acids of the stomach, it may prove poisonous when swallowed in that state. Poisoning may also result from eating articles cooked in copper vessels. The preparations of copper act as tonics in very small doses, with an especial tendency to the nervous system. Larger doses occasion irritation and inflammation of the stomach. The best antidote for metallic copper is an antacid, as magnesia.

*Cupri Sulphas*—*Sulphate of Copper*—*Blue Vitriol*.—Prepared by the action of sulphuric acid on metallic copper. Occurs in large prismatic, blue crystals, efflorescent on exposure, soluble in water; taste, very styptic; fuses when heated; incompatibles, the same as of iron.

*Effects on System*.—Small doses are astringent and tonic; larger doses vomit; still larger are poisonous. The best antidote is albumen.

Used as a tonic in obstinate ague, and in chronic dysentery; also, in epilepsy, chorea, and hysteria. Dose,  $\frac{1}{4}$  grain two or three times a day. Useful as an external application, in solution, to spongy

granulations of ulcers, and in inflamed conditions of mucous membranes, particularly, of the eye.

*Cuprum Ammoniatum*—*Ammoniated Copper*.—Made by rubbing up carbonate of ammonia with sulphate of copper; colour, dark blue. Supposed to have a special tendency to the nervous system; hence used in epilepsy, chorea, &c. Dose, gr. ss. twice a day.

#### ZINC.—(ZINCUM, U. S.)

Its preparations are useful in nervous disorders.

*Zinci Sulphas*—*Sulphate of Zinc*—*White Vitriol*.—Made by action of sulphuric acid on metallic zinc. Crystals, needle-shaped prisms, white; taste, styptic; soluble in water.

*Effects*.—Tonic and astringent; used chiefly in chorea and epilepsy. Dose 2 to 3 grains. The *solution* an excellent application to inflamed mucous membranes; strength of the solution gr. j or grs. ij to fʒj of water. It is sometimes employed in combination with the acetate of lead.

*Zinci Oxidum*—*Oxide of Zinc*.—Not much used internally; sometimes externally as an ointment. The *impure oxide*, or *tutty*, is also used in the form of an ointment for excoriated surfaces.

*Zinci Carbonas*—*Carbonate of Zinc*.—Used in the form of a cerate (*Turner's cerate*)—a good application to excoriated surfaces and certain cutaneous eruptions.

#### SILVER.—(ARGENTUM, U. S.)

*Argenti Nitras*—*Nitrate of Silver*—*Lunar Caustic*.—Prepared by the action of nitric acid in silver; evaporating, fusing, and running into moulds. Colour, nearly white; very soluble; taste styptic; and harsh. Incompatibles, the same as for iron,—also common salt.

*Effects*.—Small doses are tonic; larger, corrosive and poisonous. Best antidote is common salt. Its long use is apt to occasion a discoloration of the skin. Most used in epilepsy and chorea; also in irritable conditions of the stomach. Dose, gr. ss. to gr. iij, given in pill. Its solution is very valuable as a topical application to indolent ulcers, and to inflamed mucous membranes, as of the eye, nose, urethra, vagina, and rectum; strength of the solution from gr. ss. to gr. x to fʒj of distilled water;—also for the throat and tonsils, either applied in strong solution, or in the solid form.

#### BISMUTH.—(BISMUTHUM, U. S.)

*Bismuthi Subnitras*—*Subnitrate of Bismuth*—*Magistery of Bismuth*.—Made by the action of nitric acid on bismuth, and then throwing the resulting nitrate into water, which throws down the subnitrate. A white powder, without taste or smell. Used chiefly in disorders of the stomach, connected with diseased innervation, as gastrodynia. Dose, 5 to 10 grains. Apt to blacken the stools.

## THE MINERAL ACIDS.

Usually classed among the tonics.

*Sulphuric Acid*.—Employed only in medicine in a state of solution. Acts as a tonic, astringent, and refrigerant; used in low forms of fever, and to check excessive perspiration. The dilute acid of the Phar. contains ℥j of the concentrated acid, to ℥xiiij of water; dose, 10 to 30 drops, in a wineglass of water. The *elixir vitriol*, or aromatic sulphuric acid, contains ginger and cinnamon; it is much used in the hectic fever of phthisis, and in convalescence from acute disorders. Dose, the same.

There is also an *ointment*.

*Nitric Acid* is tonic and refrigerant; never used in its pure state; two kinds kept in the shops, the *nitric* which is colourless, and the *nitrous*, which is reddish. Used as a tonic in low forms of fever. Dose 2 to 10 drops, according to its strength. A strong solution is used externally to indolent ulcers. *Hope's mixture* consists of nitric acid, laudanum, and camphor water;—used in dysentery, &c.

*Muriatic Acid*.—Colourless when pure; used in a dilute form in low forms of fever, especially in typhus fever. Dose, 5 to 20 drops, in a wineglass of water. Used also as a gargle in scarlet fever.

*Nitro-Muriatic Acid*.—Made by mixing one part of nitric with two of muriatic acid; mutual decomposition ensues, by which nitrous acid fumes are given off, and chlorine remains dissolved in water. It is thought to have an especial tendency to the liver, and is given in hepatic diseases; also in secondary syphilis. Used likewise as a bath, or foot-bath, in these disorders. The *solution of chlorine* sometimes used in bronchitis; also the vapour of chlorine inhaled, but apt to occasion irritation.

## CLASS IV.—ASTRINGENTS.

*Def.*—“Medicines which produce contractility of the living tissues.” They occasion this effect whether taken internally, or locally applied. They also gently, but permanently, stimulate the system, causing a harder and fuller pulse, and at the same time producing a constricting effect upon secreting or bleeding orifices. They may be conveniently divided into the two classes of Vegetable and Mineral astringents. The former depend for their astringency on a principle common to all of them, named *tannic acid*; the latter possesses no such common principle, but each one of them is peculiar in its effects upon the system.

*Tannic Acid—Tannin*.—Exists in the vegetable astringents in combination with gallic acid. It is best obtained by the action of commercial sulphuric ether on powdered galls, allowing it slowly to percolate through them; the water of the ether dissolves out the tannic acid, which may be separated by evaporation.

*Prop.*—A light porous substance, of a yellowish-white colour;

very soluble in water, alcohol, and ether, and of an entirely astringent taste. *Incompatibles*,—mineral acids, alkalies, vegetable alkalies, the sesquisalts of iron, and gelatine. Acts on the system as a pure astringent; useful in diarrhœa and some forms of local hemorrhage. Dose, 3 grs., three or four times a day.

#### VEGETABLE ASTRINGENTS.

##### OAK BARK.—(QUERCUS, U. S.)

The only officinal varieties of the oak, are the *Q. alba*, or white oak, and *Q. tinctoria*, or black oak; though other species may contribute to furnish the shops. White oak bark is recognised by its whitish epidermis and superficial furrows; internally, it has a light brown colour and fibrous texture; taste, bitter and astringent; does not tinge the saliva. Black oak bark is darker coloured externally, more deeply furrowed, has a more bitter taste, and imparts a yellow colour to the saliva in consequence of its containing a peculiar principle, *quercitrine*: this principle renders the black oak bark valuable as a dye. Both impart their virtues to water and alcohol. They contain tannic and gallic acids. Not much used internally. The white is astringent; the black frequently purges from the irritation it causes. Oak bark is employed externally in the form of bath, for marasmus, or chronic diarrhœa; also as a lotion, or poultice, to indolent and gangrenous ulcers. Dose, of powder, 30 grs.; of the decoction, f ʒij; of the extract, 10 to 20 grs. The oak leaves and acorns are also astringent.

##### GALLS.—(GALLA, U. S.)

Excrescences produced by the puncture of an insect upon the young twigs of the *Quercus infectoria*, a native of Asia Minor. The market is chiefly supplied from the ports of the Levant; they are named *Aieppo galls*. There are two varieties, the blue and the white; the former are the smallest, most compact, and most valuable; the latter are of a yellowish-brown hue, lighter, and have a perforation which indicates that the insect which they contained has made its escape. The blue galls are to be preferred; they have a flinty fracture, no odour, a bitter and very astringent taste, yield their virtues to water and alcohol; they contain much tannic and gallic acids. *Incompatibles*, the same as of tannin.

*Uses*.—Chiefly externally, in the form of decoction, as a gargle or lotion; also as an ointment (*unguent. gallæ*), for piles. Dose of powder, 10 to 20 grs.; of the decoction, f ʒij.

The *syrup* is used in chronic diarrhœa.

##### KINO, U. S.

An extract, or an inspissated juice, of certain trees. Several

varieties are noticed : 1, East India or Amboyna ; 2, African—supposed to be the product of the *Pterocarpus erinacea*, of Senegal ; 3, Jamaica or West India—supposed to be derived from the *Coccoloba uvifera* ; 4, Botany Bay,—the concrete juice of the *Eucalyptus resinifera* ; 5, Caraccas.—The one most used is the Amboyna or East India. It comes in small, irregular, angular fragments, of a dark reddish-brown colour ; shining fracture ; no odour ; but a very astringent taste. Soluble in hot water and alcohol. Active principle, that variety of tannic acid which affords a greenish-black precipitate with the sequisalts of iron.

*Uses.*—One of the most used, internally, of all the astringents ; employed frequently with chalk and laudanum in diarrhœa and dysentery, not attended with inflammation ; also in passive hemorrhages, leucorrhœa, and diabetes. Dose of powder, 10 to 30 grs. ; of the infusion, (ʒij to fʒvj water,) fʒss. ; of the tincture fʒss. to fʒij. Kino is used externally, as an injection in gonorrhœa, leucorrhœa, and hemorrhages ; also for indolent ulcers.

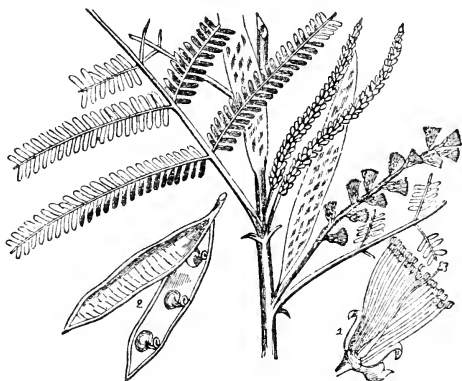
#### CATECHU, U. S.

Extract of the *Acacia catechu*, a thorny tree growing in Hindostan. Procured by making a decoction of the wood, and then evaporating to a proper consistence. Formerly called *Terra Japonica*, from its supposed earthy origin. There are several varieties of Catechu, one of which is derived from the *Betel nut*, and another, called *cutch*, or *Gambir*, from the *Naucllea Gambir* of Sumatra.

*Prop.*—Irregular masses of various sizes ; colour, externally, rusty brown, lighter within ; taste, bitter and astringent ; active ingredient, the same variety of tannin as is found in kino,—which it resembles very much in all its properties.

*Uses.*—Same as kino. Dose of powder, 10 to 30 grains.

Fig. 13.



## RHATANY.—(KRAMERIA, U. S.)

Root of the *Krameria triandra*, a small shrub growing in Peru and Brazil. The root is branching, and, as found in the shops, is in pieces of various sizes, from the thickness of a quill upwards; colour externally, dark-reddish brown; rather lighter within; taste, bitter, astringent, and sweetish; active principle, tannic acid, which resides most in the cortical portion;—imparts its virtues to water and alcohol.

*Uses.*—Same as those of kino; a strong and good astringent. The external application is very useful in *fissure of the anus*,—the saturated infusion, made by displacement, or the solution of the extract being used; likewise as an injection in leucorrhœa and gonorrhœa. Dose of powder, 20 to 30 grs.; of the infusion, (ʒj to Oj water) fʒj to fʒij; of the tincture, fʒj to fʒij; of the extract, 10 to 15 grs. There is also a *syrup*.

## LOGWOOD.—(HÆMATOXYLON, U. S.)

Wood of the *Hæmatoxylon Campechianum*, a large tree growing in Mexico, and other parts of tropical America. It is imported in the form of billets, several feet long; has a dark purplish colour externally, and a bright red hue internally. It is much used as a dyewood; kept in the shops in the form of raspings; odour, slight; taste, sweetish and astringent; contains a peculiar principle called *hematin*, or *hæmatoxylin*; also some tannin.

*Uses.*—A mild astringent; useful in the bowel affections of children. Given in decoction and extract; dose of former, fʒij; of the latter, 10 to 30 grs.

The most important indigenous astringents are the *Geranium*, *Blackberry root*, *Pipsissewa*, and *Uva Ursi*.

## CRANESBILL.—(GERANIUM, U. S.)

Root of the *Geranium maculatum*, a small perennial plant growing in moist, shady woods; often called *crowfoot*, from the shape of the leaf. The root is horizontal, about a quarter of an inch thick, and furnished with short fibres; colour externally, brownish; lighter within; no odour; taste, astringent. Virtues depend on tannic acid, and are extracted by water and alcohol.

*Uses.*—An excellent astringent; employed much in domestic practice, particularly in cases of children, to whom it may be given boiled in milk. Dose of powder, 20 to 30 grs.; of the decoction, fʒj to fʒij.

## BLACKBERRY ROOT.—(RUBUS VILLOSUS, U. S.)

## DEWBERRY ROOT.—(RUBUS TRIVIALIS, U. S.)

These two roots are identical in medical properties and uses.

They occur in pieces of various lengths, of a brownish colour, covered with a thin bark, which abounds most in the active principle, tannic acid.

*Uses.*—An excellent domestic astringent, much employed in chronic diarrhœas and dysentery; also in the latter stages of cholera infantum. Dose of powder, 20 to 30 grs.; best given in decoction, made by boiling ʒj of the smaller roots in a pint and a half of water, down to a pint; dose, fʒij.

#### PIPSISSEWA.—(CHIMAPHILA, U. S.)

Leaves of the *Chimaphila umbellata*, sometimes called *Winter-green*, a small evergreen plant, indigenous to both continents. It has a creeping root, which sends up several erect stems, from four to eight inches high. The leaves are about an inch and a half long, serrated, of a green colour. When bruised, and in the fresh state, they emit an aromatic odour. They retain their green colour, if well dried. Taste, bitter, astringent, and aromatic; water and alcohol extract its virtues, which depend on tannin and a bitter extractive.

*Uses.*—Chiefly as a mild alterative tonic in scrofulous complaints, and in diseases of the urinary organs; also, in dropsy, attended with dyspepsia and debility. It is best given in the form of decoction and extract. Dose of the former, fʒiv, several times a day; of the latter, 20 to 30 grs. An excellent mode of administering pipsissewa is in the form of *beer*, made by adding molasses, ginger, and yeast to the decoction.

#### UVA URSI, U. S.

Leaves of the *Arbutus Uva Ursi*, or *bear-berry*, a small, trailing, evergreen shrub, growing in the northern parts of both continents. The leaves are obovate, about half an inch in length, thick and entire, a good deal resembling the box leaves. They are apt to be adulterated with the leaves of the red whortleberry. No odour when fresh, but acquire the smell of hay by drying; *taste*, bitter, astringent, and sweetish; virtues are yielded to alcohol and water, and depend on tannin and a bitter extractive.

*Uses.*—Chiefly in disorders of the urinary organs, as catarrh of the bladder, chronic nephritis, diabetes, and incontinence of urine. It is not, however, a certain remedy. Dose of powder, 20 grs. to ʒj, three times a day; of the decoction, made by boiling ʒj in Ojss. of water, down to Oj, fʒj to fʒij.

There are a few other vegetable astringents, which are occasionally employed: these are the rind of the Pomegranate, (*Granati Fructus Cortex*), the bark and unripe fruit of the Persimmon (*Dyospyrus*), and the Bistort root.

The *Rosa Gallica*, or Red rose leaves, is also astringent; the

confection, (*Confectio Rosæ*,) and the compound infusion, (*Infusum Rosæ compositum*,) are officinal. The Hundred-leaved Rose (*Rosa centifolia*), is not astringent. The latter species furnishes the rose-water (*Aqua Rosæ*) of the shops, and the *Unguentum Aquæ Rosæ*, or *cold cream*.

### MINERAL ASTRINGENTS.

#### LEAD.—(PLUMBUM, U. S.)

Not employed in medicine, in the metallic state. Its preparations are characterized by the union of astringent with sedative properties; and they may all be regarded as poisonous in over-doses, with the exception of the *sulphate*, which is extremely insoluble. The poisonous impression may be produced in two modes, either by their being absorbed into the blood, or by their local irritant action. Lead is very apt, when taken in improper quantities, to cause a series of symptoms called *colica pictonum*, or *painters' colic*; of which the most prominent symptoms are, loss of appetite, painful and constipated state of the bowels, acute pain about the umbilicus, with a knotty feel of the abdominal muscles, followed by general cramps, convulsions, and death. It also occasionally produces a paralysis, most generally of the upper extremities, denominated *lead palsy*. These poisonous effects are generally the result of long exposure to the fumes of melted lead, and are usually met with in workmen of lead factories, painters, solderers, &c. It is recommended that such persons should use diluted sulphuric acid, for the purpose of converting any preparation of lead, which may be in the system, into the sulphate.

*Litharge*.—(*Plumbi Oxidum Semivitrinum*, U. S.)—Prepared in the extraction of silver from the argentiferous galena. It is in the form of small semi-vitrified scales, of a flesh colour. They usually contain some carbonic acid. Its chief use is in the preparation of *Lead Plaster*, (*Emplastrum Plumbi*), made by boiling together litharge, olive-oil, and water; it consists of an *oleo-margarate of lead*. It is the foundation of most of the other plasters.

*Carbonate of Lead*.—(*Plumbi Carbonas*, U. S.)—Called also *White Lead*. Prepared by exposing lead in thin sheets to the action of the vapours of vinegar, at the temperature of fermenting manure: the vinegar furnishes both the oxygen and carbonic acid.

*Prop.*—A white, heavy, insoluble substance, without smell and taste; one of the most poisonous of the salts of lead; not used as a medicine internally; occasionally applied to excoriated and burnt surfaces; used also in the manufacture of the plaster, (*Emplastrum Plumbi Carbonatis*) made to imitate Mahy's Plaster. It is applied to bed-sores.

*Acetate of Lead*.—(*Plumbi Acetas*, U. S.)—*Sugar of Lead*.—Pre-



pared by dissolving litharge, or the carbonate, in distilled vinegar, by the aid of heat.

*Prop.*—A white salt; crystallizes in needle-shaped forms; odour, peculiar; taste, sweetish and astringent; effloresces on exposure; perfectly soluble in pure water, but gives a turbid solution, if there be any carbonic acid present. Incompatibles, the mineral acids and their soluble salts, the alkalies, alkaline earths, and vegetable astringents.

*Uses.*—Internally, in hemorrhages, particularly hæmoptysis; also in dysentery, cholera-infantum, and in certain disorders of mucous membranes, as in yellow fever, and malignant remittents and intermittents. Dose, gr. ss. to gr. ij, every two or three hours, according to circumstances. Used very much as a topical application, particularly in inflammations of the mucous membranes and the skin. The strength of the solution, for mucous membranes, is from gr. ss. to gr. ij in a fʒ of water; for the sound skin, ʒij, dissolved in Oj of water.

*Solution of the Subacetate of Lead.*—*Liquor Plumbi Subacetatis*—(*Goulard's Extract.*)—Prepared by boiling together equal quantities of sugar of lead and litharge. It is not uniform in its strength, varying with the quantity of lead contained in the preparation. It is a colourless, limpid fluid, having a sweetish astringent taste. It is decomposed by whatever is incompatible with the acetate, and also by gum and starch. It must be preserved in closely stopped bottles, to keep it from the carbonic acid of the air.

*Uses.*—Never internally; externally, diluted, to sprains, bruises, burns, and ulcers, in the proportion of ʒij or ʒiij to the Oj of water.

*Lead Water*—*Liquor Plumbi Subacetatis Dilutus*—contains only ʒj to Oj of water.

*Goulard's Cerate*—(*Ceratum Plumbi Subacetatis*, U. S.)—is made by boiling together Goulard's extract, white wax, olive oil, and camphor: it is an excellent application to abraded surfaces, and to blisters not disposed to heal.

#### ALUM.—(ALUMEN, U. S.)

Chemically, a double sulphate of alumina and potassa; sometimes found native, though usually made artificially, either from some of the native ores of alum, or by a direct combination of the elements. Some varieties of alum contain sulphate of soda, or sulphate of ammonia, instead of sulphate of potassa.

*Prop.*—A white crystalline salt, slightly efflorescent, crystallizes in regular octohedrons; taste, sweetish and astringent; very soluble in hot water, which deposits crystals on cooling; reddens litmus; when heated, undergoes the aqueous fusion, and is converted into *dried alum* (*alumen exsiccatum.*) The alum of commerce generally contains some iron as an impurity.

Incompatibles. — The alkalis and their carbonates, lime-water, magnesia and its carbonate, sugar of lead, and tartrate of potassa.

*Uses.* — A powerful astringent, both general and local. When long used, it is apt to injure the organs of digestion. Large doses occasion irritation of the stomach and bowels, and even inflammation. Given internally, in hemorrhages, particularly of the uterus and lungs; also in colica pictonum, where it is supposed to do good by a chemical action; formerly used in intermittents. Its nauseant effect is best obviated by combining it with aromatics and opium. Employed externally, as an astringent to the throat in inflammation; also to arrest slight hemorrhages, as in epistaxis, and bleeding from leech-bites; also as an injection in leucorrhœa and chronic diarrhœa, and as a wash to indolent ulcers.

*Alum-curd* is made by rubbing up alum with the white of an egg; used in conjunctivitis.

*Alum-whey* is made by boiling ʒij of alum in a pint of milk, and straining; dose, fʒij. Dose of powdered alum, 5 to 15 grains, several times a day; in hemorrhages, the dose must be much increased.

#### CLASS V.—REFRIGERANTS.

So named from the cooling effect upon the surface of the body generally produced by their use. They are sometimes called *Arterial sedatives*, from the fact that they reduce arterial action. They are indicated in cases of high vascular action, as the different phlegmasia, and fevers unaccompanied with typhoid symptoms. Although *sedative* in their general impression upon the system, some of them, as antimony, produce a local stimulant effect upon some of the organs.

#### VEGETABLE ACIDS.

Nearly all of them are refrigerant, and are well adapted, when properly diluted, to inflammatory and febrile complaints. Too long used, they enfeeble digestion, and produce symptoms of marasmus. Those most employed in medicine are the Acetic, Citric, and Tartaric.

**ACETIC ACID**, in the form of vinegar, diluted with water, is a refreshing drink in febrile cases. It is also useful as a cooling application to the surface. The strong acetic acid is an irritant poison.

**CITRIC ACID** exists in the lemon, lime, sour orange, tamarind, and many other fruits. It is used either in the form of lemon juice, or the solid crystalline form. The decomposition of lemon juice may be partially prevented by exposing it to a freezing temperature, whereby all the watery parts are separated, and the juice much concentrated; or by making it into a syrup with sugar.

The crystalline acid is prepared by saturating lemon juice with chalk, and then decomposing the citrate of lime by sulphuric acid,

and evaporating. The crystals are large white, transparent rhombs, of a very sour taste, soluble in water; apt to be adulterated, if in powder, with tartaric acid; fraud detected by carbonate of potassa, which causes no precipitate with citric acid. A solution in the proportion of ℥j citric acid to Oj water, is about the strength of lemon juice; ℥j of acid to Oj water, is the proportion for lemonade. It is a valuable *antiscorbutic*.

TARTARIC ACID is found in the juice of the grape, tamarind, &c. It is much employed as a cheap substitute for citric acid.

#### SALINE SUBSTANCES.

Most of the neutral salts produce a refrigerant effect upon the system, both as a direct result, and indirectly, in consequence of the purgative power which many of them possess. Most of them are described under the head of *Cathartics*. The one most especially refrigerant, is

NITRATE OF POTASSA, commonly called *saltpetre*, or *nitre*. It is procured from the banks of the Ganges, as a natural exudation from the soil; also from artificial nitre-beds in Europe. When purified, the crystals are large, six-sided prisms, with numerous transverse striæ; no odour; taste, saline and cooling; soluble in water; not in pure alcohol; fuses by heat, when it may be run into moulds; a high heat decomposes it. Effects.—In moderate doses, it reduces the circulation, and diminishes the temperature of the body, not, however, as was supposed, by its solution in the stomach. It probably exerts some chemical influence on the blood, rendering it less inflammatory. At the same time, it is diuretic, or diaphoretic, according as the patient is kept cool or warm. Large quantities are apt to produce nausea and vomiting, and even poisonous effects; though very considerable doses may be taken with impunity, provided they be given largely diluted in some mucilaginous fluid. *Used* in fevers of a high grade, as an adjuvant to the lancet; also very useful in hemorrhages, and in all inflammations, except those of the stomach and bowels. Often combined with tartar emetic, and sometimes with calomel. Dose, 5 to 10 grs. every hour or two. The *Nitrous Powders* consist of a combination of nitre, tartar emetic, and calomel,—much employed in febrile complaints of a bilious character.

#### ANTIMONY.

The antimonials are the most sedative of all the refrigerants, and are used very extensively with this indication. Given in quantities too small to produce any obvious effect in the healthy system, they nevertheless prove *alterative* in disease. In rather larger doses, though still too small to occasion nausea, they produce a decided sedative action. In still larger doses, they cause nausea, thereby

directly increasing their power as sedatives or refrigerants. In yet larger quantities they vomit. Although sedative to the system at large, the antimonials act as stimulants to the lungs, skin, and kidneys, and sometimes the liver and salivary glands. They act by being taken up by the circulation.

The preparations of antimony most used are the following:—

1. *Tartar Emetic*.—(*Antimonii et Potassæ Tartras*, U. S.)—Prepared by saturating the excess of acid in the bitartrate of potassa (cream of tartar), with the sesquioxide of antimony, by boiling them together. It should always be crystallized, to free it from impurities.

*Prop.*—A white crystalline salt, without odour, of a nauseous, metallic taste, efflorescent, very soluble in water, insoluble in pure alcohol; decomposed by the pure alkalies, alkaline carbonates, and the vegetable astringents.

*Effects and Uses.*—The best of the antimonials; used as an alterative in chronic cutaneous diseases, and in scrofulous affections; but requires to be persevered in for some time. Dose as an alterative,  $\frac{1}{32}$  to  $\frac{1}{16}$  gr. In rather larger quantities, as from  $\frac{1}{12}$  to  $\frac{1}{6}$  gr., it acts as a refrigerant, and may be given whenever the action is above the normal standard, as in fevers, inflammations—especially of the lungs,—when it acts also by stimulating the secretions. It has been given in very large doses in acute pneumonia and other pectoral diseases, on the *contra-stimulant* plan of Rasori, as a substitute for the lancet, the patient taking from one to two grains, and upwards, every two hours. There is considerable risk, however, in this method, arising from the excessive depression which is sometimes produced, and also from the effect on the stomach and bowels.

The *poisonous* effects are an austere, metallic taste, excessive nausea and vomiting, burning pain in the stomach, colic, extreme depression of the circulation, spasms, watery evacuations from the bowels, and great prostration; resembling very much a violent case of cholera. The remedies are demulcent drinks, astringent infusions, and stimulants, both internal and external.

*Antimonial Wine*.—(*Vinum Antimonii*, U. S.)—A solution of tartar emetic in wine, in the proportion of gr. ij to f ʒj. The best wine must be used—as the Teneriffe, Sherry, or Madeira, or else the solution will not be perfect. This preparation is employed for its diaphoretic and expectorant effects; also as an emetic for children. Dose 20 drops to f ʒj.

2. *Precipitated Sulphuret of Antimony*.—(*Antimonii Sulphuretum Precipitatum*, U. S.)—Prepared by boiling together the sesquisulphuret of antimony and a solution of potassa; strain, and add sulphuric acid while yet hot; then wash away the sulphuret of potassium, and dry the precipitated sulphuret. It is an orange-red, insoluble powder, composed, chemically, of a mixture of the oxide and sulphuret of antimony.

*Kermes Mineral* is a similar compound, made like the preceding, with the exception that no acid is added, but the precipitate falls spontaneously.

*Golden Sulphur of Antimony* is formed by adding an acid to the liquid, after the precipitation of the Kermes mineral: it contains some uncombined sulphur.

None of these preparations are much used at present. They are occasionally given as alteratives, combined with guaiac and calomel, in the form of *Plummer's Pill*, in chronic skin diseases. Dose, 1 to 2 grs.

3. *Antimonial Powder*.—(*Pulvis Antimonialis*, U. S.) made in imitation of *James' Powder*.—Prepared by burning the sulphuret of antimony with hartshorn shavings, in a wide-mouthed vessel. It consists of phosphate of lime and oxide of antimony; colour, white; no taste or smell; insoluble in water; uncertain in its operation. Used in fevers and cutaneous diseases. Dose, 3 to 8 grs.

## LOCAL REMEDIES.

### CLASS VI.—DIAPHORETICS.

Diaphoretics are medicines which increase the function of perspiration. The name *sudorifics* is often applied to such as increase the sensible perspiration or *sweat*. They act in different ways: (1) by relaxing the surface; (2) by direct stimulation of the sudoriferous glands; (3) by stimulating the system generally. As a class of medicines, their action is not very certain, depending a good deal upon the state of the system at the time. They are useful as evacnants, promoting at the same time absorption; they also produce revulsion to the surface. Diaphoretics may be divided into the *refrigerant*, the *nauseating*, and the *alterative*.

**CITRATE OF POTASSA.**—(*Potassæ Citras*, U. S.)—Prepared by action of citric acid, or lemon-juice, on carbonate of potassa. A white, soluble, deliquescent salt; used as a diaphoretic in fevers, particularly in the forms of *neutral mixture* and *effervescing draught*.

*Neutral Mixture*—(*Solutio Potassæ Citratis*, U. S.)—Prepared by saturating lemon-juice, (or an ounce of citric acid, rubbed up with four minims of oil of lemons, and dissolved in a pint of water,) with carbonate of potash, and filtering. Dose, a tablespoonful every hour or two: this quantity contains 15 grains of the salt.

The *effervescing draught* is the same, given in a state of effervescence. It is made by dissolving ʒij of the carbonate, or ʒiij of the bi-carbonate in fʒiv water; then add a tablespoonful of this solution, mixed with the same quantity of water, to a tablespoonful of sweetened lemon-juice, or citric acid solution. Laudanum, in small quantities, may be added, if it produces griping.

*Spirits of Mindereri*.—(*Liquor Ammonia Acetatis*, U. S.)—Pre-

pared by the action of distilled vinegar on carbonate of ammonia. A limpid, colourless liquid, when properly made; *taste*, cooling and bitterish; an excellent diaphoretic in fevers. Dose, a tablespoonful every hour or two.

**SWEET SPIRITS OF NITRE.**—(*Spiritus Ætheris Nitrici*, U. S.)—Prepared by the action of sulphuric acid on alcohol and nitrate of potassa, by distillation; chemically, the hyponitrite of ethyl, dissolved in alcohol.

*Prop.*—Colourless, limpid, of an ethereal odour, and a pungent, sweetish taste; apt to deteriorate when kept, becoming acid; soluble in alcohol and water; apt to be impure, as found in the shops. It is diaphoretic, diuretic, and antispasmodic; much used in fevers with nervous irritability. Dose, 20 drops to f3j, every 2 or 3 hours.

*Nitrate of Potassa*,—already spoken of as a refrigerant. It will frequently produce diaphoresis, especially if combined with other medicines of this sort; the *Nitrous Powders* are a combination of tartar emetic, nitre, and calomel. Nitre and tartar emetic are often prescribed, as a diaphoretic, in solution.

The *Nauseating Diaphoretics*, comprise such medicines as produce diaphoresis, by relaxing the cutaneous capillaries; in this way, nearly all emetic substances will promote perspiration, if given in small doses. The only ones much employed are, Ipecacuanha and Tartar emetic. They are indicated in all cases of high arterial excitement, not attended with irritation or inflammation of the stomach. Tartar emetic is usually given in the dose of the sixth to the twelfth of a grain. Ipecacuanha is chiefly used as a diaphoretic, in combination with opium, in the form of *Dover's Powder*—(*Pulvis Ipecac. et Opii*, U. S.)—This is made by rubbing up one part of ipecac. and opium each, with eight parts of sulphate of potassa; the dose is 10 grains. It is a very useful anodyne diaphoretic, in rheumatism, diarrhœa, and dysentery; also in pneumonia and bronchitis, after proper depletion; it should not be used, if there be much arterial excitement, or determination to the head.

The chief *Alterative Diaphoretics* are Sassafras, Mezereon, Guaiacum, and Sarsaparilla.

#### SASSAFRAS, U. S.

Bark of the root of the *Sassafras officinale*, an indigenous tree. Occurs in irregular fragments, of a reddish cinnamon colour, brittle, of a very aromatic odour and taste. Virtues depend on a volatile oil. It is a mild stimulant diaphoretic, used chiefly in domestic practice; not much employed alone, but forms an agreeable adjuvant to other medicines. It is one of the ingredients in the *Compound Syrup of Sarsaparilla*.

The *sassafras pith* (*sassafras medulla*) is procured from the young twigs. It is in cylindrical peices, white, and very light; forms with

water a thick, gummy solution. The mucilage is made by adding ʒj to Oj of boiling water; it is a very pleasant application to irritated or inflamed surfaces, as in ophthalmia, erysipelas, eczema, &c.

MEZEREON.—(MEZEREUM, U. S.)

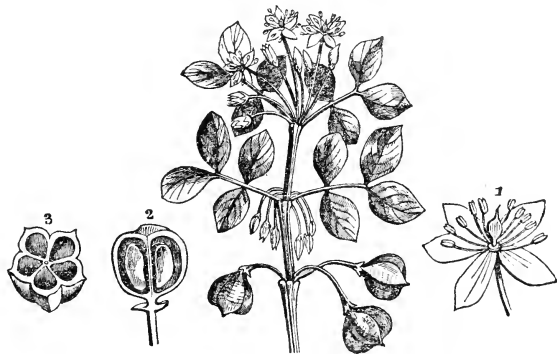
Product of several species of the *Daphne*, especially the *D. mezereum*, a shrub three or four feet high, growing in Europe. The bark of the root is the part directed by the pharmacopœias, but the bark derived from the branches is generally found in the shops. It comes in strips three or four feet long, folded in bundles, or wrapped in balls; covered externally with a grayish-brown epidermis, whitish within, tough and pliable. Taste, sweetish at first, then very acrid; yields its properties to boiling water. It contains a peculiar principle called *daphnin*, which, however, is not active: its activity depends on an acrid resin. The fresh bark applied to the skin will produce vesication. An ointment, made from the bark, has been used to maintain the discharge from blisters.

Mezereon is a stimulant alterative diaphoretic, if directed to the skin; it will act also on the kidneys. Used chiefly in combination with others, in chronic skin diseases, chronic rheumatism, and secondary syphilis. Best given in the form of decoction, made by boiling ʒij mezereon, and ʒss. liquorice root, in Oij water down to Oij. Used sometimes as a *masticatory* in cases of paralysis of the tongue.

GUAIAECUM WOOD, AND GUAIAEC.

Products of the *Guaiacum officinale*, an evergreen tree of South America and the West Indies. The wood comes in billets, covered

Fig. 14.



with a grayish bark, extremely hard and compact; the alburnum, or sap wood, is of a yellowish colour; the heart wood of a brownish-

green, commonly called *lignum vitæ*. It has no odour except when rubbed or burned; taste, bitterish and pungent; activity depends on the contained guaiac.

*Guaiac—guaiacum*—is procured by spontaneous exudation; by boiling the raspings and shavings in water; and by heating in the fire billets of the wood which have been bored longitudinally. It comes in masses of a deep olive-brown colour, mixed with various impurities; fracture resinous; odour feeble and balsamic; taste slight at first, but afterwards acrid; melts by heat, evolving a fragrant odour. Chemically, a mixture of a peculiar extractive and a resin; much more soluble in alcohol than in water.

*Effects*.—Stimulant, alterative, and diaphoretic; in large doses irritant to the bowels. Used in chronic rheumatism, secondary syphilis, and chronic skin diseases. Dose of guaiac, 10 to 30 grains. There are two tinctures, the *simple* and the *volatile*, or *ammoniated*; the latter is used in dysmenorrhœa;—dose of either, fʒj.

#### SARSAPARILLA, U. S.

Root of different species of the genus *Smilax*, as the *S. officinalis*, *S. sarsaparilla*, *S. syphilitica*, &c.; perennial, climbing plants, growing in Mexico and South America. The leaves are ovate, and alternately inserted upon short footstalks, with numerous tendrils proceeding from the stem. The roots are very long and slender, inserted upon a common caudex. Several varieties are known:—1. *Honduras sarsaparilla*,—comes in bundles two or three feet long, consisting of one or more roots, folded lengthwise, and secured by a few circular turns. 2. *Jamaica sarsaparilla*,—distinguished by the reddish colour of its epidermis, probably of similar origin with the last. 3. *Brazilian sarsaparilla*, sometimes called *Lisbon* and *Rio Negro sarsaparilla*. 4. *Para sarsaparilla*;—this comes in cylindrical bundles, about three feet long and one thick; it is an excellent variety.

The dried root has but little odour; a mucilaginous and acrid taste, especially when chewed for some time. Imparts its virtues to water and alcohol; the cortical portion is the most active. It contains a peculiar principle, called *sarsaparillin* or *smilacin*, also much starch, lignin, &c. Long boiling is injurious to it.

*Effects*.—An alterative diaphoretic; sometimes creates nausea and vomiting. Improves the state of the constitution; slightly strengthens and induces plumpness in cachectic cases, and in depraved states of the general health. Useful in secondary syphilis, chronic rheumatism, chronic cutaneous diseases, &c. It is not often administered alone; generally in combination with the other stimulating diaphoretics. Dose of powder, ʒss. to ʒj; of the *decoction*, made by boiling ʒj of the root in a pint of water down to fʒx, fʒiv. The *compound decoction*, (*Decoctum Sarsaparillæ Compositum*, U. S.), is



made by boiling together bruised sarsaparilla with guaiacum wood, mezereon, liquorice root, and sassafras, in water, for fifteen minutes, and then straining. It is made in imitation of the *Lisbon diet drink*. Dose, fʒiv. several times a day. The *compound syrup* is also officinal,—an excellent preparation; it contains sarsaparilla, guaiacum wood, red roses, liquorice root, the oils of sassafras, anise and part-ridge berry. Dose, fʒss., three times a day.

There are two extracts,—the *alcoholic*, (*Extrac. Sarsaparilla*, U. S.),—dose, 10 to 20 grains, and the *fluid extract*,—dose, fʒj.

## CLASS VII.—DIURETICS.

Diuretics are medicines which increase the secretion of urine. Like diaphoretics, their action is much influenced by the external temperature. The two functions of the skin and kidneys are opposed one to the other,—whatever favours one secretion interfering with the other, and vice versâ. Diuretics may act, 1, either by being absorbed and coming into direct contact with the kidneys; 2, by promoting absorption into the blood-vessels; 3, by a stimulating impression on the mucous membrane of the urinary passages. Sometimes stimulant and tonic articles prove diuretic by the increased quantity of blood sent to the kidneys in a given time; certain mental emotions have also a powerful effect, as fear and anxiety.

They are used chiefly in dropsies, and in inflammations and irritations of the urinary organs, after proper depletion. As a class, they are rather uncertain in their action.

Diuretics may be divided into several classes as the Saline, Alkaline, Acrid, and Sedative.

### SALINE DIURETICS.

**CREAM OF TARTAR**—(*Potassæ Bitartras*, U. S.)—Exists in various vegetable juices, particularly that of the grape. Procured from wine casks during the vinous fermentation; the salt being insoluble in alcohol, is gradually deposited as a crust on the sides of the cask. In its crude form it constitutes the *argol* of the shops, of a reddish colour. Purified by repeated solutions. When pure it is perfectly white, crystalline, has an acid taste, more soluble in hot than cold water. It is an excellent hydragogue cathartic and also diuretic. Well adapted to dropsies of an inflammatory type, from its possessing refrigerant properties. Should be given in a large quantity of cool water. Dose, ʒj to ʒij daily.

**ACETATE OF POTASSA**—(*Potassæ Acetas*, U. S.)—Prepared by action of distilled vinegar on carbonate of potassa. Very deliquescent, soluble in water and alcohol; formerly named *sal diureticus*; acts as a cathartic in large doses; produces diuresis in doses of ʒj to ʒj, every two or three hours, in a large quantity of water; used as the former.

**NITRATE OF POTASSA.**—Already spoken of under the head of refrigerants. Sometimes powerfully diuretic, especially when the surface is kept cool: used in the same cases as the two former. Dose, 10 to 20 grains, repeated, so that from ℥j to ℥ij may be taken in twenty-four hours.

#### ALKALINE DIURETICS.

**CARBONATE OF POTASSA**—(*Potassæ Carbonas*, U. S.)—Prepared from pearlsh by dissolving in cold water, filtering, and evaporating; at the same time stirring so as to cause it to granulate, the object of which is to expose as small a surface as possible to the air, and thereby prevent deliquescence. It contains impurities, as the silicate, sulphate, and muriate of potassa.

The purest carbonate, called *salt of tartar*, is made by heating two parts of cream of tartar with one of nitre.

Occurs in the form of small white globules, of a nauseous, alkaline taste. It is a decided diuretic; used chiefly as an adjuvant to others, as in dropsy accompanied with acidity of stomach; also as an antilithic in gravel. Dose, 10 to 20 grains, three or four times a day;—may be given in carbonic acid water.

The **BICARBONATE**—*Potassæ Bicarbonas*.—Is prepared by passing carbonic acid through a solution of the carbonate. Occurs in white flat prisms, inodorous, not so soluble as the carbonate.

*Uses.*—Same as the carbonate, but preferable on account of its more agreeable taste. Dose, ʒss. to ℥j, repeated.

#### STIMULANT DIURETICS.

**SQUILL**—(*Scilla*, U. S.)—Bulb of the *Scilla maritima*, a plant growing upon the shores of the Mediterranean Sea. It is a perennial plant, having a large pyriform bulb, from which spring long shining green leaves, and a single long flower stem. There are two varieties, the *white* and the *red*; but they are similar in properties. The bulb is sometimes imported whole, but generally in transverse or longitudinal slices, of a yellowish-white colour; contorted, tough; of a feeble odour, and a bitter, nauseous taste. Imparts its virtues to alcoholic water and vinegar. Contains a peculiar principle called *scillitin*.

*Effects.*—In moderate doses, stimulant to most of the secretions, particularly the kidneys and lungs. In large doses, it is emetocathartic. Much used in dropsies of an enfeebled character. Often advantageously combined with calomel, and sometimes with digitalis. Dose, 1 to 3 grs., two or three times a day, gradually increased till some obvious effect is produced. As a diuretic, it is usually given in form of pill or powder.

## MEADOW SAFFRON.—(COLCHICUM, U. S.)

Bulb of the *Colchicum autumnale*, a native of Europe, grows about 6 or 7 inches high. Bulb about the size of a chestnut, covered with a brownish membrane; internally, solid, white, and fleshy. It should be gathered in July or August. Sometimes the bulb is dried whole, but generally it is cut into transverse slices about an eighth of an inch thick, whitish, inodorous, of a bitter and acrid taste. The pieces should each have a notch on one side. Apt to be spoiled in keeping; hence very uncertain, as found in the shops. The seeds are small, of a reddish-brown colour and of a bitter acrid taste; the virtues reside in the outer coating. The seeds contain all the virtues of the bulb, and are less apt to be injured by keeping. It contains a peculiar alkaline crystalline principle, called *colchicin*, not identical with veratria, as was at one time supposed. The virtues are best imparted to wine and vinegar.

*Effects.*—Stimulant to most of the secretions; rather reduces the action of the heart and arteries; seems also to influence the nervous system. In very large doses it is irritant to the stomach and bowels. It is chiefly used in gout and rheumatism, in which it may be combined with saline cathartics and antacids. *Scudamore's Mixture* consists of a draught containing 15 to 20 grs. magnesia, ʒj to ʒij sulph. magnesia, and fʒj to fʒij vinegar of colchicum. Dose of the bulb or seeds, 2 to 8 grs.,—rarely used.

*Vinum Colchici radiceis, U. S.*—Contains half a pound of the bruised bulb in a pint of wine; colour, dark reddish brown; dose, 30 drops up to fʒj., gradually increased.

*Vinum Colchici Seminis, U. S.*—Is made by macerating ʒij. bruised seeds in a pint of wine for 14 days; dose, the same.

*Acetum Colchici, U. S.*—*Vinegar of Colchicum*,—made by macerating the bulb in vinegar, then adding alcohol.

The white hellebore of Europe, *Veratrum album*, and the green hellebore of the U. S., *Veratrum viride*, are analogous in their properties to colchicum. Both depend for their activity upon a powerful alkaline principle called *veratria*. Veratria is occasionally employed externally in the form of ointment, in cases of neuralgia. It is a violent acrid poison; even its external application is attended with a burning tingling sensation.

The ointment is made by rubbing up 10 or 20 grs. with an ounce of lard. The dose of veratria is the twelfth to the sixth of a grain.

## TURPENTINE.—(TEREBINTHINA, U. S.)

Juice of different species of the *Pinus*, *Abies* and *Larix*. Many varieties of turpentine are known in commerce, but only two are used in the United States.

1. *White Turpentine*,—*Terebinthina*.—Derived chiefly from the

*Pinus palustris*, or long leaved pine of the south. Grows from 60 to 70 feet high; the leaves are in threes, about a foot in length. The turpentine is collected by making incisions in the trunk of the tree in spring, when the juice exudes, and is collected in barrels. It hardens on exposure. Colour, yellowish-white; odour, peculiar; taste, hot, bitter, and pungent, depending on the volatile oil.

2. *Canada Turpentine*,—*Terebinthina Canadensis*.—Sometimes called *Balsam of Fir*, and *Canada Balsam*; product of the *Abies balsamifera* or *Balm of Gilead*; found in vesicles under the bark. It is a transparent, yellow, thick liquid; odour, terebinthinate and aromatic; taste, same as the former. All the turpentines are inflammable, scarcely soluble in water, soluble in alcohol; chemical composition, a resin and a volatile oil.

*Uses*.—Chronic rheumatism, and chronic disorders of the urinary organs; also, externally, as stimulants to indolent ulcers. Dose, gr. x. to ʒj. Sometimes given by enema.

The *Oil of turpentine* is more frequently employed as a diuretic in chronic nephritic complaints; dose, 10 to 20 drops.

*Tar*.—(*Pix liquida*, U. S.) Procured chiefly from the *Pinus palustris* of North Carolina, by the slow combustion of the wood arranged in large piles. It is an empyreumatic product, consisting of a resin held in solution by acetic acid and empyreumatic oil, and coloured by charcoal: slightly soluble in water; more so in alcohol and ether. The aqueous solution—tar water—is used in chronic pectoral complaints. The vapour of tar is employed for the same affections, by inhalation.

Dose, internally, ʒss. to ʒj.

The ointment of tar is officinal; used in tinea capitis.

*Pitch* is the residue after the volatile parts are driven off from tar; used in plasters.

*Creasote*—*Creasotum*.—Is one of the ingredients in the volatile oil of tar. Colourless when pure, of an oily aspect, very volatile; odour, strong, peculiar, and empyreumatic; taste, hot and acrid; slightly soluble in water, much more so in alcohol. *Uses*.—Antiseptic, styptic; employed in sickness of stomach and in hæmatemesis; dose, 1 drop every half hour or hour. Used externally as a stimulant; also in the form of ointment.

*Resin*—*Resina*. The residue after the distillation of the oil of turpentine; two varieties—the *yellow* and *white*.

*Uses*.—Chiefly to form plasters.

*Resin Cerate*.—*Basilicon Ointment*.—(*Ceratum Resinæ*, U. S.)—An excellent stimulant application to ulcers arising from burns.

COPAIVA.—(COPAIBA, U. S.)

Product of the *Copaifera officinalis*, a tree of South America. Procured by making incisions in the tree. As it flows first, it is

clear, but becomes thick and dark by exposure; colour, orange-red; odour, peculiar and strong; taste, hot and bitter; insoluble in water, soluble in alcohol. Chemically, a volatile oil and resin; virtues depend on the oil, which may be separated by distillation. Copaiva will solidify, if exposed to the air in thin layers; also if rubbed up with magnesia.

*Uses.*—A stimulant diuretic, sometimes producing nausea and vomiting; acts also upon the mucous membranes generally. Employed chiefly in gonorrhœa, before or after the inflammatory symptoms; also in chronic dysentery and chronic bronchitis.

Dose, 20 drops to ℥j, 3 times a day; of the volatile oil, 10 to 20 drops. Copaiva often given in the form of *capsules*.

#### CANTHARIDES.—(CANTHARIS, U. S.)

History, &c., described under the head of *Epispastics*. As a diuretic it is more stimulating than the preceding, being apt to irritate the urinary organs, and produce strangury. Used chiefly in chronic disorders of the urino-genital organs, as chronic gonorrhœa and leucorrhœa, incontinence and retention of urine, spermatorrhœa, and amenorrhœa; also in obstinate skin diseases. Dose, gr. i, two or three times a day; generally given in the form of *tincture*,—dose, 10 drops, gradually increased till some obvious effect is produced.

#### MILDER DIURETICS.

##### JUNIPER BERRIES.—(JUNIPERUS, U. S.)

Fruit of the *Juniperus communis*, an evergreen shrub, growing in both continents;—about the size of a pea, globular, of a dark purple colour, glaucous and shrivelled. Imported chiefly from Trieste. Odour, aromatic; taste, sweetish, warm, and terebinthinate; virtues depend on a volatile oil, and are yielded to water and alcohol.

*Effects.*—A good, moderately stimulant diuretic and carminative; used chiefly as an adjuvant;—with cream of tartar, as a drink, in dropsy. The *infusion* contains ℥j of the bruised seeds, to Oj of water. Dose of the oil, 5 to 15 drops, several times a day. The tops are also occasionally used in medicine.

##### INDIAN HEMP.—(APOCYNUM CANNABINUM, U. S.)

Root of the *A. cannabinum*, an indigeneous, herbaceous plant, emitting a milky juice when wounded. Odour, strong; taste, bitter nauseous; virtues to water and alcohol. In full doses acts as an emeto-cathartic; occasionally a very powerful diuretic in some cases of dropsy. Dose of the decoction, (℥ss. in Oij water, boiled down to Oj,) f ℥j to f ℥ij, three times a day.

## DANDELION.—(TARAXACUM, U. S.)

Root of the *Leontodon taraxacum*, an herbaceous, perennial plant. The root is spindle-shaped, several inches long, of a brownish colour externally, lighter within; all parts abound in a milky, bitterish juice, particularly the root, which is more powerful in the fresh state.

*Effects*.—Tonic, diuretic, and laxative; believed to have a specific influence over the liver; used in dyspepsia attended with derangement of the liver; and in certain forms of dropsy.

*Decoction*.— $\mathfrak{3j}$  of the fresh, or  $\mathfrak{3ij}$  of the dried root, in Oj water;—dose, f  $\mathfrak{3ij}$  several times a day.

*Extract*.—Prepared by macerating the fresh root in boiling water;—dose, 20 to 30 grs.

## FLEABANE.—(ERIGERON, U. S.)

Herbaceous parts of the *E. heterophyllum*, and *E. Philadelphicum*, indigenous plants. They are gently diuretic, and are chiefly employed as adjuvants in dropsy, and in chronic nephritic disorders. Best given in decoction,  $\mathfrak{3j}$  to Oj water,—the whole to be taken in the course of the day.

## WILD CARROT.—(CAROTA, U. S.)

Seed of the *Daucus carota*, an indigenous, perennial plant. The flowers are in umbels, which are flat at first, but afterwards contract so as to form a cup. The seeds are brownish, of an oval shape, with stiff hairs attached. Odour, slight; taste, aromatic and bitter; contain a volatile oil which may be separated by distillation.

*Effects*.—A moderately stimulant diuretic; used as an adjuvant in dropsy, in the form of infusion.

The garden carrot has similar properties, though feebler. It is sometimes used, grated, as a poultice.

*Parsley Root*—*Petroselinum*—has also diuretic properties; the same is true of *horseradish* and *mustard*. Sometimes an infusion of several of these is given, in cases of dropsy of an enfeebled character.

The only *sedative* diuretic much employed is *Digitalis*. It does not succeed so well in dropsies attended with much plethora, as in those of a relaxed debilitated character. It is useful in cases accompanied with albuminous urine. Its diuretic powers are increased by combining it with squill and calomel. It is not very speedy in its operation, generally requiring several days to produce its diuretic effect. Dose of powder, one grain twice a day; of the tincture, 10 drops; of the infusion, f  $\mathfrak{3ss}$ .

## CLASS VIII.—EMETICS.

“Medicines which, as an ordinary result, produce vomiting.” The effect of an emetic is not immediate; usually from 10 to 20 minutes elapse before vomiting occurs. Emesis is partly the act of the stomach, and partly of the brain and spinal marrow: if the brain be stupefied by narcotics, the stomach becomes very insusceptible to the action of emetics. Some emetics act only if *immediately* applied to the stomach; others produce their effect no matter how introduced into the system. The act of vomiting is chiefly *reflex*. If the eighth pair of nerves be cut, no vomiting is produced by emetics. The susceptibility to their influence is increased by irritation or inflammation of the stomach, and by fever; it is lessened by nervous disorders, and by narcotic poisons.

Emetics are useful to remove improper matters from the stomach, as poisons or ingesta; to deplete from the system; to promote the secretions; to produce muscular relaxation; to give a shock to the system, and thus break up morbid associations; to cause pressure on the surrounding viscera; to reduce arterial action; and to cause revulsion to the stomach. They should be avoided, if possible, in congestion of the brain, hernia, the advanced stages of pregnancy, and in inflammation of the stomach and surrounding parts.

## IPECACUANHA, U. S.

Root of the *Cephaelis ipecacuanha*, a perennial plant, growing in Brazil; about 5 or 6 inches high. The roots, as met with in the

Fig. 15.



shops, are several inches long, contorted, of a grayish-brown colour, about the thickness of a small quill, apparently composed of a series of transverse rings, from which cause it is often called *annulated*. The cortical portion, which includes the rings, is hard, horny, and brittle, resinous in its fracture; the ligneous portion is small and inert. Colour of powder, light fawn; odour, slight in mass. The powder excites sneezing, and, in some, asthmatic symptoms. Water and alcohol extract its virtues; but injured by long boiling; also by exposure to the light. Active principle, an alkali called *emetina*.

*Uses*.—In very small doses it is tonic and alterative; rather larger doses prove diaphoretic and expectorant; still larger quantities cause vomiting. Its emetic operation is mild, prompt, and certain; hence it is very useful as an evacuant from the stomach. It has been used with advantage in hemorrhage.—Dose, as an alterative,  $\frac{1}{4}$  to  $\frac{1}{2}$  gr.; as a diaphoretic,  $\frac{1}{2}$  to grs. ij; as an emetic, 15 to 30 grs.; best given in warm water.

The *Vinum Ipecacuanhæ* contains ʒj to Oj;—dose, as an emetic, f ʒj,—for an adult. Used chiefly as a diaphoretic and expectorant.

There are several indigenous emetics, the most important of which are the following:

**GILLENIA**, U. S.—Root of the *G. trifoliata* and *G. stipulacca*. It is sometimes called *Indian physic*, and *American ipecacuanha*. It has a long, branching root, of a reddish-brown colour.—Dose of powder, 20 to 30 grs.—A good substitute for ipecacuanha.

**LOBELIA**, U. S.—*Indian Tobacco*.—Herbaceous part of the *L. inflata*, an annual plant. Along with its emetic properties it is also narcotic, producing very much the effects of tobacco. Used chiefly in spasmodic asthma.—Dose, 5 to 20 grs. The *tincture* is officinal;—dose, f ʒj; repeated if requisite.

**SANGUINARIA**, U. S.—Root of the *S. Canadensis*, or *blood-root*;—distinguished by its red colour, and truncated appearance. Emetic, and slightly narcotic; also used in catarrhs. Dose, 10 to 20 grs.;—of tincture, f ʒij to f ʒss.

*Squill* and *Tobacco* are emetic in large doses, but are seldom employed for this purpose; the great prostration produced by the latter is an objection.

*Mustard*, in powder, is a stimulant emetic; it may be used in some cases of narcotic poisoning.

#### TARTAR EMETIC.

Differs in its action, as an emetic, from ipecacuanha, in causing much more retching, nausea, and general disturbance of the system; hence employed to act upon the surrounding viscera, as in congested liver or spleen; to break up the paroxysms of intermittents; to produce relaxation in croup and in dislocations; in nervous diseases, as in neuralgia and amaurosis. Ipecacuanha is preferable in poisoning from narcotics. Often combined with ipecacuanha. Dose, 2



or 3 grs. ; best given in divided quantities, dissolved in water. Dose of *Vinum Antimonii* as an emetic, f ʒj, for an adult.

**SULPHATE OF ZINC.**—A very prompt and powerful emetic, causing but little nausea. Chiefly used in cases of narcotic poisons,—best to combine it with ipecacuanha. Dose, (medium) gr. x ; in narcotic poisons, ʒj.

**SULPHATE OF COPPER.**—A still more powerful emetic than the last ; —used also in narcotic poisoning ;—sometimes in membranous croup. Medium dose, 2 or 3 grs. ; in cases of poisoning by narcotics, 5 to 15 grs. ;—danger of inflammation from over doses.

The *Turpeth Mineral*, *Arsenic*, and *Corrosive Sublimate*, are each emetic in large doses, but are scarcely ever used with this intention.

### CLASS IX. — CATHARTICS.

“Medicines which evacuate the alimentary canal.” They act either by increasing the peristaltic movement, or by augmenting the mucous secretions, or by stimulating the liver to throw out bile. Such cathartics as merely evacuate the intestinal contents, are termed *Laxatives* ; those which produce increased secretion into the bowels, *Purgatives* ; and such as cause large watery discharges, *Hydragogues*. Cathartics also differ as to the part of the canal which they affect ; thus aloes chiefly act upon the rectum ; gamboge and calomel upon the upper bowels ; the neutral salts upon the whole tract. Some occasion a great amount of depletion, while others, as rhubarb, produce a tonic impression. The term *drastic* is applied to such as act with great violence.

*Uses.*—To evacuate the bowels from noxious matters ; to relieve constipation and its attendant evils ; to deplete from the system ; to promote absorption, in dropsies ; to cause revulsion to the bowels, particularly in cerebral disorders. They are contra-indicated in inflammation of the mucous membrane of the bowels ; and should be cautiously employed in typhoid fever. Their activity is increased by the addition of small quantities of emetics and bitters. Their griping effect is best obviated by combination with aromatics or opium. They act most powerfully when taken in an empty stomach. Hypercatharsis is best checked by an anodyne enema.

There are several articles of diet which are laxative, and may be usefully employed in medicine, such as the ripe fruits in their fresh state, or the same dried and stewed,—particularly peaches, prunes, and tamarinds. Sugar is also laxative particularly in the form of *West India molasses* ; rye or oatmeal mush and molasses form an excellent article of diet in habitual costiveness, and in hemorrhoids. Sugar is apt to disagree with the stomach of dyspeptics, on account of its liability to generate an acid. Bran is an excellent article of

diet in dyspepsia and constipation; believed to produce its laxative impression by mechanical irritation; best used in the form of *bran-bread*, made from the unbolted flour.

#### PURGING CASSIA.—(CASSIA FISTULA, U. S.)

Fruit of the *C. fistula*, a tree growing in the East and West Indies; consists of pods about a foot in length, containing numerous seeds surrounded with a black, sweetish pulp. The pulp is procured by bruising the pods, and boiling in water. It is a mild laxative, and forms one of the ingredients in the Confection of Senna. Dose ʒj to ʒj.

#### MANNA, U. S.

Concrete juice of the *Ornus Europæa*, a tree growing in the countries bordering the Levant. Procured both by spontaneous exudation, and incisions. Three varieties found in commerce. 1. *Flake Manna*, the result of spontaneous exudation; comes in pieces two or three inches long, about an inch wide, bearing the marks of the bark, &c., on which it has concreted; colour, yellowish-white; odour, faint; taste, sweetish. 2. *Common Manna*, procured, when the season is more advanced, by incisions; consists of particles of the flake, mixed with a fluid portion and impurities; colour, darker; inferior. 3. *Fat Manna*, obtained still later in the season; consists chiefly of the fluid portion, with numerous impurities; colour, much darker. Manna consists of common sugar, united to a peculiar saccharine principle, called *mannite*.

*Uses*.—A mild laxative, adapted to cases of constipation, hæmorrhoids, and pregnancy; also to children. Dose, ʒj to ʒij.

#### CASTOR OIL.—(OLEUM RICINI, U. S.)

Product of the *Ricinus communis*, or Palma Christi, growing in various parts of the world. As found in the United States, it is an annual. The fruit is a three-celled capsule, each cell containing an oblong, spotted, brownish seed. The seeds are powerfully purgative, in consequence of an acrid principle which they contain, and which is dissipated by a high heat. The oil is procured either by expression or decoction. 1. *Expression*. The seeds are gently heated, and then subjected to powerful pressure; a thick, whitish oil exudes, which is boiled for some time in a large quantity of water; this dissolves out the mucilage, and coagulates the albumen; the clean oil is now removed, and boiled with a minute quantity of water, to drive off the acrid principle. 2. *Decoction*. The seeds are bruised and boiled in water; the oil rises and is skimmed off the surface, and is again boiled to remove the acrid principle; apt to have a darker colour than the other. The acrid principle is thought to consist of several acids.

Fig. 16.



*Uses.*—A mild and certain cathartic, intermediate in its action between laxatives and purgatives. The more it is free from colour, smell, and taste, the better; soluble in cold alcohol; particularly applicable to cases of children and pregnant women; also in irritated and inflamed bowels, colic, dysentery, and diarrhœa. Ordinary dose f ʒj, though less will frequently operate. Infants require a larger proportionate dose than adults, in consequence of their digesting it. May be given in boiling milk, hot coffee, &c.; but best in the froth of porter or ale; also as an emulsion.

*Linseed oil* and *melted butter* may be substituted for castor oil.

#### RHUBARB.—(RHEUM, U. S.)

Root of different species of *Rheum*, growing in Tartary and other

parts of Asia; also cultivated in Europe. It is a perennial plant, with large branching roots and numerous large petiolate leaves.

Fig. 17.



Fig. 18.



Fig. 19.



The roots, when dug up, are carefully dried, sorted, and sent to market. Three varieties are recognised: 1. *Russian* or *Turkey Rhubarb*. This kind is prepared with extreme care, at a frontier town between Tartary and Russia, each piece being bored down to its centre to ascertain its soundness: imported from St. Petersburg. The pieces are irregularly cylindrical in shape, with angular edges, of a lively yellow colour externally, variegated within; yields before the knife, feels gritty to the teeth, stains the saliva, and has a bitter and astringent taste: it is the most valuable. 2. *Chinese Rhubarb*. Probably of similar origin with the other; shipped from Canton; the pieces are smooth and powdery on the outside, appearing as if

rasped. Colour, not so lively; odour and taste, similar to the other; the perforation extends quite through, and sometimes presents the remains of the string upon which it was dried; inferior in value, but much cheaper. 3. *European Rhubarb*.—Comes in long thin pieces, more compact; does not tinge the saliva, nor feel gritty to the teeth; inferior to the others as a purgative.

Active principle, *rhubarberin*,—a yellow, crystalline, volatile substance; contains also tannin, oxalate of lime, colouring matter, &c. Water and alcohol extract its virtues; should not be long boiled.

*Uses*.—A good tonic cathartic, operating chiefly on the peristaltic motion; does not deplete, and hence the best purgative in typhoid cases. Much used in constipation, combined with aloes and soap. It sometimes gripes, in which case it may be combined with aromatics. Dose, as a laxative, 5 to 10 grains; as a purgative, 20 to 30 grains; given in powder or pill. The following are the official preparations:—*Infusum Rhei*, made in the proportion of ʒij to Oj water; *Tinctura Rhei*, useful in typhoid complaints; *Tinct. Rhei et Aloes*, formerly called *Elixir Sacrum*; *Tinct. Rhei et Gentianæ*; *Tinct. Rhei et Sennæ*, or *Warner's Gout Cordial*; *Syrupus Rhei*; *Syrupus Rhei Aromaticus*, or *Spiced Syrup of Rhubarb*; *Syrupus Rhei et Sennæ*.—Roasting impairs the purgative property of rhubarb, but does not affect its astringency.

#### ALOES.—(ALOE, U. S.)

Inspissated juice of the leaves of different species of aloe, as *A. spicata*, *A. Socotrina* and *A. vulgaris*,—succulent plants with long, narrow-toothed leaves, growing in tropical countries. The juice is procured either by draining from the leaves, by expression, or by boiling. Several varieties recognised in commerce: 1. *Cape Aloes*. Obtained from the *A. spicata*, growing at the Cape of Good Hope; occurs in masses of a shining, dark olive-green colour, of a vitreous fracture, translucent at the edges; powder, of a greenish-yellow colour; odour, disagreeable; taste, intensely and permanently bitter. 2. *Socotrine aloes*,—from the *A. Socotrina*; pieces of a yellowish-brown colour, less shining than the former; fracture conchoidal; odour, aromatic; taste, very bitter; much the most valuable variety. 3. *Barbadoes aloes*,—prepared in the West Indies; the product chiefly of the *A. vulgaris*; colour dark-brown, not shining; odour disagreeable; much used for horses. 4. *Hepatic aloes*,—known in India as *Bombay aloes*; probably an inferior variety of Socotrine and other sorts; it has a dark liver colour.

Aloes consists of a peculiar soluble matter termed *aloesin*, and an insoluble substance called *apotheme*. It yields its virtues to water and alcohol.

*Uses*.—A warm purgative, slow in its operation, acting on the lower bowels; will sometimes produce piles, if too long continued;

it also has a tendency to the pelvic viscera generally; chiefly given in constipation, combined with soap, rhubarb, or colocynth. Dose, as a laxative, 2 to 6 grs.; as a purgative, 10 to 15-grs. The official preparations are the following: *Pillulæ aloës et assafœtidæ*, very useful in the constipation of old people; *Pillulæ aloës et myrrhæ*, or *Rufus' Pills*; *Pill. Rhei compositæ*; *Pulvis aloës et canellæ*, or *hiera picra*; *Tinctura aloës*; *Tinc. Aloes et myrrhæ*, or *elixir proprietatis*; *Vinum aloes*.

### SENNA, (U. S.)

Leaflets of different species of *Cassia*, as the *C. acutifolia*, *C. obovata*, *C. elongata*, *C. Æthiopica*, small shrubs growing in tropical Asia and Africa. Several commercial varieties: 1. *India senna*, the product of the *C. elongata*, grown in Arabia and Africa, and thence taken to India; leaflets long and narrow, intermingled with pieces of pods. 2. *Tinnivelly senna*; probably from the same source as the preceding, but much longer and more distinct; very free from impurities, and highly esteemed. 3. *Alexandria senna*, product of the *A. obovata* and *A. acutifolia*, derived from Upper Egypt; it contains also the leaves of the *Argol*. 4. *Tripoli senna*, from the *A. Æthiopica*,—seldom now found in market.

Fig. 20.



The true senna leaves may be recognised by their oblique lower edges, and the inequality of their insertion into the footstalk; odour, faint, but peculiar; taste, sweetish and nauseous; active principle, *cathartin*. Senna is an active hydragogue cathartic; generally administered in combination with manna, or the neutral salts. *Infusion* made in the proportion of ʒj to Oj. Its griping tendency obviated by combining with aromatics, or the neutral salts. The fol-

lowing preparations are officinal: *Tinctura Sennæ et Jalapæ*, or *Elixir salutis*; *Confectio Sennæ*, or *Lenitive electuary*; *Syrupus Sennæ*; and *Fluid extract of senna*.

The leaflets of the *American Senna* — *Cassia Marilandica*, an indigenous plant—possess similar properties to those of the true senna, and may be advantageously used as a purgative.

SCAMMONY.—(SCAMMONIUM, U. S.)

Dried juice from the root of the *Convolvulus scammonia*, a climbing plant, growing in Syria and Asia Minor. It is obtained by slicing off the root, and allowing the juice to concreate. Formerly, the commercial varieties were distinguished as *Aleppo*, *Smyrna*, and *Montpellier* scammony; at present, they are generally known under the two heads of *genuine* and *factitious*. The purest kind (seldom seen here), is denominated *virgin* or *tear scammony*; it consists of shapeless masses, rather porous, of a dull ash colour, and free from impurities. The sort usually met with is in saucer-shaped pieces, three or four inches in diameter, of a dark ash-gray colour, hard, and containing numerous adulterations. It is often common to designate the genuine drug, from whatever source procured, as *Aleppo scammony*; while the term *Smyrna scammony*, is applied to the others. The *spurious* or *factitious* scammony, is chiefly manufactured in the south of France. Odour peculiar, resembling old cheese; taste acrid and bitter; chemically, a gum-resin.

*Effects*.—A drastic cathartic; overdoses cause irritation and inflammation of the bowels; seldom given alone. Dose, 5 to 10 grs.;—an ingredient in the *Compound extract of colocynth*.

JALAP.—(JALAPA, U. S.)

Tuber of the *Ipomœa Jalapa* (Fig. 21), a climbing Mexican plant. The tubers are imported either whole or sliced. They vary, from the size of a walnut to that of an orange; externally, of a blackish-gray colour, heavy, hard, and of a brownish fracture; odour peculiar and nauseous; taste nauseous; colour of powder, light brown. The root is apt to

Fig. 21.



be adulterated. Virtues imparted partly to water, and partly to alcohol. Active ingredient is a resin; it contains also much starch, and some gum and sugar.

*Effects.*—A powerful hydragogue cathartic; much used in dropsies and chronic affections of the joints, particularly in combination with cream of tartar. Dose, 15 to 30 grs.; dose of calomel and jalap, 10 grs. of each,—used in bilious complaints; dose of jalap and crem. tartar, 10 to 20 grs. of the former, and 2 to 4 drachms of the latter.

The *Resin of Jalap* is the alcoholic extract; dose, 8 to 10 grs. Extract of Jalap is used in doses of 10 to 20 grs.; the *tincture* is also officinal.

The *May apple* (*Podophyllum peltatum*), an indigenous perennial plant, possesses very similar medical properties to those of jalap. The root, which is the part used, is very long and branching, of a brownish colour externally. It may be employed in the same cases as jalap. Dose, the same.

#### COLOCYNTH.—(COLOCYNTHIS, U. S.)

Fruit of the *Cucumis colocynthis*, or *Bitter cucumber*, a vine resembling the common cucumber, growing in the south of Europe,

Fig. 22.



Asia, and Africa. Fruit about the size and shape of an orange; has a yellow rind, and a white, light, and porous pulp, containing numerous seeds. As found in the shops, it is usually divested of the rind. Taste, extremely bitter; virtues, to water and alcohol; the infusion gelatinizes on cooling in consequence of the *pectin* contained; active principle, *colocynthin*.

*Effects.*—A powerful hydragogue, producing in over-doses inflammation of the bowels. Not much used alone,—Dose, 5 to 10 grs. The *compound extract*, (*ext. colocynthisidis compositum*, U. S.,) is an



excellent cathartic; it contains colocynth, aloes, scammony, soap, and cardamoms;—dose, 10 to 15 grs.

**BLACK HELLEBORE.**—(HELLEBORUS, U. S.)

Root of the *Helleborus niger*, growing in the southeast part of Europe. Sometimes called the *Christmas rose*. The root as found in the shops, consists of a knotted caudex, from which proceed numerous black fibres, smooth and brittle: odour, slight; taste, bitter and nauseous; becomes much feebler by being kept; virtues to alcohol and water.

*Effects.*—A drastic hydragogue, also emmenagogue; much used by the ancients in mania; not so much employed at present. It is sometimes named *Melampodium*. Dose, 10 to 20 grs.;—of the *tincture*, fʒj.

**GAMBOGE.**—(GAMBOGIA, U. S.)

Inspissated juice of the *Hebradendron cambogioides*, a native of Ceylon and Siam. The juice is procured by breaking off the leaves and young shoots; at first it is of a yellow colour, but becomes a dark orange by hardening. Usually found in cylindrical pieces, many of which are hollow. Fracture glossy; colour of powder, bright yellow; no odour, and but slight taste; forms with alcohol a golden-coloured tincture, and with water a yellow turbid emulsion.

*Effects.*—A powerful drastic cathartic; overdoses dangerous. Dose, 3 to 6 grs., usually given in dropsy, combined with cream of tartar; also in tape worm.

*Compound Cathartic Pill.*—(*Pillule cathartice composite*, U. S.) An admirable compound cathartic, containing calomel, scammony, gamboge, colocynth, aloes, and jalap; dose for an adult, three pills.

**CROTON OIL.**—(OLEUM TIGLI, U. S.)

Derived from the seeds of the *Croton tigli*, a small tree growing in the East Indies. The oil is procured by first roasting the seeds and then subjecting them to pressure. As first obtained it is nearly colourless; but as found in the shops it has a yellowish-red hue; odour, faint and peculiar; taste, acrid and burning; partially soluble in alcohol, which separates it into its constituent portions; of these, the acrid principle, called *crotonic acid*, is soluble, while the true oil, which is a mild fixed oil, is not soluble. Most liable to be adulterated with castor oil; fraud detected by the solubility of the latter in alcohol.

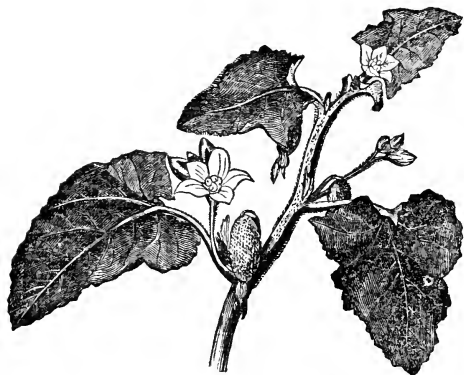
*Effects.*—One of the most powerful drastic cathartics; overdoses very dangerous; applicable in obstinate constipation, and in coma; advantage from the smallness of the dose. Dose, 1 to 3 drops, best given in form of pill made up with crumbs of bread, each containing half a drop. Applied externally, it produces a pustular eruption, and may be used as a revulsive, in diseases of the chest, &c.; it

should be mixed with olive oil. Its external irritant effect varies much in different persons.

### ELATERIUM, (U. S.)

Product of the *Momordica elaterium* or *squirting cucumber*, a

Fig. 23.



vine growing in the south of Europe. The fruit is about the size of a lime, oval, of a greenish colour, and covered with numerous prickles. When ripe it bursts, projecting its contents. Elaterium is procured by slicing the fruit, and the juice allowed slowly to drain away upon a muslin sieve, when it gradually deposits the medicine. This is in small flattish pieces, of a grayish-green colour, light

and friable; has no odour, but a bitter and nauseous taste; active ingredient, *elaterin*.

*Effects.*—Probably the most active of all cathartics. Used chiefly in obstinate dropsy. Dose of the purest, (Clutterbuck's,)  $\frac{1}{8}$  gr.; of the commercial,  $\frac{1}{2}$  gr.; dose of *elaterin*,  $\frac{1}{16}$  to  $\frac{1}{12}$  gr. Always best to commence with very small doses, from the uncertainty of the preparation.

### SALINE CATHARTICS.

Nearly all are of mineral origin. They closely resemble each other in their operation upon the system, producing watery evacuations, from their influence over the secretory vessels of the mucous membrane. They are likewise refrigerant, and are hence peculiarly adapted to febrile and inflammatory complaints, but are contra-indicated in typhoid disorders.

### EPSOM SALTS.—(MAGNESIÆ SULPHAS, U. S.)

Procured from the bittern of sea-water after the crystallization of the chloride of sodium. A better method is by the action of sulphuric acid on magnesite; also from springs. As usually found, the crystals are small and needle-shaped; contain 50 per cent. of water of crystallization; effloresce slowly; very soluble in water; taste bitter

and saline; sometimes contains sulphate of soda as an impurity. One of the best saline cathartics, and very extensively employed. Dose for an adult ℥j; best given in carbonic acid water.

GLAUBER'S SALTS.—(SODÆ SULPHAS, U. S.)

Procured as the residuum after making muriatic acid; also from the bittern of sea-water. Occurs in four-sided crystals; efflorescent; contain more than 50 per cent. water of crystallization; more soluble at 90° than 212°; taste, very nauseous and bitter; not so much used as Epsom salts;—dose about the same.

SULPHATE OF POTASH.—(POTASSÆ SULPHAS, U. S.)

Formerly called *vitriolated tartar*; the residuum after the manufacture of nitric acid, from sulphuric acid on nitre; contains no water of crystallization; occurs in small white and very hard prismatic crystals; not very soluble; not much used as a cathartic, but chiefly in the preparation of Dover's powder. Dose, ℥ss.

TARTRATE OF POTASSA.—(POTASSÆ TARTRAS, U. S.)

Formerly called *soluble tartar*. Prepared by adding cream of tartar to a hot solution of carbonate of potassa. The crystals contain no water of crystallization; they are deliquescent, have a cooling bitterish taste, and are very soluble in water;—not much used at present. Dose, ℥ss. to ℥j.

CREAM OF TARTAR.—(POTASSÆ BITARTRAS, U. S.)

Exists in the juice of grapes, from which it is deposited during the vinous fermentation, because it is insoluble in alcohol. It encrusts the sides of the wine casks, and is detached in the form of thick cakes of a reddish-gray colour, and sold under the name of *argol*. This, when properly purified, assumes the form of white transparent crystals of pure cream of tartar. It is generally kept powdered. Taste acid; soluble in sixty parts of cold water, and in fifteen of boiling water.

*Effects*.—A hydragogue cathartic; also diuretic and refrigerant. Very useful in dropsy; much employed, in combination with jalap, in chronic affections of the joints; and with sulphur in hæmorrhoids. Best given in sweetened water, or as an electuary with molasses;—dose, ℥ss. to ℥j.

ROCHELLE SALTS.—(SODÆ ET POTASSÆ TARTRAS, U. S.)

Made by adding carbonate of soda to cream of tartar. Occurs in large white transparent prismatic crystals of unequal sides; efflorescent; very soluble in water; taste less unpleasant than most of the others. It is one of the best of the saline cathartics. Dose ℥j to ℥iiss.

The *Seidlitz powders* consist of a mixture of ℥ij Rochelle salts,

and ℥ij bicarbonate of soda in one paper, and 35 grs. tartaric acid in another paper; each paper to be dissolved in a separate tumbler, and the two mixed, when effervescence occurs from the escape of carbonic acid, and the patient swallows a mixture of Rochelle salts and tartrate of soda.

#### PHOSPHATE OF SODA.—(SODÆ PHOSPHAS, U. S.)

Prepared by the action of sulphuric acid on bone earth, which consists of carbonate and phosphate of lime; sulphate of lime is thrown down, and superphosphate of lime remains in solution; this is now to be decomposed by carbonate of soda. Occurs in large rhombic transparent crystals; very efflorescent; contain more than 50 per cent. of water of crystallization; taste resembles that of common salt; soluble in water;—dose, ℥j to ℥ij. Particularly applicable to case of children; but not much used on account of its expense.

#### MAGNESIA.

Sometimes called *calcined magnesia*, and *magnesia usta*. Procured by exposing the carbonate to a red heat. A very light white powder; its degree of levity, however, depends upon its amount of trituration, its density being increased by that process; almost insoluble in water.

*Effects.*—A mild and useful cathartic, particularly when there is acidity in the primæ viæ. Its cathartic operation is somewhat uncertain, depending upon the presence of an acid: it sometimes accumulates in the bowels. It is also used in sick headaches, and in nephritic complaints; also, in bowel complaints, combined with rhu- barb. Dose ℥j,—best given rubbed up in syrup.

#### CARBONATE OF MAGNESIA.—(MAGNESIÆ CARBONAS, U. S.)

Prepared by decomposing any soluble salt of magnesia by an alkaline carbonate. Occurs in white cakes, extremely light and porous; insoluble in pure water; somewhat soluble in carbonic acid water.

*Effects.*—A gentle laxative, but dependent for its operation on the acid found in the stomach and bowels; apt to occasion flatulence from the escape of the carbonic acid. Dose, ℥j to ℥ij.

#### SULPHUR.

Used in medicine in the form of *flowers of sulphur*, or common sublimed sulphur washed in water. Odour and taste slight; insoluble in water, and nearly so in alcohol; soluble in oils.

*Effects.*—A mild laxative, but slow in its operation, sometimes griping; it has a decided tendency to the skin, and is thought to act on the bronchial mucous membrane. It is used in constipation at-

tended with piles, in combination with cream of tartar; also, in dyspepsia, chronic rheumatism, chronic catarrhs, and cutaneous eruptions. Dose as a laxative, ʒj to ʒij. Externally, an excellent remedy for scabies, in the form of *sulphur ointment*; also, in the form of vapour and bath. The bath is best in the form of the natural sulphur waters. *Sulphur precipitatum, lac sulphuris, milk of sulphur*—made by boiling together sulphur and lime, and then adding muriatic acid, which precipitates the sulphur in the form of a hydrate; colour nearly white, but darkens by exposure. It has no advantage over the other form.

#### CALOMEL.

As a cathartic, it is indicated in cases where the liver is deficient in action, or secreting vitiated bile. It is slow in its operation, requiring six or eight hours. It is apt to produce nausea and griping some time after being taken, which are no doubt owing to the bile poured out. It is believed to act by being absorbed directly into the vena porta, and so finding its way into the liver. Ordinary dose, 5 to 15 grains, but best to combine it with other purgatives, as rhubarb or jalap. There is a great difference in the susceptibility of different persons to its action. It is one of the ingredients in the *Compound Cathartic Pills*.

#### ENEMATA.

Purgative injections are very useful, particularly to act on the lower bowels, and when there is irritability or inflammation of the stomach. The common *laxative enema* is composed of a tablespoonful of salt, molasses, and lard, each, with a pint of warm water; it may be rendered more active by the addition of castor oil, or the infusion of senna. Turpentine and assafœtida are useful in tympanitis. Cold water alone is frequently employed in constipation. Large quantities of warm water are useful, by the mere distension produced.

### CLASS X.—EXPECTORANTS.

“Medicines which increase or promote the evacuation of the bronchial secretions.” In the healthy condition there is a certain amount of secretion always going on in the air passages, which is removed by evaporation or absorption; but in disease of these organs, there is either an arrest of the natural secretion, or it becomes excessive, and cough results.

Some expectorants are thought to act by producing relaxation, as the nauseating expectorants; others by stimulating the mucous exhalants; some, possibly, by sympathy from the stomach. The nauseating class are alone indicated in cases of inflammatory or febrile excitement; the stimulating, in cases of enfeebled action, or when of long duration.

## NAUSEATING EXPECTORANTS.

The emetics, generally, prove expectorant, in consequence of the relaxation produced; only two, however, are much employed with this view, *tartar emetic* and *ipecacuanha*; the dose of the former is  $\frac{1}{8}$  grain, or of *antimonial wine*, 15 to 25 drops every two hours; the dose of *ipecacuanha* is 1 to 2 grains, or of the wine, 25 to 30 drops.

## STIMULANT EXPECTORANTS.

## SENEKA.—(SENEGA, U. S.)

Root of the *Polygala senega*, indigenous in the United States. A

Fig. 24.



small herbaceous perennial, with alternate smooth leaves. The root consists of a thick, knotty head, with the radicles much twisted, with a projecting, keel-like line. Colour, yellowish-brown externally, whitish within. The cortical portion contains the active principle, named *senegin* or *polygalic acid*. Odour, peculiar; taste, at first sweetish and mucilaginous, then acid. Water and diluted alcohol extract its virtues.

*Effects*.—A stimulant, expectorant, and diuretic; large doses act as an emeto-cathartic; sometimes also produce diaphoresis and emmenagogue effects. Used as an expectorant, when there is no inflammation, in latter stages of bronchitis, humoral asthma, secondary croup, &c. An ingredient in *Coxe's Hive Syrup*.

Dose, 10 to 20 grains; of decoction (℞j to Oiss. water, down to Oj) f℞j to f℞ij, three times a day; of the syrup, f℞j.

## SQUILL.

Already described as a *diuretic*. As an expectorant, it much resembles *senega*, and is used in similar cases. May be advantageously combined with *ipecacuanha* or *tartar emetic*. Dose, gr. j, several times a day; of the *vinegar*, f℞ss. to f℞j; of the *syrup* or *oxymel*, the same dose; of the *tincture*, 20 to 40 drops. *Coxe's Hive Syrup*, (*Syrupus Scille Compositus*, U. S.,) contains equal

parts of squill and senega, together with tartar emetic; much used in croup, catarrh and hooping-cough; dose for a child, 10 drops to fʒj, according to the age.

BLACK SNAKE ROOT.—(CIMICIFUGA, U. S.)

Root of the *Cimicifuga racemosa*, sometimes called *cohosh* and *richweed*, an indigenous perennial plant, several feet high, having ternate leaves, and long racemes of white flowers. The root consists of a tuberculated caudex, several inches long, from which numerous slender brittle radicles proceed. Colour, blackish; odour, feeble; taste, bitter and astringent. Virtues to boiling water; strongest when fresh.

*Effects.*—A general tonic and stimulant to the secretions, especially of the lungs, skin, and kidneys. In very large doses, it seems to affect the brain. Used in rheumatism, hysteria, and pulmonary disorders; also an excellent remedy in chorea. Dose of *decoction*, (ʒj to Oj water,) a teacupful, several times a day.

GARLIC.—(ALLIUM, U. S.)

Bulb of the common garlic, *Allium sativum*. It is about an inch in diameter, flattened, is covered by a membrane, and consists of several small conical bulbs, arranged round a common stem, called *cloves*. Odour, strong; taste, acrid and bitter, depending on a volatile oil, which is of a yellow colour, extremely acrid and irritating. The expressed juice is the best for internal use; to be given mixed with sugar. Dose, fʒss. to fʒj.

Used in chronic catarrhs, asthma, &c. Sometimes employed externally as a poultice to the feet of children.

ASSAFŒTIDA.

As an expectorant, a good deal resembles *garlic*. A valuable remedy in coughs of a nervous character, as hooping-cough, spasmodic asthma, infantile coughs, and coughs of old people. Dose, 5 to 15 grains, given in pill or emulsion.

AMMONIAC.—(AMMONIACUM, U. S.)

Inspissated juice of the *Dorema ammoniacum*, an umbelliferous plant of Persia. Found in *tears* and in *masses*; the former is the purest; occurs in pieces of various size, spheroidal; of a reddish-yellow colour externally; brittle when cold; of a resinous fracture. The masses are of a darker colour, and contain many impurities. Odour, peculiar, increased by heating it; heat softens, but does not melt it; taste, bitter, nauseous, and acrid; chemically, a gum-resin and volatile oil, partially soluble in water and in alcohol; forming, with the former, a milky emulsion, and with the latter, a clear tincture.

*Effects.*—Similar to those of assafœtida, and the other fetid gum-resins. Used chiefly as a stimulant expectorant, in chronic enfeebled cases. Dose, 10 to 30 grains.

*Pillulæ Scillæ Compositæ*, (U. S.)—Contain squill, ammoniac, ginger, and soap; dose, 5 to 10 grains, several times a day.

Externally applied, ammoniac causes irritation of the skin. Used sometimes as a plaster.

#### BALSAM OF TOLU.—(TOLUTANUM, U. S.)

Product of the *Myrospermum Toluiferum*, or *Myroxylon Tbluiferum*, growing in S. America.—Procured by making incisions into the tree. When first procured, it is of a soft tenacious consistence, but becomes hard and darker by exposure; odour very fragrant; taste, pleasant and sweetish; inflames by heat; soluble in alcohol, ether and the fixed oils; boiling water extracts its benzoic acid; chemically, it consists of benzoic acid, volatile oil, and resin. The acid may be separated by sublimation. It is used in making the *paregoric elixir*.

*Effects.*—A stimulant expectorant; used in chronic pulmonary complaints; a pleasant adjuvant to cough mixtures; dose, 10 to 30 grs. The *tincture* and *syrup* are officinal; the latter used to flavour cough mixtures.

#### BALSAM OF PERU.—(MYROXYLON, U. S.)

Product of the *Myroxylon Peruiferum*, or *Myrospermum Peruiferum*, growing in S. America.—Believed to be procured by boiling the young branches; supposed by some, that both the balsams are the product of the same tree, one being obtained by exudation, the other by decoction. A thick viscid fluid, resembling molasses; colour, dark reddish-brown; odour fragrant, less pleasant than that of Tolu; taste, warm, bitter, and pungent; inflammable; yields its benzoic acid to boiling water; chemical composition, the same as that of Tolu.

*Effects.*—A warm stimulating expectorant and tonic, adapted to the same cases as the preceding; used sometimes externally to indolent ulcers. Dose, f3ss.

### CLASS XI.—EMMENAGOGUES.

“Medicines which promote the menstrual discharge.” It is questionable whether there are any medicines which *specifically* affect the uterus; most of them seeming to act by contiguous sympathy. As amenorrhœa is sometimes a primary disease, and sometimes the result of other causes, the treatment must, in the first place, be directed to the restoration of the constitution to a natural state: in plethoric cases, depletion will be required; in the relaxed, a tonic course. Emmenagogues are usually most efficient, when given just before the expected period of the discharge.



## SAVINE.—(SABINA, U. S.)

Leaves of the *Juniperus sabina*, an evergreen shrub, indigenous to Europe, and cultivated in the United States. It resembles in appearance the red cedar. As found in the shops, the leaves are of a greenish colour, strong heavy odour, and bitter and acrid taste; active properties depend on a yellow volatile oil.

*Effects.*—A stimulant to the secretions generally; overdoses are very irritant, and even poisonous; by some highly esteemed as an emmenagogue; its use very dangerous in pregnancy, in consequence of the irritation or inflammation of the uterus produced, bringing on abortion. It is not believed to have the power of directly exciting uterine contraction. Dose, 5 to 20 grs.; of the oil, 2 to 5 drops, three times a day; acts as a rubefacient, when applied to the skin.

Most of the drastic cathartics will prove emmenagogues, probably through the sympathy existing between the bowels and uterus. The two most employed, are *aloes* and *black hellebore*. Aloes is one of the most efficient remedies in amenorrhœa, particularly when combined with iron and assafœtida. It is contra-indicated, in cases of inflammation or hæmorrhoids. Dose, 1 or 2 grs., two or three times a day.

**BLACK HELLEBORE**—an uncertain emmenagogue, as found in the shops; usually given in the form of tincture; dose, fʒss. to fʒj, two or three times a day.

**GUALIAC** is by many highly recommended in amenorrhœa. Dr. Dewees praises it also in dysmenorrhœa. Best given either in the form of *tincture*, or *ammoniated tincture*; dose, fʒj, three times a day.

**SENEKA** is also esteemed emmenagogue by some writers; it is a general stimulant to the secretions, and may sometimes promote menstruation.

**CANTHARIDES** will often produce a decided emmenagogue effect; indicated only in cases of enfeebled action; never in cases of inflammation. Dose of tincture, 10 to 30 drops, three times a day. A blister to the sacrum will sometimes have the same effect.

The *Preparations of IRON* are perhaps the most certain of all the emmenagogues; they are more employed than the others; the *sub-carbonate*, or the *sulphate*, usually preferred. They are particularly indicated in cases of chlorosis; never in plethora; often combined with aloes.

## CLASS XII.—SIALOGOGUES.

“Medicines which promote the secretion of the saliva.” Some articles effect this, when taken internally, as antimony, silver, nitro-muriatic acid, iodine, and especially mercury; others produce it by a topical or local action, as mustard, ginger, tobacco, &c. As re-

medies, they are employed in paralytic affections of the tongue and throat; in diseases of the tonsils or salivary glands; sometimes as revulsives from neighbouring organs, as in toothache and earache. They are also called *masticatories*. They are all described under other heads.

### CLASS XIII.—ERRHINES.

“Substances which promote the nasal secretion.” As they generally excite sneezing, they are also termed *sternutatories*. They all act by direct application; and nearly any foreign substance applied to the mucous membrane of the nose will produce this effect. They are used as revulsives in amaurosis, chronic ophthalmia, &c.; also in syncope; also to promote the discharge of accumulated mucus, and of foreign bodies. The most powerful errhines, are tobacco, ammonia, euphorbium, and veratria.

### CLASS XIV.—ECBOLICS.

“Medicines which excite the uterine contractions, and thereby expel its contents.” They differ materially from emmenagogues in possessing the specific influence over the contractile powers of the womb. They are useful, not only in aiding the expulsion of the fœtus, but also in throwing off clots, hydatids, &c., from the uterus. The only unequivocal ecbolic is

#### ERGOT.—(ERGOTA, U. S.)

*Spurred Rye*.—A diseased product of the *Secale cereale*, or common rye, caused by a fungous parasite,—in the form of numerous sporidia, visible by the microscope. This fungus, when lodged upon any of the *grasses*, will produce the diseased condition of the seed called *ergot* or *spur*. Rye grown upon poor and wet soils is most subject to it. Occurs in spurred grains from half an inch to an inch in length, cylindrical, tapering and curved like a cock’s spur; colour, externally purplish-brown; internally, dull white; odour, in mass, resembling that of putrid fish; taste, acrid and unpleasant;—virtues to boiling water and alcohol.

*Effects*.—In the ordinary dose it produces no perceptible effects on the male system; but on the female it produces decided uterine contractions, particularly in the impregnated condition; and these contractions are of a *tonic* nature. It also sometimes produces nausea, giddiness, and stupor, indicating a narcotic influence.

Ergotized grain, used for a length of time, has been known to produce fatal effects—such as dry gangrene, typhus fever, and convulsions.

*Uses*.—Chiefly to facilitate labour; but *only* when the delay arises simply from a want of contractile power of the uterus;—also

to aid in the expulsion of the placenta, and of clots, hydatids, and polypi;—also in uterine hemorrhage.

Dose of powder, ℥j, —to be repeated if necessary. *Infusion*, made with ℥j of ergot to f̄iv boiling water; dose, one-third. *Vinum Ergotæ*, U. S.,—dose, f̄3j to f̄3iij. Ergot should not be kept in the powdered state.

### CLASS XV.—EPISPASTICS.

“Medicines which, when applied to the skin, produce a blister.” Called also *vesicatories*. The rubefacients will also blister if applied for a sufficient length of time.

*Effects*.—They act as general stimulants to the system; and are useful in typhoid cases; they will sometimes set aside a paroxysm of intermittent or remittent fever, by virtue of the powerful impression produced. They are powerfully revulsive, and are used in diseases of the internal organs. It is advisable not to employ them in the very height of inflammatory diseases, lest the excitement should be increased. They produce local depletion by the serous discharge which they occasion. They also do good in certain cases, by substituting their own action, which spontaneously subsides, for some morbid action in the part, as in obstinate herpes, &c. They are also employed for their local stimulant action; for the pain which they cause, in hypochondriasis; and to procure a denuded surface for the endermic application of medicines.

#### SPANISH FLIES.—(CANTHARIS, U. S.)

The *Cantharis vesicatoria* is an insect from six to ten lines in length, by two or three in breadth, of a shining green colour. They abound in the South of Europe, and are collected in the summer by shaking them from the trees in which they lodge, and letting them fall into large cloths, which are plunged into hot vinegar and water, for the purpose of destroying the insects: they are then perfectly dried in the sun, and put into cannisters. Odour, strong and peculiar; taste, acrid and burning; colour of powder, grayish-brown, with fragments of shining green. Should not be kept in the powdered state, as it is very apt to attract moisture and decompose. Apt to be attacked by insects; virtues to water and alcohol. Contain a peculiar crystalline principle called *cantharidin*.

*Effects*.—Internally, a diuretic and emmenagogue; externally, it forms the best epispastic. The following are its preparations:

*Ceratum Cantharidis*, (U. S.)—*Blistering plaster*. Made by mixing together yellow wax, rosin, lard, and powdered flies. This is the preparation used for spreading blisters. Soft leather, muslin, or paper may be employed, and the cerate applied with a spatula, without heat. The shape and size of the blister must be determined

by the part to which it is to be applied. Sometimes a thin gauze is interposed between the skin and cerate, which is thought to prevent the absorption of the active principle. From six to eight hours is sufficiently long to allow a blister to remain on: if vesication has not then taken place, a warm poultice is to be applied. For children, a much shorter time will suffice. The best *dressing* is simple cerate; or, if to be kept discharging, basilicon ointment; if not disposed to heal, a mixture of Goulard's and simple cerate. The strangury, often resulting from the application of blisters is best relieved by an anodyne enema, and the free use of diluents.

*Unguentum Cantharidis*, (U. S.)—Used only for dressing blisters, to maintain the discharge.

*Emplastrum Picis cum Cantharide*, (U. S.)—*Emplastrum calefaciens*, or *warming plaster*. Prepared by melting together the cerat. cantharidis with Burgundy pitch. Used as a gentle rubefacient in chronic cases. It sometimes causes vesication, particularly if improperly made.

*Linimentum Cantharidis*, (U. S.)—Made by digesting cantharides in oil of turpentine. A very powerful, prompt, and stimulating liniment, and vesicant. Used sometimes in typhus fever.

Other species of the *Cantharis* possess vesicant properties, particularly the *C. vittata* or *potato-fly*, which is indigenous. It is smaller than the preceding, but resembles it in all its medicinal properties.

## CLASS XVI.—RUBEFACIENTS.

“Medicines which cause inflammation of the skin, when applied externally.” The indications for their use, as well as the principles of their operation, are very much the same as those of epispastics. The latter are preferred when a slow and stimulant effect is desired; the former, where the impression is to be sudden and transient. Rubefacients cannot deplete like blisters; they are likewise inferior in their power of breaking up morbid associations, as in intermittents. As revulsives, rubefacients are most useful in spasms and nervous irritations; blisters, in local inflammations.

### BURGUNDY PITCH.—(PIX ABIETIS, U. S.)

Product of the *Abies communis* or *Norway spruce fir*, a lofty evergreen, native of northern Europe. Procured by stripping off the bark, under which it concretes in large masses; then melting in boiling water, and straining. A spurious pitch is manufactured out of rosin and common pitch.—It is hard, brittle, and of a yellowish brown colour, of a weak terebinthinate odour and taste; usually contains many impurities. Used in the form of *plaster* to the skin, where it produces a mild rubefacient effect. In some persons it

brings out a pustular eruption. The *pitch plaster*, made by spreading the melted pitch on soft leather, is used in chronic pulmonary and rheumatic complaints, &c.

CANADA PITCH.—(PIX CANADENSIS, U. S.)

Product of the *Abies Canadensis* or *Hemlock spruce*, a native of Canada and the Northern States. The pitch, sometimes called *hemlock gum*, is a spontaneous exudation on the old trees; it is scraped off, boiled in water, and strained. It is hard and brittle, of a dark brownish colour, and feeble odour; heat softens and renders it adhesive. Uses, and mode of application, the same as the former.

SOLUTION OF AMMONIA.—(LIQUOR AMMONIÆ, U. S.)

Prepared by saturating water with gaseous ammonia; found in the shops of different strengths. Applied to the skin, it produces a rubefacient, or even epispastic effect very speedily; usually employed in combination with olive oil, in the form of *Linimentum ammoniacum* or *Volatile liniment*,—made in the proportion of half an ounce of aq. ammonia to two ounces of oil; an excellent mild rubefacient in rheumatism and catarrh, especially of children; may be farther diluted if too powerful.

*Granville's antidynous lotion*, made by mixing the strongest liquor ammonia with oil of rosemary and tinct. camphor; it is a very powerful application, and will cause vesication in a few minutes; used in neuralgia, &c.

MUSTARD.—(SINAPIS, U. S.)

Product of two different species, viz.: *Sinapis alba* and *Sinapis nigra* (figs. 25, 26), natives of Europe. Two kinds of seeds are found, the *white* and the *black*; the former are of a light yellowish colour, and globular; the latter are smaller, of a dark brown colour, externally, and whitish within. They have no odour when whole; yield a yellow powder, which is decidedly odorous when moistened; taste, hot, pungent, and bitter; strongest in the black; the outer coating of both is mucilaginous; both yield a mild fixed oil, on pressure. The active principle of the black mustard is a volatile oil, which does not pre-exist in the seed, but is developed by the reaction of water upon two organic principles, named *sinapisin* and *myrosyne*. In the white mustard, the active principle is a fixed acrid substance, which does not pre-exist in the seed, but is generated by the reaction of water on *sulpho-sinapisin* and *myrosyne*.

Swallowed whole, the seeds are stomachic and laxative, and are used in dyspepsia. The powder, in small doses, is stimulant; in large quantities, emetic. Externally applied, it is an active rubefacient, and is much used under the form of mustard poultice, or *sinapism*,—made by simply stirring up the powder with warm

Fig. 26.

Fig. 25.



water; flour may be added to dilute it. It should not be allowed to remain on longer than from 15 to 30 minutes; never to produce vesication. Care should be taken not to leave it too long on persons insensible to pain, lest ulceration and sloughing result.

**OIL OF TURPENTINE** is a powerful rubefacient; used by saturating a flannel and applying it to the skin; sometimes produces a violent inflammation and eruption on the skin.

**CAYENNE PEPPER** may be advantageously used as a rubefacient, by heating it in spirits, and rubbing it over the surface; particularly applicable in the low forms of disease.

## CLASS XVII.—ESCHAROTICS, OR CAUSTICS.

“Substances which cause a slough by destroying the life of the part to which they are applied.” Some of them act directly, others indirectly, through chemical agencies. Used to form issues or running sores, to repress fungous granulations, to change the character of diseased surfaces, and to open abscesses. The *hot iron*, or *actual cautery*, is the most powerful escharotic; not so much employed at present as formerly; occasionally used to arrest hemorrhage.

The *moxa* is a modification of the actual cautery; it consists of small rolls of muslin soaked in a solution of chromate or nitrate of potassa, and dried. When used, one end is set on fire, and the other placed on the skin. It acts as a powerful revulsive; useful in deep-seated pains, paralysis, disease of spine, &c.

### LUNAR CAUSTIC.—(ARGENTI NITRAS, U. S.)

Made by dissolving pure silver in diluted nitric acid, evaporating, melting, and running into moulds. It occurs in cylindrical pieces, enveloped in paper to protect it from the light, which decomposes it. Colour, grayish-white; taste, austere and metallic; very soluble. As a caustic, it acts through its chemical affinities for the albumen of the tissue. It is a safe and excellent escharotic; particularly useful to change the character of unhealthy ulcers, whether common or spe-

cific; the best application for ulcers of the cornea; also to inflamed tonsils. Sometimes a concentrated solution is preferred. The weak solution is an admirable stimulant application, as already noticed under the head of *Tonics*.

#### POTASSA, U. S.

*Common caustic, Lapis infernalis.*—Chemically a *hydrate of potassa*; made by adding quicklime to a solution of carbonate of potassa, and evaporating the resulting solution to a proper consistence, and then pouring into proper moulds. Occurs in cylinders of a gray colour; very deliquescent; powerfully alkaline; very soluble. A more powerful caustic than nitrate of silver; apt to extend its effects, and consequently not so safe; used chiefly to form issues, which is best effected by rubbing a moistened stick of potassa over a piece of sticking plaster, applied to the skin, and having a hole in it of the size of the intended issue; sometimes used also to open abscesses, and to destroy poisoned surfaces. The strong *solution* sometimes applied to the spine in tetanus.

#### DRIED ALUM.—(ALUMEN EXSICCATUM, U. S.)

Commonly named *burnt alum*; prepared by heating alum until deprived of its water of crystallization; a dull-whitish powder; a mild escharotic; used to repress fungous granulations.

#### SULPHATE OF COPPER.

Usually applied in the solid form; in which state it forms the best remedy in *granulated conjunctivitis*. A strong solution, useful in *cancrum oris*; the weaker solution a good stimulant,—as mentioned under the head of *Tonics*.

#### ARSENIC.—(ACIDUM ARSENIOSUM, U. S.)

Procured in smelting the ores of arsenic; of a milk-white colour; vitreous fracture; transparent within, but becomes opaque on exposure; has no odour; taste, faintly sweetish; powerfully poisonous; soluble in water and alcohol. A dangerous escharotic from liability to absorption; used chiefly in cancerous sores; also in lupus and onychia maligna; should always be very much diluted before applying it.

#### CORROSIVE SUBLIMATE.

A powerful escharotic in the undiluted state, but seldom thus employed. A weak solution used as a gargle in venereal sore throat, and as a lotion in chronic skin diseases; recommended in onychia maligna, mixed with equal parts of sulph. zinc. More fully described under the head of *Mercury*.

The *Mineral acids* are all powerfully caustic in the undiluted form; not used as such, however, but employed, sufficiently diluted, as stimulant washes to indolent ulcers.

## CLASS XVIII.—EMOLLIENTS.

“Medicines which soften and relax the skin, when externally applied.” They diminish the pain and tension of inflamed parts, often assisting in producing resolution; or if too far advanced for that, they aid the suppurative process. Their action is believed to be purely mechanical. They all owe their efficacy to moisture; in fact, *water* is, by some, considered the only emollient; a temperature above 62° F. is requisite; aqueous vapour still more emollient than warm water. The usual method of applying emollients is by cataplasm, of which the best is that made from flaxseed meal. Nearly all the *demulcents* have an emollient effect when externally applied.

## CLASS XIX.—DEMULCENTS.

“Substances of a bland unirritating nature, capable of forming a viscid solution with water.” They are closely allied to emollients; in fact they produce the same effect upon the internal passages as the latter do upon the skin. They consist chiefly of gum, sugar, oil, or starch, and are useful both as adjuvants to other acrid or irritating medicines, and also, when given alone, to defend inflamed or irritated surfaces, with which they come into direct contact, as the stomach and bowels,—when they may be given either by the mouth, or by enema. Also very much used in inflammations and irritations of parts on which their action must be indirect, as in bronchitis and urinary disorders; in the latter instances, they probably act by being absorbed. Several of the demulcents are much used as articles of diet for the sick.

## GUM ARABIC.—(ACACIA, U. S.)

Product of several species of *Acacia*, especially the *A. vera*, *A. Senegal*, and *A. Arabica*. They are

Fig. 27.



growing in the deserts of Arabia, Africa and India. The gum exudes spontaneously and by incisions. The varieties are as follows:—1. *Turkey gum*, imported from the Levant; comes in small irregular fragments, either whitish, or very light yellowish red: among these are larger round pieces with numerous cracks; brittle, and completely soluble in water. 2. *Gum Senegal*, from the western coast of Africa; larger fragments, darker colour, less brittle, of a conchoidal fracture. 3. *Gum Barbary*, from the northern



part of Africa; has a dark colour, apt to contain impurities, less abundant than the others. Guerin has discovered three distinct principles in gum:—1. *Arabin*—found in pure gum arabic, and which is completely soluble in water. 2. *Bassorin*—found in Bassora gum; characterized by swelling up considerably in water, but not dissolving. 3. *Cerasin*—found in the gum of fruit trees; distinguished by being converted into arabin by the action of boiling water.

*Uses*.—Chiefly as a demulcent, in pectoral affections, diarrhœa, and dysentery; an ingredient in most cough mixtures; also in pharmacy, in the compounding of pills. *Mucilage* for drink is made by dissolving ℥j in Oj of water.

#### TRAGACANTH.—(TRAGACANTHA, U. S.)

Product of several species of *Astragalus*, particularly of *A. verus*,—small thorny shrubs growing in Persia and Asia Minor. The gum exudes spontaneously. Occurs in irregular, tortuous pieces, of a dirty yellowish colour; translucent, resembling horn; hard, but difficult to pulverize; consists chiefly of *bassorin*; swells up, but does not dissolve in water,—forms with it a paste. A demulcent,—used chiefly in the preparation of troches.

#### SLIPPERY ELM BARK.—(ULMUS, U. S.)

Inner bark of the *Ulmus fulva*, a large indigenous tree. It is stripped off in pieces several feet in length, and folded longitudinally. Colour tawny; texture fibrous; odour peculiar; taste sweetish, peculiar and mucilaginous. It is a good demulcent, and is used in dysentery, &c., also nutritious; generally given in infusion. The powder may be employed by simply stirring in boiling water, and made of any thickness, and flavoured according to the taste. A poultice made from the powder forms an excellent emollient application to the inflamed skin.

#### FLAXSEED.—(LINUM, U. S.)

Seeds of the *Linum usitatissimum*, or common flax. They are about a line in length, oval, of a brown colour, and glossy. The cuticle abounds in mucilage; the interior contains a fixed oil which is procured by expression, and called *Linseed oil*—much used in the arts. The mucilage is obtained by infusing the seeds in boiling water; not proper to boil them, since the oil would then be extracted, which is unpleasant to the taste;—proportions, ℥j to Oj water, flavoured with lemon juice and sugar;—much used in pectoral and bowel affections, and nephritic disorders. The ground seed forms with hot water an excellent emollient poultice.

## IRISH MOSS.—(CHONDRUS, U. S.)

Usually called *Carrageen*;—botanically, *Chondrus crispus*. It grows on the rocks on the northern coasts of Europe,—particularly Ireland; also in this continent. Consists of a flat cartilaginous frond, several inches long, curled, and of a yellowish colour;—odour, feeble; taste, slight; insoluble in cold water, but soluble in boiling water;—contains starch, pectin and other matters. A nutritive demulcent, used in pectoral complaints, dysentery, nephritic disorders, &c. Decoction, made by boiling ℥ss. in Ojss. to Oj. Made also in the form of a jelly, properly flavoured, as an article of diet.

## ICELAND MOSS.—(CETRARIA, U. S.)

Botanically, *Cetraria Islandica*, (*Lichen Islandicus*); grows in the northern parts of both continents,—inland. It is from 2 to 4 inches long; dry, coriaceous, and smooth; deeply channelled; of a grayish white and brown colour; no odour; of a bitter, mucilaginous taste; soluble in boiling water. It contains a bitter principle, which renders it slightly tonic as well as demulcent;—the bitterness may be removed by weak alkaline solutions. Used in chronic pectoral affections, attended with debility; also in chronic diarrhœa and dysentery. Decoction made by boiling ℥j in Ojss. of water down to Oj.

## LIQUORICE ROOT.—(GLYCYRRHIZA, U. S.)

Root of the *G. glabra*, growing in the south of Europe, having a round, tough, and pliable root. As found in the shops, it is in long pieces, varying from a few lines to an inch in thickness; of a yellowish-gray colour externally; yellow within; taste sweet and somewhat acrid. It contains a peculiar saccharine principle called *glycyrrhizin*, which differs from sugar in not undergoing the vinous fermentation: it also contains some starch, and a resinous acrid matter. A good demulcent,—used chiefly as an adjuvant with other acrid medicines. Decoction, made with ℥j to Oj water. The powdered root used for sprinkling over pills.

*Liquorice*—*Extractum glycyrrhizæ*, (U. S.),—made by evaporating the decoction. The best is imported from Calabria. Comes in black flattened cylinders, about an inch in diameter, shiny when broken; of a sweet taste;—much used in cough-mixtures and lozenges.

## BARLEY.—(HORDEUM, U. S.)

Prepared for medicinal use by cleaning the grain, and rounding and polishing in a mill; it then constitutes *pearl barley*. It is in

small white oval grains, with a dark longitudinal furrow on one side. Consists of starch, gum, sugar, and gluten;—apt to become musty by long keeping. Virtues yielded to boiling water.

*Barley Water*—(*decoctum hordei*)—made by washing 3ij barley in cold water; then boil for ten minutes in a small quantity of water; throw away this water, and add Oij boiling water, and boil down to Oj;—an excellent drink in inflammatory and febrile affections;—may be flavoured with lemon juice and sugar.

#### ARROW ROOT.—(MARANTA, U. S.)

Product of the *Maranta arundinacea*, growing in the West Indies, and Central America; also in Florida. The root is perennial and tuberous, and is prepared for use by first washing, then beating into a pulp, and thrown into water, and stirred, so as to separate the fecula; it is then strained through a sieve and allowed to dry. The best is imported from Bermuda. It is a white, light powder; no odour nor taste; chemically, a pure starch; often adulterated with potato starch; can only be distinguished by the microscope.—A nutritious demulcent, particularly adapted to children as an article of diet, also in bowel affections. Given, by first forming a paste with cold water, and then adding this to boiling milk or water.

The *Canna root*, or *Tous-les-mois*, is very similar to the arrow root: it comes also from the West Indies.

#### TAPIOCA, (U. S.)

Fecula prepared from the root of the *Jatropha manihot*, or *cassava plant*,—a native of the West Indies and tropical America. The root is large, fleshy, and tuberous. There are two varieties, the sweet and the bitter. The latter contains an acrid poisonous principle; still, it is the one most cultivated for tapioca, since its poisonous principle, being volatile, is dissipated by heat. The juice being expressed from the root, deposits its starch on standing, and is then dried by exposing it to heat. It is in irregular, hard, white, rough grains, with little or no odour and taste. Prepared for use by boiling in water, which converts it into a sort of jelly. Used exclusively as an article of diet; may be flavoured to suit the taste;—brandy or wine may be added in cases of debility, or irritability of stomach.

#### SAGO, (U. S.)

Product of the *Sagus Rumphii*, or *sago palm*, indigenous in the East Indies, growing about 30 feet high. The sago resides in the

Fig. 28.



pith of the trunk ; this is agitated in water, to which it imparts its starch ; this subsides, and is passed through a sieve, when the farina is deposited on standing, and then dried ; this is *common sago*. It is in grains of unequal size, of a yellowish colour. The finest kind, called *pearl sago*, is refined by the Chinese ; it is in small round grains, whitish, hard, and sometimes translucent, with no odour, and a slight taste. It consists almost entirely of pure starch ; insoluble in cold water ; requires long boiling.—Uses and modes of preparation, the same as tapioca.

#### CLASS XX. — DILUENTS.

“Mild liquids which dilute the contents of the stomach and bowels ; and which, entering the blood-vessels, renders the blood thinner, and, at the same time, dilute the secretions.” Water is the only liquid, strictly speaking, which can be used for these purposes ; water is, in fact, the great diluent of nature. The additions which are usually made, are for the purpose of imparting flavour, or rendering it more nutritive. Diluents are useful in inflammatory diseases,—in cases of acrid poisons,—as adjuvants to emetics, &c., also to restore a proper degree of fluidity to the blood. The demulcents form the best diluent drinks.

#### CLASS XXI. — ANTACIDS.

“Medicines which combine with and neutralize acids.” Their action is entirely chemical. Although all salifiable bases are antacids, the only ones employed remedially are the alkalies, alkaline earths, and alkaline carbonates. They do good by removing excess of acid in the stomach and bowels, which is frequently the cause of disease, as colic, diarrhœa, &c. They are also useful in the uric acid diathesis, where there is a tendency to gout and gravel.

#### MAGNESIA.

One of the most valuable of the antacids ;—very powerful, in consequence of its low combining number ; used extensively in the colics and diarrhœas of children, either alone, or combined with rhubarb or calomel ; also in sick-headaches, gout and gravel. Dose, gr. x to ʒj. The *carbonate* is given in double the dose.

## CARBONATE OF SODA.—(SODÆ CARBONAS, U. S.)

Procured from the ashes of sea-weeds, in the impure forms of *kelp* and *barilla*; generally manufactured from the sulphate, by decomposing it with carbonate of lime. It is in large, rhomboidal crystals, efflorescent, very soluble in water; taste alkaline; unequal in strength. Dose, 30 to 60 grs.;—of the dried salt, 10 to 30 grs.

## BICARBONATE OF SODA.—(SODÆ BICARBONAS, U. S.)

*Supercarbonate of Soda*.—Prepared by passing carbonic acid gas through a solution of the carbonate, and crystallizing at a low heat. Usually occurs as a white powder, and contains some sesquicarbonate;—not so soluble as the carbonate, but less disagreeable to the taste. Given in dyspepsia, &c.; also used in making soda and seidlitz powders. Dose, 3ss. to ʒj.

## CARBONATES OF POTASSA.

Already spoken of under *Diuretics*. As antacids, the *carbonate* is given in the dose of 10 to 20 grains; the *bicarbonate*, in from 20 to 40 grains. The *infusion of hickory ashes* is sometimes used as an antacid: it owes its efficacy to the carbonate of potassa which it contains.

## LIME.—(CALX, U. S.)

Used medicinally only in solution, under the name of *lime-water* (*aqua calcis*);—made by dissolving lime in water, and keeping it in well-stopped bottles, with a portion of lime undissolved, in order that it may be always saturated. It is colourless, of an alkaline taste and reaction; combines with the carbonic acid of the air, and forms a pellicle of the carbonate. Used generally in combination with fresh milk, as a remedy for irritable stomach,—a tablespoonful of each, taken every half hour. Externally, in combination with linseed oil, as a liniment for burns.

The *carbonate* is used internally in the form of *Prepared chalk*, and *prepared oyster shells*. Prepared chalk, (*Creta preparata*), occurs in the form of small, white, conical masses, insoluble in pure water, somewhat soluble in carbonic acid water. It is astringent as well as antacid, and is very useful in diarrhœas accompanied by acidity—particularly in children; dose, 10 to 30 grains, every hour or two. The *Chalk mixture* (*Mistura Cretæ*), is made by rubbing up chalk with sugar and gum, and adding cinnamon-water. Chalk is sometimes applied externally as an absorbent.

*Prepared oyster shells* (*Testa preparata*), are made from the common shells by grinding, &c., as for prepared chalk. They differ from it only in containing a little animal matter.

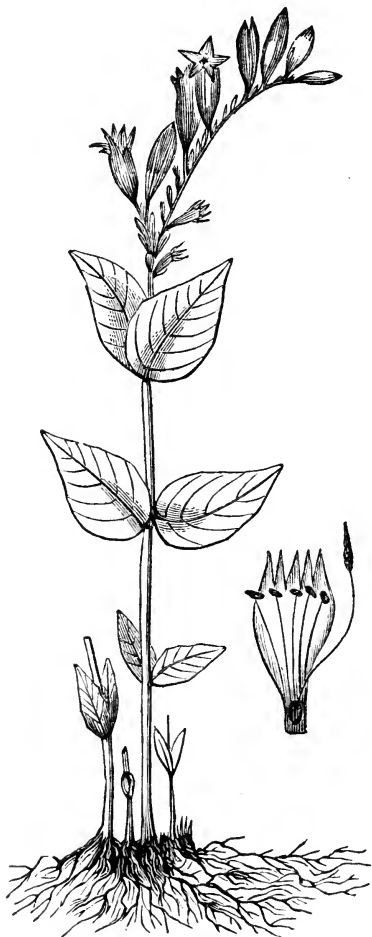
*Uses*.—The same.

## AMMONIA.

A stimulant antacid, given in aqueous or alcoholic solution. The *Aqua ammoniæ* or the *Spiritus ammoniæ* are seldom used internally, in the undiluted form. The *Spiritus ammoniæ aromaticus* is an excellent stimulant in languors, faintings, flatulent colic, &c. Carbonate of ammonia is also antacid.

## CLASS XXII.—ANTHELMINTICS.

Fig. 29.



“Medicines which destroy or expel worms from the alimentary canal.” Some act by a direct poisonous influence upon the worms, causing their death; others, by a purely mechanical method; others, again—as the drastic cathartics—through the increased amount of mucous exhalation produced.

PINK ROOT.—(SPIGELIA,  
U. S.)

An indigenous, herbaceous perennial, growing in the Southern States. The root is the officinal part. It consists of numerous branching, wrinkled fibres, attached to a caudex; colour, brownish-yellow externally; odour, faint; taste, sweetish and bitter. It contains a fixed oil, and a peculiar bitter extractive, which is the active principle, and some others. Large doses are cathartic and sometimes narcotic. It ranks high as an anthelmintic, destroying the worms. Given in powder and decoction; dose of powder for a child two to four years old, 10 to 20 grains; often combined with calomel. The infusion, made with ℥ss. to Oj. Often combined with senna, to insure its purgative effect.

## WORMSEED.—(CHENOPODIUM, U. S.)

Seed of the *C. anthelminticum*, or Jerusalem oak, and also of *C. ambrosioides*, indigenous perennial plants, growing throughout the United States. The seeds are about the size of a pin's head; of a greenish-yellow colour; pungent taste; and a peculiar aromatic odour; virtues depend on a volatile oil. They are an excellent anthelmintic; peculiarly adapted to expel the lumbrici of children; best given as an electuary with molasses; to be administered for several successive days, and then followed by a cathartic. The oil is of a light yellow colour, grows darker by time; given in the dose of 4 to 8 drops.

## POMEGRANATE BARK.—(GRANATI RADICIS CORTEX, U. S.)

The bark of the pomegranate root is powerfully anthelmintic; useful in the expulsion of the *tape-worm*; best given in decoction made by boiling ʒij in Oij water, down to Oj; dose, one third, to be taken every half hour.

## PRIDE OF CHINA.—(AZEDERACH, U. S.)

Bark of the root of the *Melia Azederach*, a beautiful tree growing in the Southern States. The bark is most powerful in the fresh state; taste, bitter and nauseous. In full doses, it is emeto-cathartic; overdoses are narcotic. Best given in decoction, repeated for several days, and then followed by a cathartic.

## MALE FERN.—(FILIX MAS, U. S.)

Root of the *Aspidium Filix Mas*, growing in Europe and North America. The root is long, cylindrical, and flexible, covered over with the remains of the leafstalks. As found in the shops, it is very apt to be deteriorated. Colour, externally, brown; odour, feeble, but peculiar; taste, astringent and nauseous. It is slightly tonic and astringent, also anthelmintic; used to expel the *tape-worm*. Not much used at present. Dose of powder, ʒj to ʒiij; of the oil, 30 to 40 drops.

## COWHAGE.—(MUCUNA, U. S.)

Legumes or pods of the *M. pruriens*, a climbing West India plant. The pod is about four inches long, shaped like an *Italic f*, covered over with brown, bristly hairs, which easily separate when handled, and produce intense itching. *Used* by steeping the pods in molasses or honey, and then scraping off with a knife. It acts as an anthelmintic in a mechanical manner,—the spiculæ, adhering to the worms, causing them to loose their hold on the intestine. Dose, of the electuary, a teaspoonful to a tablespoonful, to be given for several successive mornings, and then followed by a cathartic.

## OIL OF TURPENTINE.

Powerfully anthelmintic in large doses; particularly useful in expelling tænia; its purgative operation must be always insured by combining it with, or following it by castor oil. Dose, fʒj to fʒij. In smaller doses, it is very efficacious in removing the ascarides of children, to whom it may be given in combination with castor oil, or else by enema.

## TIN.—(STANNUM, U. S.)

Used in the form of powder, which is prepared by melting tin, stirring while cooling, and then passing through a sieve; believed to act mechanically; used chiefly to expel lumbrici and tænia. Dose, ʒj to ʒij, repeated, and then followed by a brisk cathartic.

## CALOMEL.

An excellent anthelmintic for children; best administered by giving a grain or two every night, or every other night, and following, in the morning, with a dose of castor oil and oil of turpentine. It, no doubt, acts through the agency of the bile which is poured out.

## CLASS XXIII.—MEDICINES NOT CLASSIFIED.

## MERCURY.—(HYDRARGYRUM, U. S.)

In the *metallic state*, it is not believed to act upon the system; but, when swallowed in that state, it very soon is oxidized, and then becomes efficient. The *vapour* from metallic mercury is known to be active, as is seen from its effects on artisans who work in that metal. The effects of mercury on the system may conveniently be considered under the two heads of its *alterative* and its *salivant* operation. When given in very minute doses, and continued for a length of time, it augments all the secretions, causing increased action of the mucous membranes generally; at the same time, the absorbents are stimulated to greater activity, so that under its operation, effused fluids are seen to diminish or disappear, and glandular enlargements are often dispersed. It also usually relaxes the bowels, in consequence of the augmented secretion of their mucous membrane.

In larger doses, mercury acts as a *sialogogue*, producing all the above-mentioned effects, only to a greater degree, and in addition, increased action of the salivary glands, with swelling and soreness of the gums—a train of symptoms denominated *salivation*. The signs of the mercurial sore mouth are the following: slight swelling and tenderness of the gums, particularly when the teeth are pressed together; a coppery taste in the mouth; a peculiar, unpleasant breath, and an increased flow of saliva, which may become excessive.



During this state, the fat is rapidly absorbed, the patient becoming emaciated; the nervous and circulatory systems are excited, and the blood, when drawn, exhibits the same appearance as in inflammation. On some constitutions, mercury produces a sort of poisonous effect, causing great prostration, a small and frequent pulse, with a pallid and contracted countenance. It sometimes occasions an eruption upon the skin of a miliary character, and in some instances, gives rise to profuse sweats. The remedy for these effects is pure fresh air, and a tonic course of treatment. Mercury produces its influence upon the system, in consequence of being absorbed, as is proved by the fact of its being detected in several of the secretions, as well as in the solids.

*Uses.*—(1) *As an alterative.*—In functional disorder of the digestive organs, as indicated chiefly by the appearance of the stools, which are either scanty, dry, and of a clay colour, showing a deficiency of bile, or very copious, liquid, and of a bilious colour, showing a redundancy of bile;—in constipation, which very often depends on a deficient hepatic secretion, or deficient secretion of the intestinal mucous membrane;—in some forms of chronic cutaneous disease—*Dose*,—as an alterative, half a grain, to a grain of calomel, or three grains of blue mass, every night, or every other night, to be followed next morning with a laxative, if the bowels are confined. In acute cases, much smaller doses may be given, and more frequently repeated. (2) *As a sialogogue.*—In fevers, mercury is very useful; chiefly in exciting the secretions. The proper indications for its use are a dry tongue, torpor of the bowels, dry skin, and scanty urine;—an important remedy in typhoid fever; but the *mildest* salivation is only required. In very high grades of fever, it is almost impossible to salivate.—In inflammation, it is a valuable therapeutic agent, acting as a true antiphlogistic or anti-plastic, preventing the formation of coagulable lymph, more particularly where the serous membranes are involved; generally, bloodletting should be premised: it is contra-indicated in inflammations of an erythematous, gangrenous, malignant, or scrofulous character.—In diseases dependent on disordered secretion of the liver, as dysentery, diarrhœa, ascites, &c.—To promote absorption, as in the various forms of dropsies.—To produce what has been termed its revolutionizing effect, in certain specific diseases, especially syphilis, but only in its secondary form; also, in colica pictonum, in which it may be usefully combined with opium. It is contra-indicated in scrofula, phthisis, all malignant diseases, and suppurations. *Dose*, as a salivant, half a grain to a grain of calomel, or 3 to 5 grs. blue pill, three times a day: opium to be added, if it purge. If the stomach be irritable, the mercurial ointment may be rubbed on the insides of the arms and thighs, or applied to blistered surfaces; or fumigations with cinnabar may be resorted to. There is a great difference in the susceptibility of dif-

ferent persons to the salivant action of mercury; it is much more difficult to salivate children than adults. Sometimes the medicine accumulates in the system, and breaks out with great violence.

In producing salivation, the mildest impression is all that is required; excessive salivation is always to be avoided. The treatment for it is to reduce the local inflammation by leeches and blisters, if necessary; astringent and detergent washes of alum, sugar of lead, &c., and opium internally.

#### PREPARATIONS OF MERCURY.

Not, at present, given in the liquid form. When given in the metallic state, it is *extinguished*, by being first rubbed up with different substances, which serve to divide it very minutely, and perhaps, partially to oxidize it.

*Blue Mass*—(*Massa Pillularum Hydrargyri*, U. S.)—Made by rubbing up metallic mercury with conserve of roses;—requires a long trituration. Colour, bluish; becomes darker by exposure; weight of the officinal pill, (called *blue pill*), three grains. Dose, as a sialogogue, one pill, three times a day; as an alterative, one pill, every other night; sometimes given in emulsion.

*Mercury with chalk*—(*Hydrargyrum cum Cretâ*, U. S.)—Prepared by triturating mercury with prepared chalk; colour, bluish-gray; a mild mercurial, particularly useful in the bowel affections of children. Dose, from 1 to 10 grs., three or four times a day.

*Mercurial Ointment*—(*Unguentum Hydrargyri*, U. S.)—Sometimes called *blue ointment*; prepared by rubbing up together mercury, lard, and suet, until the mercury is extinguished; colour, bluish; becomes darker by age; used, by rubbing into the skin; also to blistered surfaces.

*Mercurial Plaster*—(*Emplastrum Hydrargyri*, U. S.)—Made by rubbing up mercury with melted rosin and oil, and then mixing with melted lead-plaster; used to discuss glandular swellings, &c.

*Mild Chloride of Mercury*—(*Hydrarg. Chloridum Mite*, U. S.)—Chemically, a *protochloride*; common name, *Calomel*; made by subliming a mixture of the protosulphate of mercury and chloride of sodium; double decomposition ensues, resulting in the formation of protochloride of mercury and sulphate of soda; crystalline at first; requires to be powdered and washed in water; colour, ivory-white; no taste or smell; insoluble in water or alcohol; incompatibles, alkalies, alk. earths, and sulphurets. Dose, as a sialogogue, gr. ss. to gr. j, three times a day; as an alterative, gr. j, every night, or every other night. *Howard's calomel* is a very fine variety, made by allowing the vapour to come in contact with watery vapour.

*Corrosive Chloride of Mercury*—(*Hydr. Chloridum Corrosivum*, U. S.)—Common name, *Corrosive Sublimate*; chemically, a *bichloride*; made, by subliming a mixture of the bisulphate of mercury

and chloride of sodium. At first, it is in white, semi-transparent masses; soluble in water and alcohol; taste, metallic and styptic; very poisonous; best antidote is albumen; not much used internally; not so liable to salivate as calomel; externally applied, it is escharotic; a weak solution, or ointment is employed in venereal sore throat and cutaneous diseases.

*Black Oxide of Mercury*—(*Hydr. Oxidum Nigrum*, U. S.)—Chemically, a *protoxide*; made by adding calomel to lime-water, or a solution of potash; colour, black; used only as a wash for chancre.

*Red Oxide of Mercury*—(*Hydr. Oxidum Rubrum*, U. S.)—Chemically, a *binoxide*; common name, *Red precipitate*; made by heating the nitrate; occurs in small, shining, red crystals; never used internally; but externally, as a stimulant for old and indolent ulcers; also, for psorophthalmia, in the form of ointment.

*Iodide of Mercury*—(*Hydrarg. Iodidum*, U. S.)—Chemically, a *protiodide*; made by rubbing up mercury and iodine together; colour, greenish-yellow; used in secondary syphilis; dose, one grain, gradually increased.

*Biniodide of Mercury*—(*Hydrarg. Iodidum Rubrum*, U. S.)—Prepared, as the former, with double the quantity of iodine; colour, brilliant red; used as an ointment in skin diseases.

*Red Sulphuret of Mercury*—(*Hydr. Sulphuretum Rubrum*, U. S.)—Common name, *Cinnabar*; found native; made, by heating together mercury and sulphur; colour, fine red; powder is called *vermilion*,—used for fumigation.

*Black Sulphuret of Mercury*—(*Hydr. Sulphuretum Nigrum*, U. S.)—Old name, *Ethiops mineral*; prepared by rubbing sulphur and mercury together in a mortar; colour, black; scarcely ever used at present.

*Yellow Sulphate of Mercury*—(*Hydr. Sulphas Flavus*, U. S.)—Common name, *Turpeth mineral*; made by the action of boiling water on the bisulphate; the yellow subsulphate precipitates; very little used; emetic, in the dose of 5 grains.

*Nitrate of Mercury*—(*Hydrarg. Nitras*, U. S.)—Used only in the form of ointment,—called *citrine ointment*. This is of a fine citron colour, when first made, but spoils by being kept; much used in skin diseases, and as a stimulant to ulcers.

*Ammoniated Mercury*—(*Hydrargyrum Ammoniatum*, U. S.)—Common name, *White precipitate*; made by adding the solution of ammonia to a solution of corrosive sublimate; occurs in white masses, without odour; used only as an ointment for cutaneous diseases.

## IODINE.—(IODINUM, U. S.)

A simple, non-metallic solid, of a bluish-gray colour, and metallic lustre, with a peculiar odour; volatile; sparingly soluble in water; more so in alcohol.

*Effects on System.*—In very small doses, it acts as a general tonic, occasionally increasing the flow of urine, and sometimes producing salivation. If continued for a length of time, it stimulates the absorbents, causing emaciation. If still longer employed, it acts upon the nervous system and digestive organs. In large doses, it is a corrosive poison. Used chiefly to promote the absorption of indurations and enlargements, &c. Probably, the best remedy in goitre, in which it may be employed both internally and externally. Scrofula is another disease in which iodine acts beneficially, particularly in the form of glandular swellings, ophthalmia, abscesses, &c.; also in chronic rheumatism, chronic, cutaneous diseases, and tertiary syphilis. Dose,  $\frac{1}{4}$  to  $\frac{1}{2}$  a grain, but not in substance, on account of its difficult solubility.

*Tinctura Iodini*, U. S.—Contains 30 grs. iodine to fʒj alcohol; not quite saturated; when long kept, it is partially decomposed; dose, 10 to 20 drops, in sweetened water. The tincture used advantageously, externally, in lupus, erysipelas, and other skin diseases, and also in affections of the joints; to be applied by means of a small brush.

*Iodide of Potassium*—(*Potassii Iodidum*, U. S.)—Made by mixing together iron filings and iodine with water, by which iodide of iron is formed; then decomposing with carbonate of potassa. It is in the form of white cubical crystals, somewhat deliquescent; very soluble in water and alcohol; taste, acrid and saline; its aqueous solution has the property of dissolving iodine. It acts on the system very much as iodine, though less energetically;—used in cachectic conditions, particularly in tertiary syphilis; in the various forms of scrofula, rheumatism, &c. Dose, 3 to 20 grs., three times a day. Sometimes it produces some irritation of the bowels, and some vertigo.

*Lugol's Solution of Iodine*—(*Liquor Iodini Compositus*, U. S.)—Made by dissolving ʒij iodide of potassium and ʒj iodine, in fʒvij water; dose, 6 to 10 drops, three times a day, gradually increased. This is an active and excellent preparation, much used by Lugol in the treatment of scrofula.

There are many other preparations of iodine, more or less employed; as the *iodide of lead*; *iodide of sulphur*,—used in the form of an ointment, in certain cutaneous affections; *iodide of zinc*, &c.

*Iodine Ointment*—(*Unguentum Iodini*, U. S.)—Made by rubbing up together iodine and lard.

*Unguent. Iodini Compositum*, (U. S.)—Made like the other,

with the addition of some iodide of potassium: both are used in indolent scrofulous tumours. Iodine is sometimes employed in the form of bath.

ARSENIC.—(ARSENICUM, U. S.)

Probably inert, so long as it retains its metallic state; but very active, as an oxide, or salt.

*Effects.*—In very minute doses, it is tonic and alterative; but, if persisted in, it causes muscular debility and general depression of the system. It acts by being absorbed into the blood, as is proved by its existence in the secretions. In large doses, it is a powerful corrosive poison. Symptoms of poisoning—pain and heat of stomach, pain of throat, vomiting of acrid matters, incessant thirst, prostration, and death. Antidote—the *hydrated sesquioxide of iron*, which acts chemically, forming an insoluble arsenite of iron.—Used chiefly in intermittent diseases; will often cure intermittent fever, when quinine fails; also, in chronic skin diseases, particularly of a scaly character; also, in nodes. Dose of arsenious acid,  $\frac{1}{2}$ th of a grain, three times a day, in pill.

*Fowler's Solution* — (*Liquor Potassæ Arsenitis*, U. S.)—Made by boiling together 64 grs. arsenious acid and carbonate of potassa, each, in fʒxij water, and then adding fʒss. spirits of lavender, to impart a colour. Dose, 10 drops; but often this will be found too much for some constitutions.

The arsenical preparations should be given on a full stomach, and their effects very carefully watched. One of the first symptoms of the system being brought under their influence, is an œdema of the eyelids, which will subsequently spread over the face.



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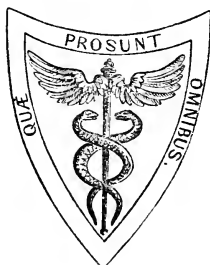
BY  
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PHILADELPHIA:  
LEA AND BLANCHARD.  
1848.

Entered, according to Act of Congress, in the year 1848,  
BY LEA AND BLANCHARD,  
In the Clerk's Office of the District Court for the Eastern District of  
Pennsylvania.

C. SHERMAN, PRINTER,  
19 St. James Street.







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# C H E M I S T R Y.

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## GENERAL OBSERVATIONS.

CHEMISTRY is the science which treats of the laws that relate to chemical attraction.

*Chemical attraction* or *affinity* may be defined to be “the attraction existing between heterogeneous particles.” It is distinguished from *cohesion*, which is “the attraction between homogeneous particles.” Like cohesion, chemical attraction can only be exerted at insensible distances.

Material substances are divided by the chemist into *simple* or *elementary*, and *compound*. The simple bodies are such, as have as yet resisted all efforts to decompose them. Compound bodies are those that may be resolved into two or more elements. The number of simple bodies recognised by chemists has varied very much at different times ; at present it is about *sixty*.

As material bodies are more or less constantly influenced by the imponderable agents, Caloric, Light, and Electricity ; and as these agents, no doubt, modify chemical attraction, it will be proper to commence with a brief description of their properties and effects.

# PART I.

## CHAPTER I.

### IMPONDERABLE SUBSTANCES.

#### SECTION I.

##### CALORIC.

THE term *Heat* is used in two different senses: one signifying the sensation conveyed by a heated body; the other, the material *cause* of heat; this is called *caloric*. The effect of the union of caloric with ponderable matter is to communicate a repulsive property to its different molecules, overcoming its cohesion; and causing, successively, expansion, fusion, and vaporization. Caloric is usually spoken of under the two heads of *sensible*, or that which is evident to the thermometer, and *latent*, or that which is insensible to the thermometer. *Latent heat* may be illustrated by the following experiment:—Mix a pound of water at  $174^{\circ}$ , and a pound of water at  $32^{\circ}$  together; the temperature of the mixture will be the mean of the two, or  $103^{\circ}$ ; but if a pound of snow or ice at  $32^{\circ}$ , be used instead of the water at  $32^{\circ}$ , the resulting temperature will still be only  $32^{\circ}$ , but the ice will have melted. Hence, in this last experiment, as much heat has been rendered latent *in the melting of the ice*, as would have raised an equal weight of water *one hundred and forty-two degrees*. Again, if a vessel containing water be placed over the fire, the thermometer will indicate the constant increase in its temperature up to the boiling point,  $212^{\circ}$ ; *beyond* this point, however, provided the steam escape, the successive portions of heat received by the liquid will be entirely insensible; that is, the additional caloric will be rendered latent. This latent caloric may, however, be proved to exist, or may be rendered *sensible* by conducting the steam into cold water, when it will be found to raise a quantity of water ten times heavier than itself, nearly one hundred degrees; or, if concentrated in one of these parts, the rise of temperature would be nearly 1000 degrees. Hence it follows, that as much heat is absorbed (rendered latent) in producing steam, as would raise the water of which it consists, 1000 degrees, or to about a red heat, if prevented from assuming the aeriform state.



The above law is universal. Whenever a solid body becomes liquid, or whenever a liquid becomes gaseous, a quantity of heat disappears, or is rendered latent; and conversely, when a gaseous body is converted into a liquid, or a liquid into a solid, a corresponding degree of caloric is given out, or rendered free. The amount of latent heat varies much in different substances.

On this principle, the cold produced by the various *frigorific* mixtures is explained; thus a mixture of snow and salt produces a cold of zero, in consequence of the attraction between the salt and water producing liquefaction, and thereby rendering latent a large amount of caloric. A notable depression of temperature is also caused by a simple solution of certain salts in water, as of nitre, sal ammoniac, &c. A striking example of the reverse process, or the rendering latent heat sensible, is afforded in the slaking of lime by water; here, the large amount of heat evolved arises from the water passing into a solid state, in its combination with the lime. Latent heat has hence been denominated the *heat of fluidity*, since it is necessary to maintain bodies in the fluid condition.

#### EFFECTS OF CALORIC.—EXPANSION.

*Expansion* is one of the first effects of caloric. It is caused by the repelling power produced by the caloric upon the particles of the body. As it is opposed to cohesion, it follows that those bodies are most expanded by heat which are least influenced by cohesion; thus gases are more expansible than liquids; and liquids more than solids.

*Expansion in Solids.*—Proved, by accurate measurement before and after heating;—by an accurately fitted metallic plug and ring; if the plug be heated it will be too large for the ring;—the same is shown in heating the tire of a wheel before hooping it;—seen also in the elongation of the metallic bar of the *pyrometer*, by heat.

Of solid bodies, the *metals* are the most expansible. Metals are not equally expansible;—lead is most so; platinum the least. If a thin, straight bar of iron be firmly riveted to one of brass, and then exposed to heat, the brass being more dilatible than the iron, forces the bar into a curve, the convex side of which is brass; if it be artificially cooled, the brass contracts more than the iron, and the reverse of the above effect is produced. The supposed exception to the general law that solids expand by heat in the case of clay, is only an *apparent* one; the *contraction* of this substance as seen in Wedgewood's *pyrometer*, by the action of heat, is due to the shrinking produced by the loss of water.

*Expansion in Liquids.*—Liquids differ from *fluids* in not being elastic;—they are more expansible than solids, as shown by placing an alcoholic and a mercurial thermometer in the same heated sub-

stance; the alcohol will rise much higher in the tube than the mercury. Liquids are not equally expansible; in being heated from  $32^{\circ}$  to  $202^{\circ}$ , alcohol expands  $\frac{1}{9}$ th of its bulk; water  $\frac{1}{3}$ d; mercury  $\frac{1}{5}$ th. The *rate* of expansion in liquids is not uniform,—it increases with equal increments of heat. Exception to the law that liquids expand by heat, in the case of water near the freezing point, which *expands* on being cooled below  $39^{\circ}$ —hence ice swims on water; this expansion is due to a new arrangement of its particles in the act of freezing.

*Expansion of Gases.*—Gases are much more expansible than either liquids or solids;—their *rate* of expansion is uniform, and is the same for all gases, being about 480th of the whole volume for every degree of Fahrenheit.

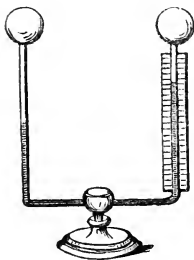
Fig. 1.



*Thermometers* are instruments for measuring sensible heat by means of the expansion and contractions of some fluid. *Sanctorio's* thermometer was the first invented;—it consisted of a glass tube terminating in a bulb, partially filled with air, and the open end plunged into some coloured liquid; the expansion or contraction of the contained air was marked by the depression or rise of the liquid. This thermometer is liable to two objections: the expansibility of air is too great to mark very considerable changes of temperature; and it is liable to be influenced by atmospheric pressure.

*Leslie's differential thermometer* is a modification of Sanctorio's air thermometer; it consists of a glass tube bent at right angles, and terminating in two bulbs. Both bulbs contain air, but the greater part of the tube is filled with a coloured fluid. So long as the same temperature acts upon both bulbs, no change can take place; but the slightest difference between the temperature of the two is detected by the movement of the liquid under the pressure of the air.

Fig. 2.



Liquids are much better suited than gases for thermometers; and of liquids, mercury is the best adapted, on account of the great range between its boiling point,  $656^{\circ}$ , and its freezing point,  $-40^{\circ}$ ; it is also very sensible to the action of heat; and its dilatations between  $32^{\circ}$  and  $212^{\circ}$  are nearly uniform. The essential parts of a thermometer consist of a tube of a uniform small bore, terminating in a bulb; the ball and part of the tube are filled with mercury, and the air expelled by boiling the mercury, and then hermetically sealing the tube. The *boiling point* is ascertained by im-

mersing the bulb in boiling water; the *freezing point*, by immersing it in melting ice. The distance between these two points is marked in various modes; in Fahrenheit's scale, the freezing point is marked  $32^{\circ}$ , and the boiling point,  $212^{\circ}$ ; the intermediate divisions being 180 degrees. In the centigrade thermometer, (Celsius'), the freezing point is zero, and the boiling point  $100^{\circ}$ . In Reaumur's, the freezing point is zero, and the boiling point  $80^{\circ}$ . As the ratio between these three scales is that of 180, 100, and 80, or 9, 5, 4, it is easy to reduce one to the other. The alcoholic thermometer is used when extremely low temperatures are to be measured.

#### COMMUNICATION, OR TRANSFER OF HEAT.

Heat may be communicated to bodies in different modes:—by *contact*, as in the conduction of solids, and the circulation of liquids; by *radiation*, and by *reflection*.

*Conduction of heat.*—By this is meant the passage of heat from one particle of a body to another. This conducting power is very different in different bodies; metals are the best conductors of heat, but not all equally so; gold is the best conductor, lead the worst; glass and porcelain are worse conductors than the metals. Liquids and gases are nearly destitute of conducting power, as may be shown by applying heat to the top of them; the mode of heating them is to apply the heat at the bottom, when, instantly, there are two currents set in motion, the hot particles rising towards the surface, and the colder ones descending: this process is termed *circulation*.

*Radiation of heat.*—That mode by which heat is given off to some distance on all sides, by a heated body, is termed *radiation*; and the heat, *radiant heat*. Heat is emitted from a hot body in all directions, and in straight lines or radii, just as rays of light are emitted from a luminous body. These calorific rays pass freely through the air, or a vacuum, without sensibly affecting its temperature. When they fall upon the surface of a solid body, they may be disposed of in three different ways:—1, they may be *reflected*; 2, they may be *absorbed*; or 3, they may pass through it, or be *transmitted*. In the first and third cases, the temperature of the body is unaffected; in the second case, it is elevated.

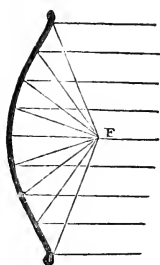
The radiating power of bodies varies very much; it depends chiefly upon the nature of their surfaces, those which are rough and soiled throwing out more heat than those which are smooth and polished; *lamp-black* is the best radiator, *polished metals* the worst. Colour *alone* has no influence upon it.

*Reflection of heat* resembles reflection of light;—familarly shown by holding a sheet of polished metal near the fire at an angle; the heat will be reflected in the corresponding angle; it may be better

Fig. 3.



Fig. 4.



shown by placing a red-hot iron ball in the focus of a parabolic mirror; the calorific rays impinging on the mirror, will be reflected, in straight lines; and if another similar mirror be properly adjusted, many feet distant, these rays may be made to converge again in its focus, so as to affect a thermometer placed there, or even to set fire to phosphorus.

It is a law, that the best radiators are the worst reflectors, and *vice versa*; but the power of *absorbing* heat is in *direct* proportion to the radiating power. The power of absorbing heat has been thought to depend upon the *colour* of the substance; but this has been questioned. The laws of radiation explain the formation of *dew*; the surface of the ground being cooled down after sunset by radiation, the aqueous vapour existing in the air is deposited in the form of dew. If the night be cloudy, however, the rays of heat are intercepted by the clouds which reflect them back, and hence little or no dew is deposited. It is also well known, that the most perfect radiators, such as grass, wood, leaves, &c., are the most covered with dew, while a piece of polished metal, &c., would be scarcely moistened. In the same manner also, the production of the land and sea breezes of tropical islands is accounted for.

*Transmission of heat.*—By this is meant the passage of the calorific rays through certain media. Substances which transmit such rays are called *translucent*, or *diathermanous*; it may easily be shown by interposing a piece of plate glass between a red-hot body and a mirror; while all the rays of *light* will pass through the glass, many of the rays of *heat* will be arrested by it, so that but a very feeble effect is produced at the focus of the mirror. The only substance perfectly diathermanous is *rock salt*; other media, though entirely transparent, intercept the rays of heat to a greater or less extent. It has also been shown that radiant heat, like light, is capable of being *polarized*.

*Vaporization* signifies the conversion of a solid or liquid into a vapour or gas, by heat. Vapours differ from gases only in being easily compressed into a liquid. Vaporization includes both *ebullition* and *evaporation*. In ebullition, the formation of the vapour is so rapid, that it rises to the surface in the form of bubbles, which then burst; the point at which this takes place is called the *boiling point*, and is always constant under the same circumstances; it varies very much for different liquids; thus, for water, it is 212° F.;

for alcohol,  $172^{\circ}$ ; for ether,  $96^{\circ}$ ; for sulphuric acid,  $620^{\circ}$ ; for mercury,  $662^{\circ}$ . The boiling point is chiefly influenced by the degree of pressure to which the liquid is subjected. On the earth's surface the atmosphere exerts a pressure upon every object of 15 pounds to every square inch; this force must be overcome by the elasticity of the vapour of a liquid before it can boil; hence, as the atmospheric pressure varies, the boiling point must equally vary; hence water will boil at a much lower point on a mountain, or in a partially exhausted receiver, than at  $212^{\circ}$ . So constant is the ratio between the depression of the boiling point and the diminution of the atmospheric pressure, that it forms a good method for ascertaining the height of mountains,—a depression of one degree being equivalent to an elevation of about 548 feet. Liquids boil, in vacuo, at a temperature  $140^{\circ}$  lower than in the open air. The influence of diminished pressure in depressing the boiling point of a liquid, is shown in the experiment denominated the *culinary paradox*. A small flask of water is made to boil for a few minutes until the steam freely issues from the orifice; when it is firmly corked. On removing it from the heat, the ebullition of course ceases; but it may be made to commence again by simply applying cold water to the upper part of the flask; the cold condensing the vapour, and thereby diminishing the pressure.

On the other hand, the boiling point may be much elevated by increasing the pressure. In this way, water may be prevented from boiling by the pressure of its own vapour—being confined in a strong metallic vessel. There is no limit to the degree to which water may be thus heated, provided the vessel be strong enough to bear the enormous pressure of the vapour thus generated. It is on this principle that the *high pressure* steam engine acts.

As already mentioned, a large amount of heat is rendered latent, by the production of steam.

A cubic inch of water, in becoming steam, under the ordinary pressure of the atmosphere, expands nearly into a cubic foot.

*Evaporation* differs from ebullition only in being a slower process, and not attended with the appearance of boiling; it occurs at common temperatures;—takes place in all fluids, and some solids, as camphor;—is much more rapid in such as have a low boiling point, as ether and alcohol. Evaporation is influenced by 1, extent of surface; 2, temperature:—heat is favourable to it; 3, hygrometric state of the atmosphere:—dryness favours it; 4, by a current of air; 5, by amount of pressure. The effect of removing the pressure is well seen by putting ether under a receiver, and removing the air; the evaporation is so rapid as to produce ebullition.

Cold is always produced by evaporation, in consequence of the amount of heat which is rendered latent. This is shown by placing a few drops of ether on the hand and exposing it to the air; or

putting ether on the bulb of a thermometer, and noting the depression on the scale. By means of the cold produced by evaporation water may be frozen, by placing it over sulphuric acid in a receiver, and quickly exhausting the air. The same thing is also shown by Wollaston's *Cryophorus* or frost-carrier, which consists of a glass tube of the figure represented in the cut. The bulb contains water,

Fig. 5.



the rest of the space being filled with its vapour. The empty extremity being plunged into a mixture of snow and salt, the solidification of the vapour gives rise to such a quick evaporation from the surface of the water, that the latter freezes.

*Specific heat, or capacity for heat.*—By this is meant the ratio of the heat a body may contain, with the bulk or weight of the body. A simple experiment will prove that different bodies, though exhibiting the same *apparent* temperatures, contain, in reality, very different amounts of heat. Thus, in mixing a pound of mercury at  $162^{\circ}$  with a pound of water at  $100^{\circ}$ , the temperature of the mixture will be  $102^{\circ}$ ; here, the mercury, by losing  $60^{\circ}$ , raises the water  $2^{\circ}$ . But if the water be at  $162^{\circ}$ , and the mercury at  $100^{\circ}$ , the temperature of the mixture will be  $160^{\circ}$ ; in this case, the water, by losing  $2^{\circ}$ , raises the mercury  $60^{\circ}$ . From this it appears that the same heat which would raise water  $2^{\circ}$ , will raise an equal weight of mercury  $60^{\circ}$ , being in the ratio of 1 to 30. By a similar experiment in oil and water, it is found that the ratio between them is that of 2 to 1.

There are three different modes of ascertaining the specific heat of various substances. The first is by observing the quantity of ice melted by a given weight of the substance heated to a particular temperature; the second, by noting the time which the heated body requires to cool down through a certain number of degrees; the third is the method of mixture, just pointed out, and is the one usually preferred.

*Means of producing heat.*—It will suffice here merely to mention them; viz., lenses and mirrors, percussion, friction, condensation, combination, electricity, galvanism, fermentation, and vitality.

## SECTION II.

### LIGHT.

There are two theories of Light: one—the Newtonian—is that

it consists of infinitely small particles, emitted by luminous bodies; the other,—that it depends upon undulations, transmitted through a highly elastic medium of extreme tenuity, called an *ether*, just as sound is produced by the undulations of the atmosphere.

Light travels in straight lines in every direction, with extreme rapidity; it occupies about eight minutes in coming from the sun to the earth, which is at the rate of 200,000 miles in a second.

When a ray of light falls on a plain surface, it may either be absorbed, or reflected, or it may be transmitted through it.

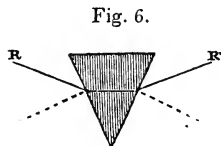
By *reflection* is meant that property which causes a ray of light, striking upon a bright surface, to be thrown back, at an angle which is always equal to the angle of incidence.

*Refraction of light*, is where a ray in passing from one medium into another of different density, is bent from its straight line. Where the ray passes from a rarer to a denser medium, it is refracted *towards* a line perpendicular to the surface of the latter; but when it passes from a denser to a rarer medium, it is bent *from* a line perpendicular to the surface of the denser substance. Different substances possess different degrees of refractive power; generally speaking, the densest substance refracts most; the same is true also of combustible substances.

White light is compound,—that is, it is made up of different coloured rays, as may be proved by admitting a ray of light through a small aperture into a dark room, and interposing a glass prism; it will not only be refracted from its straight course, but will be decomposed into seven differently coloured spaces, forming a figure termed the *solar spectrum*. The upper part of the spectrum is red; the lower, violet; the intermediate portion, commencing with the violet, being indigo, blue, green, yellow, and orange, all gradually shading off into each other. These were termed by Newton the *prismatic* or *primary* colours, from the impression that they were the elements of white light.

Brewster's opinion, which is rather the received one at present, is that there are only *three* primary colours, viz., *blue*, *yellow*, and *red*; and that when these are mixed in definite proportions, white light will result; but that when any of them is in excess, then the effect of *colour* will be produced. The colours of natural objects are supposed to result from the surfaces of these bodies absorbing certain rays, and reflecting or transmitting others; thus an object appears red because it absorbs a portion of the yellow and the blue rays composing the white light which falls upon it, while it reflects the red rays.

The greatest *illuminating* power of the spectrum is about its



middle, or rather, between the yellow and green; the greatest *heating* power is in the red space or beyond it, varying with the kind of prism used; the *deoxidizing* power is greatest in the violet space, or just beyond it. The red ray is the least refrangible; the violet ray the most so.

The *chemical* effects of light are well marked; thus a mixture of chlorine and hydrogen may be kept for any length of time in the dark; but under the influence of light, a combination soon ensues; so the blackening and the decomposition of the salts of silver occur rapidly in the light. But the most remarkable chemical effect produced by light is upon the leaves of growing plants, which then possess the property of decomposing the carbonic acid of the air, appropriating the carbon to themselves, and giving out the oxygen.

### SECTION III.

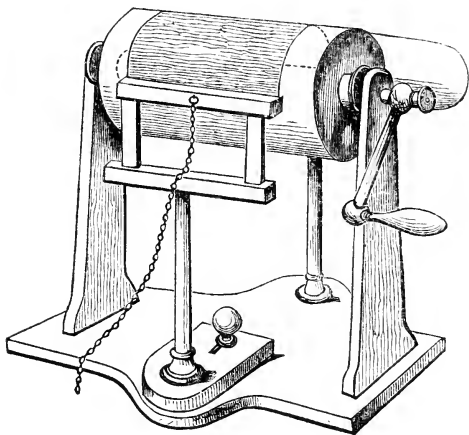
#### ELECTRICITY.

The term *electricity* is derived from the Greek word signifying *amber*, since this is the substance in which electrical excitement was first discovered. Electrical excitement may be produced by rubbing glass, amber, or resin, which will then attract light bodies. There are two varieties or states of electricity, the *vitreous*, or that excited in glass, which is also called *positive* electricity,—and the *resinous*, or that excited in resins, called also *negative* electricity. The difference between these may be easily shown by suspending a light pith ball, or a feather, by means of a thread of silk; then on exciting a dry glass tube and presenting it to it, the body will be attracted, but after a few moments it will be repelled, in consequence of receiving electricity from the glass tube; if now, a stick of resin properly excited be presented to it, it will be attracted; but after touching the resin and receiving some of its electricity, it will soon be repelled by it; but, on the other hand, attracted by the glass. This experiment establishes the law “that bodies similarly electrified, repel each other, but dissimilarly electrified, they attract.” Electricians divide bodies into *electrics*, or *non-conductors*, as glass, resin, sulphur, &c., and *non-electrics* or *conductors*, as the metals, water, &c. The essential parts of the *electrical machine*, are, 1, the *electric*, which is usually a glass cylinder or plate, contrived so as to be capable of turning by means of a handle; 2, the *rubber*, which is a stuffed cushion covered with an amalgam of tin, zinc, and mercury, against which the electric is rubbed; 3, the *prime conductor*, which is a metallic cylinder armed with a number of points for the more perfect collection of the electricity. Both cushion and conductor should be *insulated*, that is, supported on a pedestal of glass, which is a non-conductor. The cylinder, as it turns, becomes charged with



positive (vitreous) electricity, by friction against the cushion, and is as quickly discharged, by the row of points, into the prime conductor, which, as it is insulated, thus acquires a charge of positive elec-

Fig. 7.



tricity, which it will yield up on contact with any body, with a peculiar noise and spark. The maximum effect is produced when the rubber is made to communicate with the earth by means of a chain. If *negative* electricity be wanted, the conductor must be made to communicate with the earth, and the rubber insulated.

The *Leyden jar* is an instrument for *accumulating* electricity. It depends on the principle that a large amount of the two different sorts of electricity may reside on the two surfaces without any tendency to equilibrium, on account of the non-conducting power of the glass. It consists of a thin glass jar coated on both sides with tin foil to within a few inches of the top; a wire, terminating in a metallic knob, communicates with the interior coating. When the outside coating is connected with the earth, and the knob placed near the prime conductor of the machine, the inner and outer surfaces become respectively positive and negative. If, now, the two coatings be made to connect by means of a bent wire, the equilibrium is restored, a bright spark is perceived, along with a sharp snap, and if the body be interposed, the *electric shock* is felt. The *electric battery* is only a great number of such jars connected together by their inner and outer coatings respectively; the whole then act as one

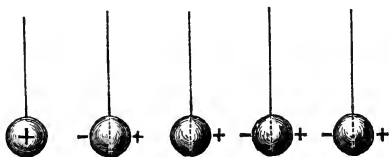
Fig. 8.



very large jar, by which great extent of surface and an enormous accumulation of electricity are gained; the whole may be discharged at the same moment,—and the effect is, of course, exceedingly powerful.

By *electrical induction* is meant the power which an electrified body has to produce an oppositely electric condition in a contiguous body; it is by virtue of this law, that when an electrified body, as a glass tube previously rubbed, approaches a light body, as a feather or pith-ball, it immediately *attracts* it, having first *induced* in it an opposite electrical state. A series of globes suspended by silk

Fig. 9.



threads, in the manner represented, will each become electric by *induction*, when a charged body is brought near the end of the series. The positive and negative signs are intended to represent the *states*.

The electrical state of the atmosphere is liable to disturbance: experiment has shown that the higher regions of the air are usually in a positive state: in cloudy and stormy weather, the clouds near the surface often appear in a negative state. In a thunder-storm, the cloud and the earth may be considered as representing the two coatings of the Leyden jar, differently electrified,—and the intervening air, the bad conducting glass. The dangerous effects of lightning are much lessened by the use of *lightning rods*, which are metallic conductors terminating above in a point, and below passing to a considerable depth into the earth. The object of the *pointed* extremity is to conduct off the discharge silently; a blunt extremity would give rise to a spark, and perhaps a shock, which might be unsafe; this may be easily shown by experiment with the electrical machine.

Fig. 10.



*Electrometers* and *electroscopes* are instruments for indicating or measuring the electrical intensity. The most simple one is that named the *gold leaf electrometer*; it consists of a pair of gold leaves suspended from the top of a bell-jar and communicating above with a metallic cap. When an electrified body is brought near to the cap, its presence is immediately detected by the divergence of the gold leaves. There are other electrometers known by the names of *quadrant electrometer*, *torsion electrometer*, *balance electrometer*, &c.

## SECTION IV.

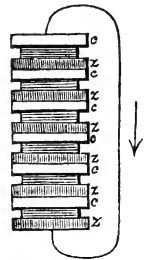
### GALVANISM, OR VOLTAIC ELECTRICITY.

When two solid bodies, as two pieces of metal, are plunged into a

liquid capable of acting upon them unequally, the electric equilibrium is disturbed, the one acquiring the positive condition, and the other the negative. Thus, a piece of zinc and a piece of copper, placed in a dilute solution of sulphuric acid, will cause such a disturbance of the electrical equilibrium; the zinc being the metal most attacked, becomes *negative*, while the copper becomes *positive*; and on making a communication between the two, an electrical current is set in motion. The intensity of the electricity thus developed is extremely feeble; but by arranging a number of single pairs of metals with the intervention of a fluid, or moistened cloth, in such a manner that the direction of the current shall be the same in each, the intensity will be very much augmented; upon this principle the *pile of Volta* and the *Crown of Cups* are contrived.

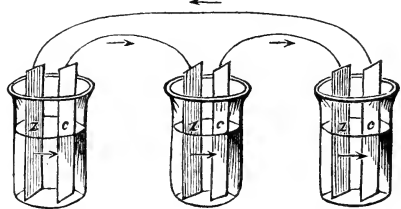
The *Voltaic pile* consists of a number of small plates of zinc and copper arranged in a pile, each pair being separated by means of a piece of cloth moistened with sulphuric acid, as seen by the figure. If the two terminal plates be now touched with wet hands, a prolonged electric shock will be experienced, the intensity of which may be increased to almost any extent, by simply increasing the number of plates.

Fig. 11.



The *Crown of Cups* is similar in principle, though different in form; it consists of any number of cups or glasses, arranged in a row or circle, each containing a piece of copper and zinc, and some dilute acid. The copper of the first cup is connected with the zinc of the second; the copper of the second, with the zinc of the third, and so on; on establishing a communication between the first and last plates, a discharge takes place as before.

Fig. 12.



Whenever such an arrangement consists merely of a single pair of conductors, and an interposed liquid, it is called a *simple circuit*; when two or more alternations are concerned, it is a *compound circuit*; but, however complex the apparatus may be, the *principle* is, in all cases, precisely the same. The disturbance of the equilibrium may be considered as commencing at the surface of the most oxidizable metal, and to be propagated through the liquid to the least oxidizable metal; hence, when insulated, the zinc end of the series is always negative,

and the copper end positive. When the two extremities are joined, the current continues to pass from the copper to the zinc; so that in fact, we may consider that there are two currents: one, *in* the battery, passing from the zinc to the copper; the other, *out* of the battery, going from the copper to the zinc, as shown by the arrows in the preceding figure.

*Cruikshank's trough*, is a modification of Volta's pile; it consists of numerous pairs of zinc and copper plates soldered together, and cemented water-tight into a mahogany trough, which thus becomes divided into a series of cells or compartments, capable of receiving the exciting liquid. This apparatus is well adapted to exhibit effects of tension, and to give shocks.

Fig. 13.



The *quantity* of electricity set free, is to be distinguished from its *tension*; the first is measured by its *chemical* effects—particularly the power of decomposition; the last, by its power of overcoming obstacles, and passing through imperfect conductors.

The *quantity* of electricity set free, is to be distinguished from its *tension*; the first is measured by its *chemical* effects—particularly the power of decomposition; the last, by its power of overcoming obstacles, and passing through imperfect conductors.

*Different theories as to the nature and cause of galvanism.*—Galvani supposed it to be developed in the animal upon which he was experimenting, and that the metals served merely as conductors; Volta, on the other hand, supposed it to be developed by the contact of dissimilar metals. Subsequently, Faraday brought forward the theory of *chemical action*, which is now most generally adopted.

The most important effect produced by galvanism, is that of the decomposition of compound bodies. It was by means of this agent that Sir H. Davy made the discovery of the metals of the alkalis. When compound bodies in the fluid state are traversed by a galvanic circuit, a decomposition usually takes place according to a uniform and constant rule; certain elements, as oxygen, chlorine, iodine, acids, &c., appearing at the *positive* or *copper* end of the battery, and others, as hydrogen, the metals, &c., at the *zinc* or negative end. Hence the division of bodies by chemists according to their electrical habitudes; those which go to the positive pole being called *electro-negative*,—at the head of which stands oxygen; and those which go to the negative pole being called *electro-positive*, of which, hydrogen is the first.

The *electrodes* or *poles* of a battery are the points of the circuit (usually the extremities) where the electrical phenomena are manifested. The decomposition of a fluid by galvanic action is termed *electrolysis*; and the liquids which are capable of being thus acted on are named *electrolytes*.

*Magnetic effects of galvanism.*—Among the effects of galvanism, its influence over the magnet is very remarkable. Although the

fact had been long known that electricity was capable of inducing and destroying magnetism, as witnessed in the effects of lightning on the compass-needle, it was not until the year 1819 that the laws of these phenomena were established by Ørsted, and the science of *electro-magnetism* truly developed. It is found that if a galvanic current be set in motion near a magnetic needle, the latter will arrange itself across the current, so that its axis may be perpendicular to the wire.

When an electric current is passed at right angles to a piece of iron or steel, the latter acquires magnetic polarity, either temporary or permanent; the direction of the current determining the position of the poles. This effect is very much increased by causing the current to circulate a number of times around the bar, which soon acquires extraordinary magnetic power. A piece of soft iron in the form of a horseshoe, surrounded thus by a coil of copper wire, insulated by being covered with silk, may be made to become so highly magnetic simply by connecting the two ends of the iron with a small battery of a single pair of plates, as to be capable of sustaining a very heavy weight.

As electricity can produce a magnetic influence, in the same manner it is found that magnetism can call into activity electric currents. If the two extremities of the coil of the electro-magnet just described, be connected with a galvanoscope, and the iron magnetized by the application of a steel horseshoe magnet to the ends of the bar, a momentary current will be developed in the wire, and pointed out by the movement of the needle. On removing the magnet, whereby the polarity of the iron is at once destroyed, a second current will become apparent, but in the opposite direction to that of the first. By using a very powerful steel magnet, surrounding its iron keeper or armature with a very long coil of wire, and then making the armature itself rotate in front of the faces of the magnet, so that its induced polarity shall be rapidly reversed, magneto-electric currents may be produced of such intensity as to give bright sparks, and powerful shocks, and exhibit all the phenomena of voltaic electricity. The accompanying figure represents such an arrangement. There is a great variety of form in electro-magnetic machinery; but in all, even the most complicated, the *essential principle* is the same, viz.: the development of an electrical current by magnetic action.

Fig. 14.

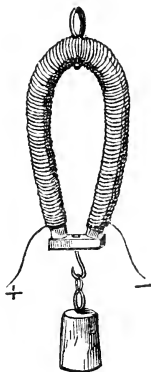
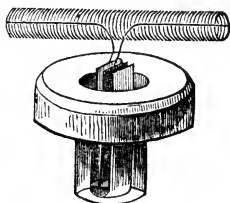


Fig. 15.



## PART II.

### INORGANIC CHEMISTRY.

#### CHAPTER I.

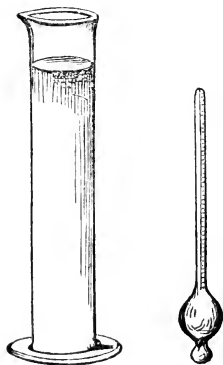
##### PRELIMINARY REMARKS ON SPECIFIC GRAVITY, NOMENCLATURE, ETC.

**SPECIFIC GRAVITY.**—By this is meant the ratio of the weight of a body to its bulk, or the weight of a body compared with the weight of an equal bulk of some standard, which is received as unity. In solids and liquids this standard is pure water at the temperature of  $60^{\circ}$  F.

*To find the specific gravity of a liquid*, it is only requisite to weigh equal bulks of that liquid, and water at the same temperature, and then divide the weight of the liquid by the weight of the water; the quotient will of course be greater or less than unity, as the liquid employed is heavier or lighter than water. Now, the simplest mode of weighing equal bulks is to weigh them in succession in the same vessel, taking care to have exactly the same quantity in both cases. Another method is to employ a solid body, as the stopple of a bottle, ascertain how much weight will sink it in the given liquid, and divide this by the weight required to sink it in water; this is obviously the same as ascertaining the weights of the relative bulks of the two, since a solid body always displaces *its own bulk* of a liquid.

*Hydrometers* are instruments employed for ascertaining the specific gravity of liquids. They consist of hollow metallic balls, attached to a thin stem, and having a weight beneath, to keep it erect. The use of the hydrometer is very simple. The liquid to be tried is put into a narrow vessel, and the instrument floated in it. It is obvious that, the denser the liquid, the higher will the hydrometer float; and, vice versâ; the point on the graduated stem will then express the specific gravity.

Fig. 16.



*To find the specific gravity of a solid.*—The principle here is precisely the same as in the case of liquids: the rule being “to divide the weight of a given bulk of the body, by the weight of an equal bulk of water;” and the mode adopted, is first to weigh the body in the air, then to weigh it in water; find out how much it loses by being weighed in water, (which will

express precisely the weight of an equal bulk of water,) and then divide the first weight by this last, and the quotient will be the specific gravity. This rule is founded on the hydrostatic law that when a solid is immersed in a fluid, it loses a portion of its weight exactly equal to the weight of the portion of fluid displaced; that is, equivalent to the weight of its own bulk of that fluid. If the solid be lighter than water, as in the case of cork, its specific gravity may be found by suspending a small glass funnel from a scale beam, and counterpoised so as to be just below the surface of the water; the lighter body is then to be thrown up under the funnel, which will, of course, destroy the equilibrium, and elevate the funnel. Ascertain how much weight will counteract the buoyancy of the light body, add this to its weight, and divide its weight by the sum; the quotient must, of course, be less than unity.

To ascertain the specific gravity of *gases*, it is only requisite to fill a globe of known capacity with the gas, then to weigh it, and to divide the result by the weight of the same bulk of atmospheric air, which is the standard, or unity, for gases. It must also be remembered that the specific gravity of gases is influenced by their *purity*, their *hygrometric condition*, the degree of *pressure* to which they are subjected, (their bulk being inversely as the pressure,)—and their *temperature*.

*Chemical nomenclature.*—In the formation of a chemical nomenclature, the names given to many of the elements were expressive of some of their striking properties:—thus *oxygen*, from two Greek words, signifying to produce an acid, from the idea that oxygen was the sole acidifying principle; *hydrogen*, from two words signifying to produce water;—others again derived their names from words expressive of their *colour*, as chlorine, iodine, cyanogen, &c. The compounds of oxygen were named *oxides* or *acids*, according as they do, or do not possess acidity. Acids derive their name from the substance acidified by the oxygen, by the termination in *ic*; thus sulphuric, carbonic, phosphoric, &c. Should the substance be capable of forming more than one acid, the name of that containing least oxygen is made to terminate in *ous*, as sulphurous, nitrous, &c. When the same substance forms several acids with oxygen, the Greek preposition *hypo* is generally prefixed to express the relative quantity of oxygen; thus, *hyponitrous* and *hyposulphuric* indicate acids containing less oxygen than nitrous and sulphuric acids respectively; sometimes the particle *per* is prefixed to express the highest amount of oxygen, as *perchloric acid*.

The nomenclature of the *salts* is made to depend on the termination of their acid; thus, acids ending in *ous* form salts terminating in *ite*, as sulphite, nitrite, from sulphurous and nitrous acids; acids ending in *ic*, as sulphuric or nitric, form salts terminating in *ate*, as sulphate and nitrate.

The termination of names of compound bodies is directed chiefly by analogy; thus the non-acid compounds of chlorine, iodine, bromine and fluorine, from the analogy of these bodies with oxygen, are named *chlorides*, *bromides*, *iodides*, &c. The compounds of the inflammables terminate generally in *wret*, as *carburet*, *sulphuret*, *phosphuret*, &c.

Different *oxides* of the same metal are distinguished by the numerals prefixed. The oxide containing a single equivalent of the metal and oxygen, is named *protoxide*; that containing the greatest amount of oxygen, the *peroxide*; the intermediate oxides are expressed by Latin numerals, as the *deutoxide* or *binoxide*, *teroxide* or *tritoxide*, &c.; the Greeks numerals, *dis*, *tris*, &c., prefixed, denote oxides containing one equivalent of oxygen with *two*, *three*, or *more* equivalents of the metal; thus, the *dioxide* of copper. A *suboxide* signifies an oxide containing less oxygen than a protoxide.

The same system is also extended to salts, where there is more than one formed by an acid with the same base. When the salt is *neutral* it is simply named according to the nature of the acid, as sulphate or nitrite; if it contains two equivalents of the acid, it is named a *bisulphate*, or a *bicarbonate*, &c. If it contains two equivalents of the base, it is named a *disulphate*, &c. The term *sesqui*, (one and a half,) is used to indicate the relation of 1 to  $1\frac{1}{2}$ , or 2 to 3, as in the sesquioxide of iron, a compound consisting of two eq. of iron and three of oxygen.

The generic part of the name of a compound is usually formed from that ingredient which is the most electro-negative; thus in compounds formed between oxygen, chlorine, iodine and sulphur, we say oxide of chlorine, chloride of iodine, iodide of sulphur; and not chloride of oxygen, iodide of chlorine, or sulphuret of iodine.

It is often, however, very difficult to apply appropriate names to the highly complex bodies of the organic world; in which cases more particularly, the use of chemical signs or *symbols* becomes very advantageous, as will be briefly shown.

Every elementary substance is designated by the first letter of its Latin name, in capital, or by the first letter conjoined with a second small one most characteristic, since the names of many bodies begin alike; thus, Aluminium, Al.; Arsenic, As.; Bromine, Br.; Boron, B.; Barium, Ba.; Carbon, C.; Chlorine, Cl.; Hydrogen, H.; Iodine, I.; Iron (ferrum), Fe.; &c. It is always understood that these symbols express *one equivalent of the substance*.

Combination between bodies is expressed by a mere juxtaposition of the symbols, or sometimes by interposing the sign +: thus water is expressed by HO, or H+O; hydrochloric acid, by HCl, or H+Cl; protoxide of iron, by FeO, or Fe+O.

When more than one equivalent is intended the number is either prefixed to the symbol, or else placed after it: thus, sulphuric acid,



$S + 3O$ , or  $SO^3$ , or  $SO_3$ ; hyposulphuric acid,  $2S + 5O$ , or  $S^2O^5$ , or  $S_2O_5$ , &c. Sometimes abbreviations are made use of: thus, two equivalents of a substance are indicated by the symbol with a short line drawn through or below it; an equivalent of oxygen is signified by a dot, and one of sulphur by a comma, thus sesquioxide of iron,  $\ddot{F}e.$ ; bisulphuret of carbon,  $\ddot{C}$ , instead of  $CS_2$ .

*Chemical affinity.*—The most simple case of chemical affinity is where two bodies unite together to form a third body; as copper and zinc forming brass; sulphuric acid and soda to form sulphate of soda.

The second case of affinity, called *single elective attraction*, is where two heterogeneous bodies having united together to form a compound, another body, being blended with them in solution, unites with one of the former; for example, potash being added to a solution of sulphate of magnesia, unites with the sulphuric acid, and precipitates the magnesia; water on being added to the tincture of camphor, (camphor and alcohol,) will unite with the alcohol and precipitate the camphor.

The *third* case of affinity, called *double elective attraction*, is where two compound bodies, on being intimately mingled, undergo a mutual decomposition, the four components interchanging places: thus, a solution of acetate of lead and a solution of sulphate of zinc, on being mixed, give rise to an acetate of zinc and a sulphate of lead.

The *fourth* case of affinity is where two bodies being in combination, a third, on being added *in excess*, combines with both the others; thus, ammonia being added to the solution of sulphate of copper, at first throws down the oxide of copper; but on continuing to add the ammonia, the excess combines with the precipitated oxide, which is then redissolved.

*Circumstances modifying chemical affinity.*—One of these is *heat*; thus, by heating mercury in the air, it will combine with oxygen; and by simply increasing the temperature, it will separate again from the oxygen. Another modifying agent is *solution*: many substances which, when in the dry state, evince no tendency to unite, when moistened or dissolved, exhibit a powerful affinity; thus tartaric acid and a carbonated alkali may be kept together, if dry, without any union; but if moistened, effervescence takes place. *Mechanical division* also greatly promotes chemical action, as may be seen by the action of nitric acid on a brass ball being far less violent than when the metal is presented to it in the form of filings or leaves. The *nascent state* is also peculiarly favourable to chemical combination.

*Tables of affinity* consist of a series of substances placed in a

column, in the order of their affinity for any one substance at the head of the column, as in the following example :

*Sulphuric Acid.*

Baryta,  
Strontia,  
Potash,  
Lime,  
Magnesia,  
Ammonia.

*The atomic theory.*—The doctrine of *atomic weights* and *chemical equivalents* is based upon the supposition that every substance is divisible into ultimate particles termed *atoms*, which atoms unite together in certain definite proportions to form various compound bodies.

The *chemical equivalent* of a body is the number expressing its *least combining proportional* ; as these merely express the ratio, any one body may be selected as a standard ; either oxygen or hydrogen are generally employed,—more frequently hydrogen,—which being placed at unity, the *equivalent number* or *chemical equivalent* of oxygen would be 8 ; since eight atoms of oxygen always unite with one of hydrogen. In the same way the equivalent of chlorine has been fixed at 36 ; that of nitrogen at 14 ; that of iron at 28 ; and so on. An atom of a compound body will of course be compound, as an atom of water, or of sulphuric acid ; so also, the *chemical equivalent* of a compound body is the sum of the equivalents of its constituents ; thus the equivalent of water is 9, (8+1 ; ) that of sulphuric acid 40, (16+24 ; ) and so on.

## SECTION I.

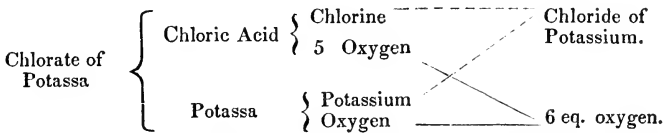
### SIMPLE NON-METALLIC BODIES.

#### OXYGEN.

Exists abundantly in nature, constituting one-fifth of the atmosphere, and eight parts in nine of water ; also, in all organic matter.

Discovered in 1771 by Priestley, and by Scheele in 1775 ; named *dephlogisticated air* by Priestley, *empyreal air* by Scheele, and *vital air* by Condorcet ;—the name *oxygen*, derived from two Greek words signifying to *generate an acid*, was given by Lavoisier, under the idea that it was the sole acidifying principle. *Prepared* by heating either the peroxides of mercury, lead, or manganese, or the nitrate or chlorate of potassa. When either of the peroxides is exposed to heat, a portion of their oxygen is driven off, and they are converted into either protoxides or sesquioxides. Perhaps the best mode of procuring it is to heat the chlorate of potassa, which yields a large

quantity of oxygen,—the gas coming both from the acid and base, and the salt becoming converted into the chloride of potassium. This is shown by the following diagram :



If a little powdered peroxide of manganese be previously mixed with the chlorate of potassa, a less amount of heat will be required, although none of the oxygen comes from the manganese. Oxygen should be collected over water, in a *pneumatic trough*,—a large vessel holding water, and fitted with a shelf for holding the receivers, which must always be below the level of the liquid.

*Properties.*—Colourless, tasteless, inodorous; sp. gr. 1.1026;—has never been condensed into a liquid; it is the most perfect negative electric; is very sparingly soluble in water; a powerful supporter of combustion and of life; has a strong attraction for most simple bodies. Its power of supporting combustion shown by immersing in it a candle with a red hot wick, which is instantly relighted; or by the burning of fine iron wire, or of phosphorus and sulphur, in it; the compounds which are always thus formed are termed either *oxides* or *acids*, according as they do, or do not, possess acid properties. *Ordinary combustion* is only the rapid union of a body with oxygen; and the body, when burnt, is always increased in weight; which increase is exactly equal to the amount of oxygen which has disappeared. Oxygen is equally essential to respiration: no animal can live in an atmosphere deprived of oxygen; pure oxygen is injurious to life, on account of its highly stimulating properties, all the functions becoming extremely excited. Eq.=8;—combining vol.=50;—Symbol, O.

*Theory of combustion.*—The term *combustion*, in its widest sense, signifies “a chemical combination, attended with the evolution of light and heat.” In its *restricted* sense, it means “the rapid union of a combustible with oxygen.” Before the discovery of oxygen gas, the phenomena of combustion were explained on the *Stahlian*, or *phlogistic theory*, that all combustibles contained a principle named *phlogiston*, to which they owed their combustibility; and that when they burned, they gave out their phlogiston, and then ceased to be combustible. A metallic oxide was consequently regarded as a simple substance, and the metal itself as a compound of the oxide with phlogiston.

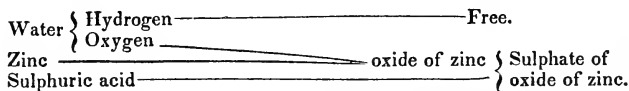
Lavoisier proved the incorrectness of this doctrine, by showing that a body on undergoing combustion, so far from giving out any thing, always acquires oxygen; thus on burning a piece of phospho-

rus in oxygen, some of the gas disappeared, the phosphorus increased in weight, and the increase of the latter was precisely equal to the loss of the former. Lavoisier, however, went too far in supposing that oxygen was the *sole* supporter of combustion; since it has been proved that other gases, as chlorine, cyanogen, &c., will also support it. He also accounted for the intense light and heat produced during combustion, on the principle of latent heat; but in this he was subsequently proved to be incorrect. No *certain* explanation of these phenomena have indeed been given, though they have been attributed to *chemical action* by some, and to *electricity* by others; this latter view is adopted by Berzelius.

All combustibles do not emit an equal amount of heat on being burned.

#### HYDROGEN.

Exists abundantly in nature; constitutes one-ninth by weight, of water, and two-thirds by volume; named from the Greek words signifying *to generate water*. Prepared always by decomposing water, which may be effected either by bringing steam in contact with red hot iron, which then combines with the oxygen of the water, liberating pure hydrogen; or by the action of dilute sulphuric acid on pieces of zinc or iron; in this case the water of the sulphuric acid yields its oxygen to the zinc, and its hydrogen escapes: the oxide of zinc at the same time unites with the acid to form the *sulphate of zinc*, thus:—



*Prop.*—Colourless, inodorous, tasteless; the lightest body in nature, sp. gr. 0.06896; 100 cubic inches only weigh 2.137 grs. It cannot be compressed into a liquid; a non-supporter of combustion and respiration, though its latter property arises, not from any noxious property of the gas, but only from an absence of oxygen; it is highly inflammable, burning with a pale bluish flame; when mixed with a due proportion of oxygen, (2 measures of hydrogen to 1 of oxygen,) it explodes violently, either by a heated body, or the electric spark, giving rise to the formation of water.

Spongy platinum is instantly made red hot by a jet of hydrogen, which, in its turn, is then inflamed;—a mixture of hydrogen and oxygen, will burn slowly without explosion, when the temperature is raised a little above that of boiling mercury. The burning of hydrogen with oxygen is accompanied with the evolution of a great amount of heat; on this principle the *oxy-hydrogen blowpipe* is constructed, consisting of an apparatus by which a mixture of hydrogen and oxygen is made to burn from a jet, care being taken to guard against the danger of explosion, by means of Hemming's safety tube; the

heat thus produced is sufficient to melt the most refractory metals.—Symb. H;—Eq. 1.

Hydrogen forms two compounds with oxygen: water, or the *protoxide*, and the *peroxide*.

*Water*, HO,—first proved to be composed of hydrogen and oxygen, by Cavendish; this may be shown *synthetically*, by mixing one volume of oxygen with two of hydrogen, and exploding the mixture, when water will be the sole product,—or, *analytically*, by decomposing water either by red hot iron, or by galvanism; in the last case, a small portion of water is interposed between a pair of platinum plates, connected with the extremities of a voltaic apparatus of moderate power; pure oxygen gas is evolved at the positive plate, (or that connected with the copper end,) and pure hydrogen at the negative, or zinc extremity; the gases may be properly collected and measured.

The composition of water is, by weight, 8 parts of oxygen, and 1 of hydrogen; by volume, 1 volume of oxygen, and 2 of hydrogen.

*Prop.*—Colourless, inodorous, tasteless; powerful refractor of light; imperfect conductor of heat and electricity; very incompressible; sp. gr. 1. It does not occur, in nature, chemically pure;—can only be procured pure by distillation. Water acts powerfully as a chemical agent, forming compounds termed *hydrates*; sometimes the reaction is accompanied with the evolution of heat, as in the slaking of lime. Water also enters into the composition of many crystals, constituting their *water of crystallization*; its *solvent* properties are pre-eminent. Water in its natural state always contains atmospheric air, as may be shown by placing it under a receiver and exhausting the air; bubbles of gas will make their escape. Recently boiled water has the property of absorbing gases, though in different degrees.

*Peroxide of Hydrogen*, HO<sub>2</sub>, called also *oxygenated water*, is procured from the peroxide of barium, by the action of dilute hydrochloric acid, and then precipitating the baryta by sulphuric acid; the excess of oxygen of the peroxide, instead of escaping, unites with the water, converting it into the peroxide of hydrogen.

*Prop.*—A colourless, transparent liquid; inodorous; has a metallic taste; sp. gr. 1.45; remarkable for its proneness to decomposition,—a temperature of 212° causing explosion; it also bleaches and oxidizes.

#### NITROGEN.

Constitutes about  $\frac{4}{5}$ ths of the atmosphere, and is found abundantly in nature, under various combinations; may be procured in several

Fig. 17.

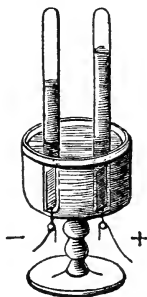
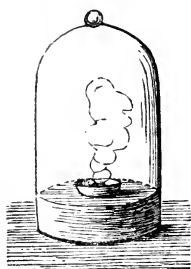


Fig. 18.



ways, of which the most simple is to burn out the oxygen from a confined portion of air, in a bell-glass inverted over a dish of water, by means of a piece of phosphorus; the phosphorus is converted into phosphoric acid, and the remaining gas is tolerably pure nitrogen. A purer gas may be obtained by passing atmospheric air over copper heated to redness; or by passing chlorine through a solution of ammonia, (nitrogen and hydrogen;) in this last case there is a risk of the formation of the chloride of nitrogen, a very explosive compound.

*Prop.*—Distinguished for its negative properties; destitute of colour, taste, or smell; a non-supporter of combustion and life; has no noxious properties; is not inflammable; sp. gr.  $\cdot 972$ ; Eq. =  $14\cdot 15$ ; Symb. N.

Nitrogen forms five compounds with oxygen, and one mixture, viz.: the atmosphere.

The *atmosphere* is composed of about  $\frac{4}{5}$ ths of nitrogen,  $\frac{1}{5}$ th of oxygen, and some carbonic acid and watery vapour. The air may be analyzed either by burning a piece of phosphorus in a known portion of it, or by passing it over finely divided copper, heated to redness, or by mixing it with hydrogen in definite proportions, and exploding the mixture by the electric spark; the last method is best accomplished by means of a *eudiometer*—a stout glass tube, so arranged that known bulks of gas can be measured. Suppose 100 measures of atmospheric air be mixed with 50 of hydrogen, and the mixture exploded; the volume, after explosion, will be found reduced to 87 measures; hence there has been a diminution of 63 measures, of which one-third, or 21 measures is oxygen; the remaining two-thirds is hydrogen.

*Prop.*—Colourless and invisible; when pure, has no taste or smell; sp. gr. 1; it is 800 times lighter than water at  $60^{\circ}$ . At the level of the sea, it exerts a pressure of 15 pounds on every square inch, and is capable of supporting a column of water 34 feet high, and one of mercury 30 inches; that is, a column of mercury one inch square and 30 inches long, has the same weight (nearly 15 pounds) as a column of water 34 feet long, and as a column of air of equal base reaching to the extreme limit of the atmosphere.

The density of the atmosphere varies with the altitude; diminishing as the height increases. Height of the atmosphere not absolutely known;—believed to be about 45 miles. From this fact arises the value of the barometer as an instrument for measuring heights, since as the elevation *increases* in *arithmetical* progression, the density *diminishes* (or the barometer falls) in *geometrical* progression.

The *barometer* is a glass tube closed at one extremity, a little over 30 inches in length; it is filled with mercury, and then inverted,

so as to place the open end in a small cup of mercury; the pressure of the atmosphere upon the mercury in the cup sustains the mercury in the column, as before mentioned.

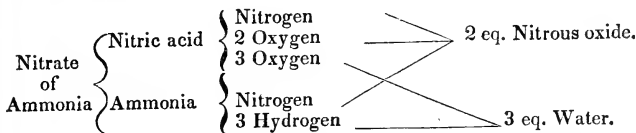
The use of the barometer as a *weatherglass* depends on the fact that the pressure of the atmosphere varies at the same place; and the weather is generally found to be fair when the pressure is greatest, or when the barometer stands high, and *vice versa*.

The elasticity of the air, as well as of gases generally, depends upon the degree of *pressure*; by the law of Mariotte, their volume is always *inversely* as the pressure.

COMPOUNDS OF NITROGEN WITH OXYGEN.

These are Protoxide of Nitrogen, Deutoxide of Nitrogen, Hyponitrous Acid, Nitrous Acid, and Nitric Acid.

*Protoxide of nitrogen*, NO, called also *nitrous oxide*, and *laughing gas*;—prepared by heating the nitrate of ammonia; the rationale is as follows:



*Prop.*—Colourless, transparent, almost inodorous; sp. gr. 1.5; a powerful supporter of combustion; water dissolves nearly its own volume; may be condensed into a liquid at 45° by a pressure of 50 atmospheres; when mixed with hydrogen in equal volumes, it explodes with violence by the electric spark, liberating its own measure of nitrogen. Its most remarkable property is its exhilarating effect on the animal system, when respired.

*Deutoxide or Binoxide of nitrogen*, NO<sub>2</sub>; prepared by the action of nitric acid on copper turnings; part of the oxygen of the acid combines with the copper, the oxide thus formed uniting with the undecomposed nitric acid; another portion of the oxygen unites with the nitrogen to form the deutoxide. It is colourless, but has a strong affinity for oxygen, acquires a dark red colour when it comes in contact with the air, which will serve to distinguish it; it is irrespirable; a supporter of combustion in some cases,—as of charcoal and phosphorus; but it extinguishes a lighted candle. From its affinity for oxygen, it may be used with advantage in *eudiometry*.

*Hyponitrous acid*, NO<sub>3</sub>; prepared by adding four measures of deutoxide of nitrogen to one of oxygen, and exposing the mixture to a temperature of 0° F.; they condense into a thin liquid of a greenish colour;—vapour, orange red; it is decomposed by water into nitric acid and deutoxide of nitrogen; it cannot be made to unite *directly* with metallic oxides.

*Nitrous acid*,  $\text{NO}_2$ , is always formed whenever deutoxide of nitrogen comes in contact with the atmospheric air, producing dense orange-coloured fumes;—procured in a liquid form by heating nitrate of lead in a retort; oxide of lead remains behind, and the acid is resolved into a mixture of oxygen and nitrous acid, the latter being condensed into a liquid by surrounding the receiver by a powerful freezing mixture.

*Prop.*—At a low temperature it is nearly colourless; acquires an orange tint on raising the temperature; sp. gr. 1.451; very volatile, boiling at  $82^\circ$ ;—is acid, pungent, and corrosive; is decomposed, on being added to water, into nitric acid and deutoxide of nitrogen; very irrespirable; supports the combustion of a burning taper and of phosphorus, but extinguishes sulphur;—a powerful oxidizing agent.

Nitrous acid combines with nitric acid, which thereby acquires a strong orange tint, and constitutes the fuming-red *nitrous acid* of the shops, and the *nitroso-nitric acid* of Berzelius. The colour of the mixture varies with the strength of the nitric acid, becoming yellow, green, and blue, and finally disappearing altogether, as the quantity of water in the acid increases.

*Nitric acid*,  $\text{NO}_3$ ; procured synthetically, by passing a succession of electric sparks through a mixture of nitrogen and oxygen confined in a tube;—best prepared by the action of sulphuric acid on nitre (nitrate of potassa) with the aid of heat; nitric acid vapours pass over along with water, and the bisulphate of potassa remains in the retort: this constitutes the *aqua fortis* of commerce.

*Prop.*—When thus procured, liquid nitric acid is of a yellowish colour, which is dependent upon some nitrous acid fumes; when perfectly pure it is colourless; sp. gr. about 1.5; contains about 25 per cent. of water; emits dense, white, suffocating fumes when exposed to the air; boils at  $187^\circ$ ; on adding different portions of water to the strong acid, several definite combinations of acid and water appear to be generated, remarkable for the difference observed in their boiling and freezing points.

The nitric acid of commerce is apt to contain traces of sulphuric and hydrochloric acids; the former is detected by adding chloride of barium—an insoluble sulphate of baryta being precipitated; the latter, by nitrate of silver—an insoluble chloride of silver being thrown down. Nitric acid is a powerful oxidizer, acting with great violence on many of the metals; it decomposes all *organic* substances, and acts on the skin as a caustic. The salts formed by nitric acid are termed *nitrates*.

The best tests for nitric acid are,—its solvent power over gold, if hydrochloric acid be present; the formation of the well known nitrate of potassa; the red tint communicated to a salt of morphia; and the bleaching effect upon a boiling solution of sulphate of indigo, provided no chlorine be present.



## CARBON.

This is a very abundant product of nature, being a constituent of all organic bodies; its purest form is the diamond, a native crystal of carbon; which is proved to be pure carbon by burning it in oxygen gas, the sole product being carbonic acid. The next purest native variety is graphite or plumbago, which also contains some iron; next to this comes anthracite coal. It is the essential ingredient of common charcoal, which is prepared by burning wood in close vessels. *Coke* is the charcoal of bituminous coal; *lampblack*, that of resin; *ivory black* or animal charcoal is prepared from bones.

*Prop.*—Carbon, as it exists in the diamond, is the hardest substance in nature; it crystallizes in the form of the octohedron or cube; sp. gr. 3.52; is very unchangeable; bears an intense heat in close vessels without fusing; is not acted on either by acids or alkalis. As obtained from wood, it is hard and brittle; its apparent lightness is due to its porosity; a bad conductor of heat; a good conductor of electricity; is very combustible,—when burnt in the air or in oxygen, giving rise to carbonic acid; has the property of absorbing a large quantity of gases or vapours into its pores, though in very different proportions: thus, of ammonia, 90 times its volume is absorbed, while of hydrogen, it takes up less than twice its own bulk.

Another very useful property of charcoal, is its power of absorbing the colouring matters from organic solutions; animal charcoal is best for this purpose. Charcoal is also highly antiseptic; it is hence used for purifying water, in filtering machines; also to remove the odour from tainted flesh.—Eq.=6.12. It forms two direct compounds with the oxygen, namely, carbonic oxide and carbonic acid.

*Carbonic oxide gas*, CO.—Prepared by passing carbonic acid gas over red hot charcoal or iron, one half of its oxygen being removed and it becoming converted into carbonic oxide; or preferably by the action of sulphuric acid on oxalic acid, (an organic acid consisting of equal measures of carbonic acid and carbonic oxide,) which is immediately resolved into its constituents; and on passing the gases through a strong solution of potassa, the carbonic acid is absorbed, and the carbonic oxide may be collected.

*Prop.*—Colourless and inodorous; sp. gr. 0.9927; sparingly absorbed by water; is neither acid nor alkaline; a non-supporter of combustion, but combustible, burning with a lambent blue flame, giving rise to carbonic acid; it is irrespirable. Mixed with oxygen, it may be exploded by the electric spark, forming carbonic acid.

*Carbonic acid*, CO<sub>2</sub>.—Discovered by Dr. Black in 1757, and named by him *fixed air*; prepared by the action of sulphuric or muriatic acid on any carbonate; the gas comes off with effervescence.

*Prop.*—Colourless; of a pungent odour and taste; very irrespi-

able; sp. gr. 1.524. It may be condensed into a liquid at  $32^{\circ}$  by a pressure of 36 atmospheres; this liquid may be frozen by the cold produced by its own evaporation, which is estimated at  $148^{\circ}$ . The liquified acid is colourless, and limpid like water; the *solid* acid resembles snow. Carbonic acid acts upon animals as a poison, producing asphyxia; it is injurious even when largely diluted with air; hence the evils resulting from imperfect ventilation. It sometimes accumulates in wells and mines, constituting the *choke-damp* of miners. Water absorbs its own volume of this gas, at any pressure; consequently the amount absorbed is determined simply by the degree of pressure to which the gas is subjected; in this way carbonic acid water is manufactured. Carbonic acid exists in the air, as has been mentioned; also in common spring water, which owes to it its pleasant flavour; the gas may be entirely driven off by boiling; hence water which has been boiled is quite insipid.

The best test for carbonic acid is *lime-water*, to which it always imparts a cloudiness, resulting from the formation of *carbonate of lime*. This may be seen also by breathing through a tube immersed in lime-water.

#### SULPHUR.

Is found uncombined in the neighbourhood of volcanoes, as in Italy and Sicily; also abundantly in a state of combination with various metals, as iron, lead, copper, antimony, &c., constituting the *pyrites* of mineralogists; procured by exposing iron pyrites to a red heat in close vessels.

*Prop.*—A yellow brittle solid, without odour and taste, under ordinary circumstances, but acquires a peculiar odour when rubbed; sp. gr. 1.99; a non-conductor of heat and electricity; melts at  $232^{\circ}$ , at which point it is a liquid of an amber colour. If the heat be increased, it begins to thicken and acquires a reddish tint; between  $428^{\circ}$  and  $482^{\circ}$ , it is thickest; and beyond this it again becomes thinner up to its boiling point,  $600^{\circ}$ ; burns when heated up to  $300^{\circ}$  in the open air. The *roll brimstone* of commerce, is melted sulphur run into cylindrical moulds. *Flowers of sulphur* are minute crystals of sulphur, obtained by subliming sulphur in close vessels. The sp. gr. of the vapour is 6.654. The vapour will support combustion. Crystals of sulphur may be procured by melting any quantity in an earthen vessel, and when partially cooled, breaking the crust and pouring out the liquid contents. Crystals are often found on breaking the roll brimstone of commerce.

Sulphur is insoluble in water; soluble in the fixed and volatile oils;—the best solvent is the bisulphuret of carbon; it dissolves in alcohol if both substances are brought together in the state of vapour. Eq. = 16. Symb. S.

Sulphur forms six compounds with oxygen, of which the most important are sulphurous and sulphuric acids.

*Sulphurous acid*,  $\text{SO}_2$ —the product when sulphur is burned in the open air or in dry oxygen; prepared conveniently by the action of sulphuric acid on mercury or copper; a part of the acid is decomposed, yielding up sulphurous acid and oxygen; the oxygen uniting with the metal.

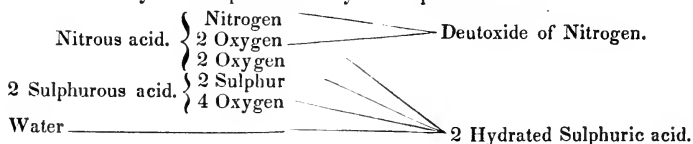
*Prop.*—Colourless; of a pungent, suffocating odour, and acid taste; sp. gr. 2.2105;—is condensed into a liquid at  $45^\circ$  by a pressure of two atmospheres, and at  $0^\circ$  under a pressure of one atmosphere;—a non-supporter of combustion, and a non-combustible;—cannot support respiration; water at  $60^\circ$  absorbs 32 times its volume; possesses bleaching properties; its solution first reddening and then bleaching litmus. Its salts are termed *sulphites*: they are not of much importance.

*Sulphuric acid*,  $\text{SO}_3$ —known in commerce as *oil of vitriol*; may be procured in two modes: first, by exposing the protosulphate of iron (green vitriol) to a red heat, by which the sulphuric acid is driven off and condensed, and the peroxide of iron remains. The acid thus procured is an oily brown liquid, of a sp. gr. of 1.9, fuming in the air and very corrosive; it is known in commerce as *fuming sulphuric acid*, or *acid of Nordhausen*, from the place of its manufacture.

The second method is the one usually adopted. It depends upon the fact that when sulphurous and nitrous acid are present along with some water, the sulphurous acid takes oxygen from the nitrous acid, the first becoming sulphuric acid, and the last deutoxide of nitrogen. The mode adopted is the following: a mixture of sulphur and nitre is exposed to heat in such a manner, that the vapours are carried into a leaden chamber, upon the bottom of which is a stratum of water. The nitric acid of the nitre gives up oxygen to some of the sulphurous acid, thereby converting it into sulphuric acid which immediately combines with the potassa; the greater part of the sulphurous acid enters the leaden chamber when it comes in contact with deutoxide of nitrogen, atmospheric oxygen, and watery vapours, forming a white crystalline compound, believed to be composed of sulphuric acid, hyponitrous acid, and water. When this solid falls into the water on the floor of the leaden chamber, it is decomposed into sulphuric acid, (which is dissolved by the water,) nitrous acid and deutoxide of nitrogen. The nitrous acid thus set free, as well as that produced by the reaction of atmospheric oxygen on the deutoxide of nitrogen, is again mingled with sulphurous acid and watery vapours as before, and gives rise to the formation of another portion of the crystalline compound, which, in its turn, becomes decomposed on falling into the water. When the water in the leaden chamber

becomes sufficiently saturated, it is drawn off and concentrated in platinum vessels, by heat, until it attains the sp. gr. of about 1.84.

The theory of the process may be expressed thus:—



*Prop.*—A dense, colourless, oily liquid, of an intensely sour taste and acid reaction;—consists of 40 parts, or 1 eq. anhydrous acid, and 9 parts or 1 eq. water;—extremely corrosive;—decomposes all organic substances;—has a powerful attraction for water, and when mixed with it gives rise to a great elevation in the temperature;—freezes at 15°.

*Anhydrous* sulphuric acid may be procured by heating the Nordhausen acid in a retort, to which is adapted a receiver surrounded with ice; a vapour passes over, which condenses into white silky crystals, resembling asbestos. It has such a strong affinity for water, that when put into that liquid it hisses like a hot iron; it is very volatile, boiling at 104°;—it does not display any acid reaction unless moisture be present. *Test*—chloride of barium.

*Hyposulphurous acid*,  $S_2O_2$ , cannot exist in an isolated form; it is produced when sulphur is digested in a solution of sulphate of potassa,—a *hyposulphite* of potassa is formed.

*Hyposulphuric acid*,  $S_2O_5$ , is procured in solution by suspending peroxide of manganese in water artificially cooled, and then transmitting through it a stream of sulphurous acid gas; the *hyposulphate* of the protoxide of manganese is thus formed, which is decomposed by baryta, and the barytic salt in its turn decomposed by sulphuric acid.

Two other acids of sulphur have recently been discovered, called respectively the *sulphuretted hyposulphuric acid*,  $S_3O_5$ , and *bisulphuretted hyposulphuric acid*,  $S_4O_5$ .

#### SELENIUM.

A very rare substance, much resembling sulphur in its chemical habitudes. It is a reddish brown solid body, having an imperfect metallic lustre, and a sp. gr. of 4.3;—melts at about 212°, and boils at 650°. It forms an oxide and two acids.

#### PHOSPHORUS.

Exists in bones and urine;—prepared from bones, in which it exists as phosphate of lime, by calcining, and then adding sulphuric acid and water; the sulphate of lime is precipitated, and the phosphoric

acid left in solution. This is evaporated, mixed with charcoal and exposed to a high heat; the phosphorus distils over into water.

*Prop.*—When pure it much resembles wax, being soft and flexible, and of a flesh colour; sp. gr. 1.77;—fuses at  $108^{\circ}$ ;—boils at  $550^{\circ}$ ;—insoluble in water, but dissolves in naphtha and oils;—very inflammable;—burns with a bright flame generating phosphoric acid. It undergoes a slow combustion in the open air, giving a luminous appearance in the dark; this combustion may, however, be entirely prevented by the presence of olefiant gas, vapour of ether, or an essential oil. Eq.=15.7, or (according to some) 31.4. Symb. P.

Phosphorus forms four compounds with oxygen.

*Oxide of phosphorus*,  $P_3O$ , or  $P_2O$ , formed by melting phosphorus under hot water, and bringing a stream of oxygen gas in contact with it:—it has a red colour;—is insoluble in water, alcohol, or ether.

*Hypophosphorous acid*,  $P_2O$ , or  $PO$ ;—is formed when phosphuret of barium is put into water;—it is a powerful deoxidizing agent.

*Phosphorous acid*,  $P_2O_3$ , or  $PO_3$ ; formed by burning phosphorus in a limited supply of oxygen or air; in this state it is anhydrous, and is in the form of a white powder, very deliquescent. It forms *phosphites*, which are of little importance.

*Phosphoric acid*,  $P_2O_5$ , or  $PO_5$ ;—prepared by burning phosphorus in the open air or in oxygen, by which it is procured in the anhydrous form; also by heating phosphorus in nitric acid; also from bones, by acting in the phosphate of lime (which is formed as already described) by carbonate of ammonia, then evaporating the phosphate of ammonia, and heating in a platina crucible.

*Prop.*—Very deliquescent; is a powerful acid; very sour, but does not corrode like nitric and sulphuric acids. It is capable of existing in three different states or modifications, forming three separate classes of salts, which differ completely in properties and constitution. They are distinguished by the names *tribasic*, *bibasic*, and *monobasic* acids, according to the number of equivalents of base required to form neutral salts.

The *tribasic phosphoric acid* is the acid of the well-known phosphates; it is characterized by yielding with a soluble salt of silver, a yellow insoluble phosphate. It contains 3 eq. water.

The *bibasic phosphoric acid*, also called the *pyrophosphoric acid*, is procured by heating the former acid at a temperature of  $415^{\circ}$ ;—it is distinguished from the tribasic acid by yielding a *white* instead of a yellow precipitate with the salts of silver. It contains 2 eq. of water.

The *monobasic phosphoric acid*, also named *paraphosphoric acid*, is procured when phosphorus is heated in the open air, and also when a concentrated solution of the tribasic or bibasic acids is heated to redness. By the former method, it is anhydrous; by the latter,

it is a hydrate. The hydrate is very fusible, and on cooling it condenses into a transparent brittle solid, called *glacial phosphoric acid*, which is very deliquescent. It contains one eq. of basic water. It forms an insoluble compound with albumen.

#### BORON.

Is the basis of boracic acid;—may be procured from boracic acid by heating it with potassium; the oxygen of the acid, uniting with the potassium, sets the boron free.

*Prop.*—A dark olive-coloured substance; insoluble; a non-conductor of electricity; when burned in the open air or oxygen, it generates boracic acid, Eq.=10. Symb. B. It forms only one compound with oxygen, namely, *boracic* or *boric acid*. This can be procured by decomposing baborate of soda (borax) by means of sulphuric acid; the sulphate of soda remains in solution, and the boracic acid is deposited in the form of crystals.

It is sparingly soluble in cold water, more so in hot water, and very soluble in boiling alcohol. The alcoholic solution when set on fire, burns with a beautiful green flame, a good test of its presence. When boracic acid is heated, it melts into a glassy mass.

The most important salt of boracic acid is *borax*—a baborate of soda.

#### SILICON.

The basis of silex or silicic acid;—procured by heating the double fluoride of silicon and potassium; the latter combines with the fluorine, liberating the silicon.

*Prop.*—A dark brown powder, a non-conductor of electricity, and without the metallic lustre; heated in the air, it burns, and is converted into silicic acid;—forms only one compound with oxygen. Eq.=22·5. Symb. Si.

Silicic acid,  $\text{SiO}_2$ ,—known also as silex or siliceous earth—exists abundantly in nature in the form of quartz and sand. Rock crystal is a very pure form of it.—Prepared by igniting transparent rock crystal, throwing it when red hot into water, and then reducing to powder; or by heating together powdered quartz or sand and carbonate of soda: a silicate of soda is formed, which is to be boiled in water; hydrochloric acid is then added, which combines with the soda, precipitating the silicic acid in the form of a gelatinous mass.

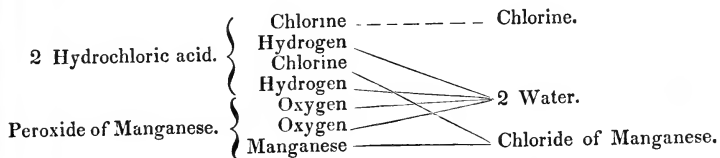
*Prop.*—A white powder, insoluble, tasteless; sp. gr. 2·69; very infusible; has no action on test paper on account of its insolubility; but it is a powerful acid, since it forms salts with the alkalies. Common glass is a silicate of potash. The best varieties of glass are made out of a pure alkali and very fine sand, free from iron: flint-glass contains some litharge, or red lead, also. If the proportion be

reversed so as to have one part of silicic acid with three of potash, we have a soluble silicate of potash called *liquor silicum*, or *liquor of flints*.

## CHLORINE.

Chlorine, along with iodine, bromine, and fluorine, forms a group of simple bodies whose chemical habitudes are remarkably similar.

Chlorine exists abundantly in nature as an ingredient in common salt. It was discovered, in 1774, by Scheele, and by him called *dephlogisticated marine acid*. The French chemists named it *oxymuriatic acid*, from an opinion that it consisted of muriatic acid and oxygen. In 1809, Davy discovered its true nature, and gave to it the name of *chlorine*, from a Greek word signifying greenish-yellow. Prepared by the action of hydrochloric acid on peroxide of manganese, with the aid of heat; chlorine is set free, and water and a chloride of manganese are formed, thus:



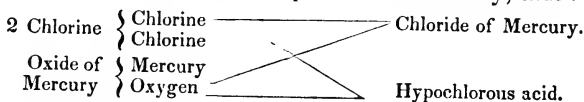
*Prop.*—A yellowish-green gas, irrespirable, exciting strong spasms of the glottis;—sp. gr. 2.47;—water at 60° absorbs twice its volume. It is best collected by conducting it by means of a tube, into the bottom of tall receivers, the air being thereby displaced. The watery solution, on being exposed to the light, is slowly changed into chlorohydric acid, oxygen being set free. When moist chlorine is exposed to a cold of 32° yellow crystals are formed, being a compound of chlorine and water. Chlorine is condensed into a liquid by a pressure of four atmospheres. It is a non-combustible, but a supporter of combustion; a lighted taper burns in it for a short time, but several of the metals, as antimony, tin, copper, and arsenic take fire spontaneously when presented to it, in a finely divided state. In these cases, a chloride of the metal is formed. The strongest affinity of chlorine is for hydrogen: it is in consequence of this that it acts so powerfully as a *bleaching* agent, water being always decomposed in the process, the hydrogen uniting with the chlorine to form chlorohydric acid, and the oxygen which is set free being the real decolorizing agent.

Chlorine is also useful as a *disinfecting* agent. The best test for chlorine is a soluble salt of silver;—a white insoluble chloride of silver is formed.

The non-acid compounds of chlorine are called *chlorides*.—Eq.= 3 . Symb. Cl.

Chlorine forms *four* compounds with oxygen; none of them are very permanent, but they are all easily decomposed.

*Hypochlorous acid*,  $\text{ClO}$ , or protoxide of chlorine, is obtained by the action of chlorine gas on peroxide of mercury, thus:—



It is a pale yellowish gas,—possesses powerful bleaching properties, and forms bleaching salts.

*Chlorous acid*,  $\text{ClO}_2$ , peroxide of chlorine;—prepared by heating a mixture of sulphuric acid and chlorate of potassa; the chloric acid which is set free is spontaneously decomposed into chlorous acid and hypochloric acid, the latter remaining in union with the potassa. It has a richer colour than chlorine, and is very explosive.

*Chloric acid*,  $\text{ClO}_3$ , the most important compound of the series;—prepared by adding sulphuric acid to the chlorate of baryta. If chlorine gas be transmitted through a solution of caustic potassa, a chlorate of potassa crystallizes, and the chloride of potassium remains in solution. The chlorates are easily recognised;—they give out pure oxygen when heated, passing into chlorides; they yield chlorous acid on being heated with sulphuric acid; but give no precipitate with silver.

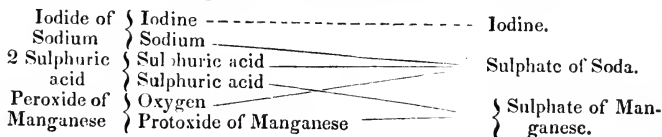
*Perchloric acid*,  $\text{ClO}_7$ , prepared by acting on the perchlorate of potassa with sulphuric acid. It has a very strong affinity for moisture;—forms salts resembling the chlorates.

*Chloride of nitrogen*,  $\text{ClN}_4$ , prepared by transmitting chlorine gas through a solution of muriate of ammonia; globules of an oily aspect are formed, which subside to the bottom;—it is the most explosive substance known.

Chlorine also forms compounds with carbon, carbonic acid, phosphorus, boron, and silicon. The important compound of chlorine and hydrogen will be described subsequently.

#### IODINE.

Exists in sea-weeds and in certain saline springs;—usually prepared from *kelp*, an impure carbonate of soda; the mother waters of this contain iodine in combination with sodium or potassium. From this the iodine may be evolved by the action of sulphuric acid and peroxide of manganese; the rationale is as follows:—





*Prop.*—A solid of a bluish-black colour, and metallic lustre; in crystalline scales;—sp. gr. 49; fuses at  $225^{\circ}$ ; boils at  $347^{\circ}$ ; colour of vapour a rich violet; slowly volatile at common temperatures, exhaling an odour resembling that of chlorine; density of vapour 8.716, being the heaviest of all vapours; very sparingly soluble in water, but soluble in alcohol. The best test for iodine is starch, with which it forms a blue compound.

The affinities of iodine are not so strong as those of chlorine, since the latter always displaces iodine from its compounds.

The non-acid compounds of iodine are called *iodides*.—Eq.=126. Symb. I.

Iodine forms at least two compounds with oxygen.

*Iodic acid*,  $\text{IO}_3$ , forms iodates.

*Periodic acid*,  $\text{IO}_7$ .

Iodine forms a compound with chlorine, the *chloride of iodine*;—also with nitrogen, a very explosive compound, similar to the chloride of nitrogen;—also with phosphorus and sulphur.

#### BROMINE.

Is found in sea-water as a bromide of magnesium; also in certain saline springs;—procured from bromide of potassium by sulphuric acid and peroxide of manganese; the reaction is precisely similar to that in the case of iodine.

*Prop.*—A very volatile liquid, of a deep reddish-brown colour; freezes a little below  $0^{\circ}$ ; boils at  $116^{\circ}$ ; odour very suffocating and offensive; slightly soluble in water; more so in alcohol and ether. The aqueous solution bleaches. It is very poisonous; its chemical habitudes closely allied to those of chlorine and iodine; it forms compounds with oxygen, chlorine, iodine, hydrogen, sulphur, phosphorus, carbon, and silicon.—Eq.=78.4. Symb. Br.

#### FLUORINE.

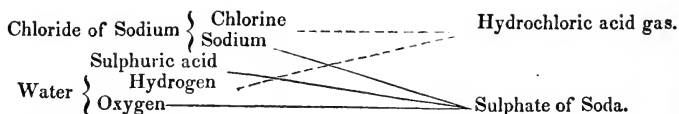
Occurs in nature in combination with calcium, in the well-known *fluor spar*; has only lately been isolated, on account of its energetic affinities. It is a yellowish gas, with an odour resembling chlorine;—has a powerful affinity for hydrogen and the metals;—sp. gr. 1.289;—Eq.=18.68. Symb. F. Its compounds with hydrogen, silicon, and boron will be described in the subsequent section.

### SECTION II.

#### COMPOUNDS OF SOME OF THE FOREGOING SIMPLE SUBSTANCES WITH EACH OTHER.

##### COMPOUNDS OF HYDROGEN.

*Chlorine and Hydrogen*;—*Hydrochloric acid*, *Chlorohydric acid*, or *Muriatic acid*,  $\text{ClH}$ ;—prepared by the action of dilute sulphuric acid on chloride of sodium, according to the following rationale:



*Prop.*—A colourless gas; gives off dense fumes on exposure to the air; has a very powerful affinity for water, and hence must be collected over mercury; condensed into a liquid by a pressure of 40 atmospheres; sp. gr. 1.269; water absorbs 418 times its bulk.

The solution of this gas in water constitutes the muriatic acid of commerce. This, when pure, is colourless; but usually has a light straw colour—due to impurities. When mixed with nitric acid it forms *aqua regia*, which has the property of dissolving gold, in consequence of the chlorine evolved; water and nitrous acid are also formed at the same time.

*Hydrogen and Iodine.*—*Hydriodic acid*, HI.—A gas much resembling hydrochloric acid;—prepared by heating water in union with iodide of phosphorus; the hydrogen combines with the iodine to form hydriodic acid, and the oxygen with the phosphorus to form phosphoric acid.

*Prop.*—Colourless, acid; has a strong affinity for moisture, and gives out white fumes in the air. It is decomposed by chlorine, with the formation of hydrochloric acid and evolution of iodine; sulphuric and nitric acid also decompose it by imparting oxygen, likewise evolving iodine.

*Hydrogen and Bromine.*—*Hydrobromic acid*, HBr;—prepared like hydriodic acid, from a bromide of phosphorus.

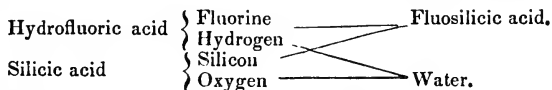
*Prop.*—A colourless gas, irrespirable, and acid; is decomposed by chlorine, but not by iodine.

*Hydrogen and Fluorine.*—*Hydrofluoric acid*, HF;—prepared by the action of dilute sulphuric acid on fluoride of calcium (fluor spar); the chemical changes are analogous to those occurring in the preparation of hydrochloric acid.

*Prop.*—At 32° it is a colourless liquid, but when exposed to the air, it flies off in dense white fumes; sp. gr. 1.0609;—its affinity for water surpasses even that of sulphuric acid, the combination being accompanied with a hissing noise; its vapour is extremely pungent; it is very destructive to organized bodies, as the skin, upon which it produces a deep and painful ulcer. It acts powerfully on glass, forming with it fluosilicic acid; on this account it must be prepared in metallic vessels. From its affinity for glass, it may be used for etching on that substance; the glass being coated with a thin film of wax and the figures traced with a pointed instrument; it is then submitted to the action of the gas which, acting only on the exposed portions of the glass, leaves an indelible mark upon them.

Under this head it will be convenient to allude to some other compounds of fluorine.

*Fluosilicic acid*,  $\text{SiF}_3$ ,—is formed whenever hydrofluoric acid comes in contact with glass; it is best made by heating a mixture of powdered fluor spar and glass with strong sulphuric acid; the changes are as follows:—the hydrofluoric acid (generated by the action of the sulphuric acid on fluoride of calcium) reacts with the silicic acid of the glass so as to form water and fluosilicic acid, thus:

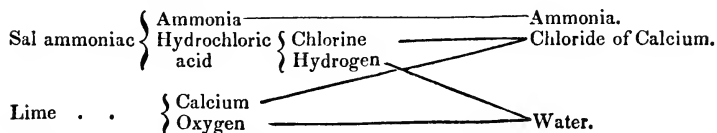


*Prop.*—A colourless irritating gas, producing white fumes on escape into the air, from the action of moisture; is decomposed by water into pure silicic acid, which is deposited in flakes, and into a new acid termed *hydrofluosilicic acid*—a compound of hydrofluoric and fluosilicic acids.

*Fluoboric acid*,  $\text{BF}_3$ .—Prepared by heating a mixture of powdered fluoride of calcium and vitrified boracic acid together; fluoboric acid and lime are generated.

*Prop.*—A colourless pungent gas; decomposed by water into boracic acid and *boro hydrofluoric acid*.

*Hydrogen and Nitrogen.*—*Ammonia*, or *volatile alkali*,  $\text{NH}_3$ ;—prepared by heating a mixture of powdered sal ammoniac and quick lime; by a double decomposition we have gaseous ammonia, chloride of calcium, and water, thus:



*Prop.*—A colourless gas, of a strong and pungent odour; very rapidly absorbed by water, (more than 700 times its own volume;) sp. gr. .589; has a powerful alkaline reaction; is condensed into a liquid under a pressure of 6.5 atmospheres at 60°; cannot be formed artificially by a direct union of its elements, but is an abundant product of the putrefaction of animal substances; it may be decomposed by the electric spark, by chlorine, and by being passed through a red-hot porcelain tube.

The solution of ammonia (*aqua ammoniac*) may be prepared by simply saturating water with gaseous ammonia; it is colourless, and possesses the pungent odour and alkaline reaction of the gas.

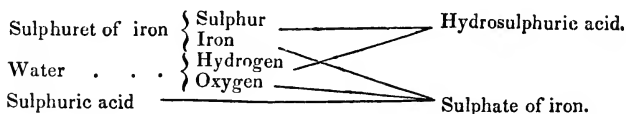
Ammonia forms salts with the different acids, which are all decomposed by a red heat, and by a less powerful heat, if they are mixed with an alkali or alkaline earth. The ammoniacal salts were

formerly considered to be formed by a direct union of the alkali and the acid; but, at present, the acid is believed to unite with the oxide of a hypothetical metal termed *ammonium*. This supposed metal has never been isolated, but is inferred to exist from the fact that when ammonia is decomposed by a galvanic current, and the negative wire terminates in some mercury, an amalgam is formed, having all the characters of an ordinary metallic amalgam: but when left to itself, this amalgam rapidly decomposes into mercury, hydrogen, and nitrogen. Ammonium is believed to be composed of ammonia and one eq. of hydrogen; it is represented by  $\text{NH}_4$ , and the base of the ammoniacal salts would consequently be represented by  $\text{NH}_4\text{O}$ .

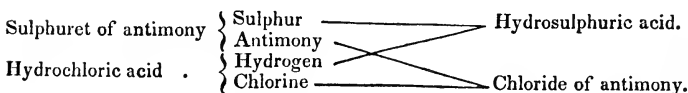
The most important of these salts are the *chloride of ammonium*, (sal ammoniac,) the *carbonates*, the *nitrate*, and the *sulphate*.

There is believed to be yet another compound of hydrogen and nitrogen, to which the name of *amide*, or *amidogen*, is given. Like ammonium, it has never been isolated: it is represented by  $\text{NH}_2$ .

*Hydrogen and sulphur*.—*Sulphuretted hydrogen*, *hydrosulphuric acid*,  $\text{HS}$ .—Conveniently prepared by the action of dilute sulphuric acid on sulphuret of iron; or by chlorohydric acid on sulphate of antimony, as follows:—



or



*Prop.*—A colourless gas, having the odour of rotten eggs; irrespirable, acting as a narcotic; combustible, burning with a blue flame, producing water and sulphurous acid; a non-supporter of combustion; becomes a liquid under a pressure of 17 atmospheres; is decomposed by chlorine, with a deposition of sulphur; sp. gr. 1.171; it has the properties of a weak acid, reddening litmus paper, and forming salts.

The best test is acetate of lead, with which it forms the black sulphuret of lead.

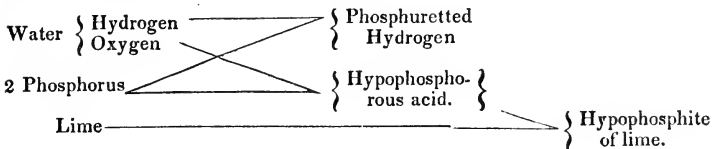
Hydrosulphuric acid is valuable to the chemist as a test for metallic solutions, causing with them an insoluble precipitate of the sulphuret of the metal.

There is another compound of sulphur and hydrogen, called *per-sulphuret of hydrogen*.

*Hydrogen and Selenium*.—*Hydroselenic acid*,  $\text{HSe}$ ;—in its general properties, resembles hydrosulphuric acid.

*Hydrogen and Phosphorus*.—*Phosphuretted hydrogen*,  $\text{P}_2\text{H}_3$ , pre-

pared by boiling together hydrate of lime, water, and phosphorus; the water is decomposed, and hypophosphite of lime and phosphuretted hydrogen are formed, thus:—



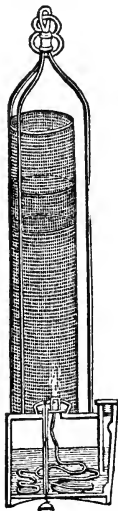
The most remarkable feature of this gas is its spontaneous inflammability; so that if the beak of the retort in which it is evolved be placed under water, as each bubble of gas rises through the liquid it takes fire, and forms a beautiful ring of a dense white smoke, which enlarges as it ascends.

*Compounds of Carbon and Hydrogen.*—The number of these compounds has now become very great; but most of them belong properly to the domain of organic chemistry; two of them, however, are generally considered under the head of inorganic chemistry: these are Light carburetted hydrogen and Olefiant gas.

*Light carburetted hydrogen, marsh gas, fire-damp, dicarburet of hydrogen, CH<sub>2</sub>*;—is formed in stagnant pools by the decomposition of vegetable matters; and may be procured by stirring up the mud at the bottom of the pool, and collecting the gas. It may be prepared by strongly heating a mixture of acetate of soda, hydrate of potash and quicklime: the gas is derived from the decomposition of the acetic acid of water.

*Prop.*—Colourless, tasteless, nearly inodorous; a non-supporter of combustion or respiration, but very combustible, burning with a bright yellow flame;—mixed with oxygen in due proportions, it forms an explosive mixture; products of its explosion or combustion, water and carbonic acid; sp. gr. .559. This gas is frequently evolved in large quantities from coal mines, and explodes on contact with the flame of the miner's lamp, causing the most disastrous consequences. Sir H. Davy's *safety-lamp* was invented to obviate these fatal results. It consists of a common oil-lamp, enclosed in a cage of wire-gauze, made double at the upper part, containing about 400 apertures to the square inch. When this lamp is taken into an explosive mixture, although the fire-damp, passing inside the gauze, may burn within the cage with such energy as to heat the metallic tissue to redness, the flame is not communicated to the mixture on the outside, in consequence of the cooling effect produced upon the heated gas by the wire-gauze; most fortunately, the

Fig. 19.



fire-damp has a very high kindling point; it will not inflame at the red heat of wire-gauze.

Chlorine does not act on light carburetted hydrogen, if kept in the dark; but if the light be admitted, a combination ensues, attended with the formation of hydrochloric and carbonic acids.

*Olefiant gas*,  $C_2H_2$ ;—so called, from its property of forming an oil-like liquid with chlorine. Prepared by heating a mixture of strong sulphuric acid and alcohol; at first ether is formed, and comes over along with vapour of alcohol; afterwards the olefiant gas comes over along with sulphurous and carbonic acid; the two latter are to be absorbed by potassa.

*Prop.*—Colourless, tasteless, and inodorous; water absorbs about  $\frac{1}{8}$ th of its volume; a non-supporter of combustion and respiration; but burns with a dense bright light, producing carbonic acid and water; mixed with a due proportion of oxygen, it explodes by means of the electric spark; sp. gr. .981; mixed with chlorine, it combines with it in equal measures, forming a heavy, oily liquid, of sweetish taste and ethereal odour.

The gas employed for illuminating purposes is usually made from coal, oil, resin, and other organic substances containing a large quantity of carbon and hydrogen. The coal is distilled in cast iron retorts, maintained at a bright red heat; and the volatilized products conducted through long pipes into receptacles where it is purified by means of hydrate of lime. Coal gas contains a number of different principles, as light carburetted hydrogen, olefiant gas, hydrogen, carbonic oxide, nitrogen, and some other volatile substances. Besides these, a number of other matters are separated in the processes of condensation and purification, as tar, sulphuretted hydrogen, sulphate of ammonia, &c. The relative illuminating power of different varieties of coal and oil gas depends upon the relative amount of carbon and hydrogen contained; the light being greatest when these are in excess, provided always, there be enough oxygen to burn them completely.

#### COMPOUNDS OF NITROGEN AND CARBON.

*Cyanogen*, *Bicarburet of nitrogen*,  $NC_2$  or Cy. Prepared by heating in a retort the bicianide of mercury; the cyanogen passes off in the form of a gas, and the mercury sublimes.

*Prop.*—Colourless, of a strong and peculiar odour; condenses into a liquid at  $45^\circ$  under a pressure of 3.6 atmospheres; a non-supporter of combustion, but inflammable, burning with a characteristic purple flame, producing water and carbonic acid. Water absorbs 4 or 5 times its volume, and alcohol much more; sp. gr. 1.806.

*Paracyanogen* is the name given to the black matter left in the retort after the preparation of cyanogen.

*Cyanogen and Hydrogen.*—*Hydrocyanic acid, Cyanhydric acid, Prussic acid, CyH.* Prepared in the anhydrous form, by passing sulphuretted hydrogen over fragments of bicyanide of mercury, contained in a horizontal glass tube, and receiving the product in a vessel surrounded with a freezing mixture. Gentle heat is applied to the tube, and the cyanogen reacting with the sulphuretted hydrogen, produces hydrocyanic acid and the sulphuret of mercury.

*Prop.*—A thin, colourless liquid, exceedingly volatile; sp. gr. 7058; boils at  $79^{\circ}$  and freezes at  $0^{\circ}$ ; has a powerful characteristic odour of peach blossoms or oil of bitter almonds; has a very feeble acid reaction; unites with water and alcohol in all proportions. In its anhydrous state it is one of the most poisonous substances known. The best antidotes are chlorine and ammonia. It is very liable to decomposition, especially if exposed to the light.

The *solution* of hydrocyanic acid is best prepared by the action of dilute sulphuric acid on the ferrocyanide of potassium.

Hydrocyanic acid is an organic product, being frequently met with in the vegetable kingdom. It is believed, however, not to pre-exist in vegetables, but to be due to the mutual reaction of two organic principles, named *amygdaline* and *emulsine*, or *synaptase*, with water.

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## CHAPTER II.

### METALS.

#### GENERAL PROPERTIES.

THEY are all conductors of heat and electricity; they are positive electrics; they are opaque; possess generally a well-marked lustre, termed *metallic*; are generally good reflectors of light. The number generally admitted by chemists is forty-two. They vary greatly in specific gravity,—between potassium, which is lighter than water, and platinum which is twenty-one times as heavy.

Properties which are peculiar to certain metals.—*Malleability, ductility, tenacity, the welding process, hardness, and the crystalline structure.*

All are solid at common temperatures, except mercury. Their fusing point varies very much—ranging between mercury, which is  $-39^{\circ}$ , and platinum, which is infusible at the heat of a smith's forge.

Metals often unite together to form *alloys*. When mercury unites with another metal, the compound is named an *amalgam*. Examples of alloys: *brass*, from copper and zinc; *bronze*, from copper and tin; *bell-metal*, from copper and tin; *type-metal*, from antimony

and lead; *solder*, from tin and lead; gold and silver coins are also alloys. Many of the alloys occur native.

But few of the metals are found native, that is, in their uncombined form. They usually are united with either oxygen or sulphur, or else they occur as salts.

Metals differ greatly in their attraction for oxygen; some have such a powerful affinity for this agent, that they decompose water, in order to unite with it. On the other hand, gold, silver, and platinum are very difficult to oxidize. The term *noble* has been given to such metals as are not liable to tarnish on exposure to the air.

Most metals may be oxidized by exposure to heat in the open air. This process was formerly termed *calcination*; and the product formed, *a calx*. Another mode of oxidizing is by *deflagration*, or by heating with nitrate of potassa, or chlorate of potassa. Nitric and nitro-hydrochloric acids are also powerful oxidizing agents.

Metallic oxides may be *reduced* either by heat alone, as in the case of the oxides of the noble metals, or by the united agency of heat and combustible matter, as hydrogen, charcoal, and the *black flux*; or by galvanism, which is still more powerful; or by the agency of deoxidizing agents, as phosphorous acid, protochloride of tin, &c.; or by precipitation from their solutions by means of other metals; thus silver is thrown down from a solution of its nitrate by means of mercury; copper, by means of iron, and so on.

The compounds of metals with oxygen, are for the most part *oxides*; occasionally, they are *acids*. Arsenic is the only one which forms an acid, without, at the same time, forming an oxide. Most of the metallic oxides act as *salifiable bases*—that is, form salts with acids. Generally, but not always, this property is confined to the *protoxides*.

Chlorine, bromine, iodine, and fluorine have also a strong affinity for metals,—particularly the two former.

Sulphur has a strong tendency to unite with metals: the combination may be effected either by heating the powdered metal and sulphur together; by igniting together a metallic oxide and sulphur; by heating a sulphate, along with combustible matter, by means of which the oxygen is removed in the form of carbonic acid, or by the action of hydrosulphuric acid. Several of the metallic sulphurets (sulphides) occur native, as of lead, antimony, iron, zinc, &c.

The compounds of selenium and the metals closely resemble the sulphurets.

Phosphorus and hydrogen occasionally unite with the metals.

#### CLASSIFICATION OF THE METALS.

Class I. *Metals of the Alkalies.*

“ II. *Metals of the Alkaline Earths.*

“ III. *Metals of the Earths.*

“ IV. *Metals proper.*



SECTION I.

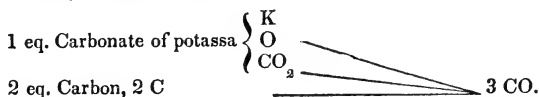
CLASS I.

METALS OF THE ALKALIES.

The metals of the alkalies are *Potassium*, *Sodium*, and *Lithium*.

POTASSIUM.

Discovered in 1807 by Davy, by the agency of galvanism.—Prepared by exposing a mixture of carbonate of potash and charcoal to a high heat, in a gun-barrel; the potassium distils over, leaving carbonic oxide, thus :



*Prop.*—Solid at ordinary temperatures—soft and malleable between the fingers—of a white colour and metallic lustre—brittle at 32°—melts at 150°; sp. gr. .865,—has a powerful affinity for oxygen;—cannot be kept in the air or water;—preserved under naphtha. It takes fire when thrown on water, with the disengagement of hydrogen, which combines with a portion of the potassium, forming potassiumated hydrogen, which also takes fire, increasing the brilliancy of the flame;—potash is formed as the result. The equivalent of potassium (kalium) is 39 15; its Symbol, K.

It forms two compounds with oxygen, potash, KO, and the peroxide, KO<sub>3</sub>.

*Protoxide of potassium* or *potash*, is found whenever potassium is exposed to air or water. In the anhydrous form, it is a white solid, very caustic; has a strong affinity for water, with which it forms a hydrate.

The *hydrate of potassa*, KO+HO, also named *common caustic* and *potassa fusa*, is prepared by decomposing carbonate of potash, by lime; the carbonate of lime is thrown down, and the potassa remains in solution; this is concentrated by heat, and then poured out into moulds. Pure hydrate of potassa is a white solid, very deliquescent, soluble in water and alcohol. The common caustic potash may be purified by dissolving in alcohol. The solution, like lime-water, rapidly absorbs carbonic acid from the air. The solid hydrate, from its affinity for water, is used to free gases from hygrometric moisture.

*Peroxide of potassium*, KO<sub>3</sub>, is formed when potassium is burned in dry oxygen, or in the open air; it is of an orange colour.

The most important salts of potassa are the *nitrates*, the *carbonates*, the *sulphates*, and the *chlorate*. The impure carbonate (*pot*

and *pearl ashes*,) is procured by lixiviating the ashes of inland plants, and evaporating to dryness; purified by redissolving in water, and boiling. The pure carbonate (salt of tartar,) is made by decomposing cream of tartar by a high heat. Composition,  $\text{KO} + \text{CO}_2$ .

The *bicarbonate*,  $\text{KO} + 2\text{CO}_2$ , is formed by passing a stream of carbonic acid through a solution of the carbonate. It is not so soluble as the carbonate. A *sesquicarbonate* is said to exist.

The *sulphate*,  $\text{KO} + \text{SO}_3$ , is the residue left in the retort in the preparation of nitric acid. The *bisulphate*,  $\text{KO} + 2\text{SO}_3$ , is more soluble, and has an acid taste and reaction. There is also a *sesquisulphate*.

The *nitrate*,  $\text{KO} + \text{NO}_5$ , named also *nitre* and *saltpetre*, occurs native, as an efflorescence on certain soils;—is manufactured also from artificial nitre-beds. Shape of crystals, six-sided prisms; very soluble; contains water mechanically confined, which causes the crystals to *decrepitate* when thrown upon hot coals. When heated, it gives off oxygen, and is converted into a *nitrite*; a high heat entirely decomposes it. From its power of imparting oxygen, it is the active ingredient in *gunpowder*, which is a mixture of nitre, charcoal, and sulphur. When gunpowder is fired, the oxygen of the nitre combines with the carbon to form carbonic oxide; the sulphur with the potassium; and the nitrogen is set free.

The *chlorate*,  $\text{KO} + \text{ClO}_5$ , is remarkable for its deflagrating properties; it yields a large quantity of oxygen gas, on being heated.

Sulphur, chlorine, iodine, and bromine, also form compounds with potassium.

*Tests for the salts of potassa.*—1. Tartaric acid in excess gives the sparingly soluble bitartrate, (cream of tartar.) 2. A solution of chloride of platinum causes a yellow precipitate. 3. The alcoholic solution of carbazotic acid precipitates the yellow carbazotate of potassa. 4. The salts of potash usually colour the flame of the blowpipe purple or violet.

#### SODIUM.

History and mode of preparation the same as those of potassium.

*Prop.*—A white metal; resembles potassium in most respects; sp. gr. .972; decomposes water with great violence, but does not inflame on account of its rapid motion; if this be restrained by means of gum or sugar, it takes fire and is converted into *soda*. Eq. = 23.3; Symb. (Natrium,) Na. It forms two compounds with oxygen, the *protoxide* (soda,)  $\text{Na O}$ , and the *peroxide*,  $\text{Na O}_3$ ; these are formed like, and correspond with, the analogous compounds of potassium.

*Hydrate of soda*,  $\text{NaO} + \text{HO}$ ,—prepared from the carbonate by the action of quicklime. Very similar in its properties to the hydrate of potassa.

*Carbonate of soda*,  $\text{NaO} + \text{CO}_2 + 10\text{HO}$ . Prepared by lixiviating the ashes of marine plants, and evaporating;—this is known under the commercial names of *barilla*, and *kelp*, which contain many impurities. A purer variety is made by heating together sulphate of soda, lime, and sawdust in a reverberatory furnace. Sulphuret of calcium, sulphurous acid, and carbonate of soda are formed. This salt is in large rhombic crystals, very soluble in water, of a caustic alkaline taste, and alkaline reaction.

*Bicarbonate*,  $\text{NaO} + 2\text{CO}_2 + \text{HO}$ ,—formed as the bicarbonate of potassa. Less soluble than the carbonate.

*Sesquicarbonate*,  $2\text{NaO} + 3\text{CO}_2 + 4\text{HO}$ .—Occurs native.

*Sulphate of soda*—*Glauber's salt*,  $\text{NaO} + \text{SO}_3 + 10\text{HO}$ ; the residue left in the process for making hydrochloric acid. A very soluble salt; more so at  $90^\circ$  than at  $212^\circ$ . There is also a *bisulphate*.

The *nitrate of soda* is very similar in properties to the nitrate of potash. The three *phosphates* are spoken of under the head of phosphorus.

*Chloride of Sodium*,—*Common Salt*,—is found in sea-water and saline springs; it occurs also as a mineral, under the name of rock salt;—procured by evaporation from its solution. The crystals decrepitate when thrown on hot coals; are very soluble in water, and are slightly deliquescent. Iodine, bromine, sulphur, and fluorine, also combine with sodium.

*Tests for soda and its salts*.—All the soda salts are soluble; they communicate a yellow colour to the blowpipe flame. Soda forms with sulphuric acid, the well known Glauber's salt. Soda is less soluble than potassa.

## LITHIUM.

*Prop.*—A white metal resembling sodium, procured by electrical action from *lithia*, its protoxide, which is found in petalite, and some few other rare minerals. The *hydrate of lithia* generally resembles the hydrates of soda and potassa, but is less soluble.

*Test.*—It communicates a carmine-red colour to outer flame of blowpipe.

## SECTION II.

### CLASS II.

#### METALS OF THE ALKALINE EARTHS.

This class includes Barium, Strontium, Calcium, and Magnesium.

#### BARIUM.

Procured by means of mercury from baryta or its carbonate, through the agency of galvanism or heat.

*Prop.*—A grayish-white metal, heavier than water; has a strong affinity for oxygen; malleable.—Symb. Ba.; it forms two oxides.

*Protoxide or Baryta*,  $BaO$ .—Occurs in nature as a carbonate and sulphate; may be obtained by decomposing the nitrate by heat. It has a strong affinity for water, forming with it a hydrate, with the evolution of heat. The hydrate is a white powder, resembling slacked lime; its solution, like lime-water, attracts carbonic acid from the air.

*Peroxide of barium*,  $BaO_2$ , is used in making the peroxide of hydrogen.

The salts of baryta are chiefly remarkable for their high specific gravity; the most important are the carbonate, sulphate, and nitrate. The sulphate is very insoluble. The soluble salts are poisonous. Chlorine, iodine, bromine, and sulphur, form compounds with barium.

*Test for baryta.*—It forms a very insoluble *sulphate*.

#### STRONTIUM.

Procured as barium.—Symb. Sr. Forms two oxides.

*Protoxide*,—*Strontia*,  $SrO$ ,—prepared like baryta, which it much resembles. Its other compounds are similar to those of baryta.

*Test.*—It communicates a blood-red colour to the flame of the blowpipe.

#### CALCIUM.

A silver-white metal, procured like barium;—forms with oxygen two compounds. Symb. Ca.

*Protoxide, Lime*,  $CaO$ ,—obtained by heating the native carbonates.

*Prop.*—Lime is white,—infusible,—has a strong affinity for water, forming with it a solid hydrate, with the evolution of much heat; this is seen in the common process of *slaking*. The hydrate is far less soluble in water than those of baryta and strontia; it is more soluble in cold than in hot water; *lime-water* is thus made. Exposed to the air, it attracts carbonic acid, forming a pellicle; hence it is a good test for carbonic acid; it has an alkaline reaction. The hardening of mortar is probably due to the gradual absorption of carbonic acid, or to the combination of the sand and lime, forming a *silicate*.

The most important salts of lime are the sulphate, carbonate, phosphate, and hypochlorite.

*Sulphate of lime or Gypsum*,  $CaO + SO_3$ , is found native; the native crystals are called *selenite*.

*Prop.*—A sparingly soluble salt; forms with water a hydrate; it is found in most spring water.

*Carbonate of lime, Limestone, or Chalk*,  $\text{CaO} + \text{CO}_2$ , is also found native.—The purest varieties constitute *marble*.

*Prop.*—Insoluble in water, but soluble if carbonic acid be present; exists in many natural waters, as a supercarbonate, and is deposited from them as *stalactites*.

The *phosphate of lime* exists in bones.

Chlorine, iodine, bromine, fluorine, and sulphur form compounds with calcium.

*Chloride of calcium* is prepared by the action of hydrochloric acid on carbonate of lime. It is distinguished for its great affinity for moisture, and hence is of great use to the chemist in removing water from substances; also for forming frigorific mixtures. The *fluoride* is found native as *fluor spar*.

*Hypochlorite of lime*, commonly called *chloride of lime*, is the well-known bleaching powder;—prepared by the action of chlorine on thin strata of hydrate of lime.

*Test for lime.*—Oxalic acid forms an insoluble *oxalate*.

#### MAGNESIUM.

Obtained by heating the chloride with potassium. It is a white, malleable metal; heated in the air, is converted into magnesia.

*Magnesia* is the only oxide,  $\text{MgO}$ .—Prepared by driving off the carbonic acid from the carbonate by heat. It is a soft, white, insoluble powder.

*Carbonate of magnesia* occurs native; may be easily prepared by double decomposition;—is very nearly insoluble.

*Sulphate of magnesia, Epsom salts*,  $\text{MgO} + \text{SO}_3 + 7\text{HO}$ , exists in sea-water, and certain mineral springs; it is very soluble; forms crystals of a right rhombic prism.

*Test for magnesia.*—Forms the well-known Epsom salt with sulphuric acid.

### SECTION III.

#### CLASS III.

##### METALS OF THE EARTHS.

This class includes Aluminium, Yttrium, Glucinium, Zirconium, and Thorium.

#### ALUMINIUM.

Prepared in the same manner as magnesium; has a gray colour; of difficult fusibility; forms alumina when burnt in the air.

*Alumina* is a sesquioxide,  $\text{Al}_2\text{O}_3$ ; exists abundantly throughout nature, constituting the different sorts of *clay*; prepared by adding

carbonate of potassa to a solution of alum; the hydrate of alumina is precipitated.

*Properties.*—Has no taste or smell; feels pasty to the tongue; is very insoluble and infusible; has a strong affinity for water; acts but feebly as a base.

The most important salt of alumina is *alum*—a double sulphate of alumina and potassa: either soda or ammonia may be substituted for the potassa in alum. The salts of alumina are useful as *mordants* in dyeing. Alumina forms the basis of porcelain and earthenware. *Tests for alumina.*—Caustic potash and soda give with it white gelatinous precipitates;—the well-known characteristics of *alum*;—and the blue colour given by nitrate of cobalt by heat.

The remaining metals of the earths are of no particular importance.

## SECTION IV.

### CLASS IV.

#### METALS PROPER.

This class may conveniently be subdivided into three orders, viz.

1. Metals whose oxides are reduced by heat alone,—noble metals;
2. Metals whose oxides form powerful bases;
3. Metals whose oxides form weak bases or acids.

#### ORDER I.—METALS WHOSE OXIDES ARE REDUCED BY HEAT.

##### GOLD.

Occurs either pure, or combined with silver or copper; is usually separated from impurities by amalgamation with mercury, which is afterwards driven off by heat. May be obtained pure by dissolving in nitro-muriatic acid, and then precipitating by a protosalt of iron.

*Prop.*—It has a well-known yellow colour; is the most malleable, and one of the most ductile of all metals; is not tarnished by either air or moisture; sp. gr. 19·3. Symb. (Aurum,) Au. The only solvent for gold is a mixture of nitric and hydrochloric acids, or rather, the solution of chlorine which thence results. An ethereal solution of gold is made by agitating ether with the strong aqueous solution; this may be used for gilding. If, *protochloride of tin* be added to the solution of gold, the *purple powder of Cassius* is thrown down. Gold forms compounds with oxygen, chlorine, iodine, and sulphur. Gold coins are always alloyed with copper or silver, which increase its hardness. The best *test* for gold is the protochloride of tin.

## SILVER.

Occurs native, and in combination with gold and other metals; also with chlorine and sulphur. One of the most abundant silver ores is the *argentiferous galena*. It is extracted either by amalgamation, or by *cupellation*,—the latter process being only applicable to the combinations with lead. Pure silver may be procured by precipitation from a solution in nitric acid, by means of chloride of sodium; and heating the resulting chloride with carbonate of soda.

*Prop.*—The whitest of all metals; has a brilliant lustre; is very malleable and ductile; the best conductor of heat and electricity; sp. gr. 10·5; is not acted upon by moisture or air, unless sulphur be present; its proper solvent is nitric acid; Symb. Ag.; forms two or three oxides, of which the protoxide acts as a base. The most important salt is the *nitrate*, or *lunar caustic*,—made by dissolving silver in nitric acid, and evaporating. The crystals are colourless; very soluble in water; the solution becomes dark coloured when exposed to light, probably from the formation of an oxide.

The *arbor Diana* is made by suspending mercury in a solution of the nitrate: the silver is precipitated in the form of crystals. It is also precipitated by the chlorides, phosphates, chromates, arseniates, arsenites, and several of the metals.

The best *test* is chlorine, or a soluble chloride.

Silver forms compounds with chlorine, iodine, and sulphur.

## PLATINUM.

Occurs only in the metallic state, generally combined with other metals, particularly palladium, osmium, rhodium, and iridium. It is found in grains, which are converted into masses by intense heat and pressure.

*Prop.*—It has a whitish colour; very malleable; the most ductile of metals; the heaviest body in nature; sp. gr. 21·5; is soft; can be welded, like iron; undergoes no change by exposure to air, moisture, or the highest heat of a smith's forge; can only be fused by galvanism or the oxy-hydrogen blowpipe; it is dissolved by nitromuriatic acid. In its habitudes with oxygen, chlorine, and sulphur, it resembles gold.

*Spongy platinum* has the singular property of causing the union of oxygen and hydrogen gases, producing combustion.

*Tests.*—A solution of chloride of potassium produces with chloride of platinum a double chloride, of a pale yellow colour; sal ammoniac gives with it a yellow precipitate, which, by heat, yields spongy platinum.

The metal iridium is said to be a little heavier than even platinum; its sp. gr. being 21·8. The other metals associated with platinum (palladium, osmium, and rhodium), need no particular description.

## MERCURY OR QUICKSILVER.

Occurs in the metallic state; but more frequently as a sulphide or chloride;—extracted by heat, which sublimes the mercury.

*Prop.*—The only metal fluid at ordinary temperatures;—has a silver-white colour, and brilliant lustre; becomes solid at  $-39^{\circ}$ , when it is malleable; boils at  $662^{\circ}$ ;—sp. gr. 13.6; that of frozen mercury, about 14. Pure mercury is not altered by the air at common temperatures, but absorbs oxygen when heated. Hydrochloric acid has no action, nor sulphuric acid, unless concentrated and boiling; nitric acid, even when cold and dilute, acts upon it, forming a nitrate.

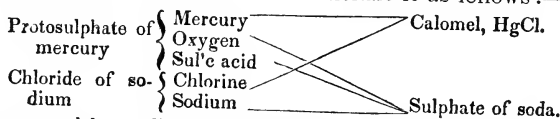
Mercury forms two oxides, the *black* and the *red*. The eq. is 202, (Turner, Hare,) or 101, (Graham, Kane, &c.) The nomenclature of the different compounds will, of course, depend upon the adoption of either one of these.

*Protoxide*,  $\text{HgO}$ , (suboxide,  $\text{Hg}_2\text{O}$ .)—Prepared by action of caustic potash on a solution of the nitrate, or on calomel; it is a dull gray powder, insoluble in water;—decomposed, by the action of light, into the red oxide and metallic mercury.

*Peroxide*,  $\text{HgO}_2$ , (protoxide,  $\text{HgO}$ .) *red oxide*.—Prepared by the combined agency of heat and air; by heating the nitrate; or by precipitation from a solution of corrosive sublimate, by means of potassa. It is often called *red precipitate*. It is in the form of fine red shining scales, very slightly soluble in water; converted by heat into metallic mercury and oxygen.

Chlorine forms two compounds, *calomel* and *corrosive sublimate*.

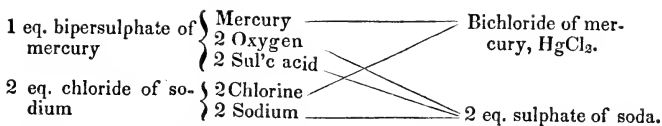
*Protochloride*, or calomel,  $\text{HgCl}$ , (subchloride,  $\text{Hg}_2\text{Cl}$ .) Prepared either by *precipitation*, by means of chloride of sodium in a solution of the nitrate; or by subliming together the protosulphate of mercury and chloride of sodium. The rationale is as follows:—



As prepared by ordinary sublimation, calomel occurs in yellowish white masses; but if the vapour be conducted into a recipient containing watery vapour, it is condensed in a very fine white powder. It is insoluble, tasteless; sp. gr. 7.2; is apt to contain a little corrosive sublimate, which can be removed by washing, or throwing down by ammonia. Potassa or lime decompose it, throwing down the black oxide.

*Bichloride*, or *corrosive sublimate*,  $\text{HgCl}_2$ , (called chloride,  $\text{HgCl}$ .)—Prepared by burning mercury in chlorine gas; by action of hydrochloric acid on the red oxide; or preferably, by subliming together the bisulphate with common salts, thus:—





*Prop.*—Crystalline; soluble in water, alcohol, and ether. The alkalis and their carbonates throw down from it the red oxide; ammonia in excess throws down from its solution the *white precipitate*, which is considered to be an *amo-chloride* of mercury (Kane). *Albumen* is the best antidote for it.

There are two iodides, two bromides, and two sulphides of mercury. The bisulphide occurs native, under the name of *cinnabar*; its powder is called *vermilion*. *Ethiop's mineral* is made by triturating mercury and sulphur together, until the globules disappear; it is considered to be a mixture of sulphur and the bisulphide.

The most important *salts* are formed with nitric and sulphuric acids, each of which unites with the protoxide and the peroxide. The *turpeth mineral* is the subsulphate, formed by throwing the sulphate into water.

## SECTION V.

### ORDER II.—METALS WHOSE OXIDES FORM POWERFUL BASES.

This order includes Iron, Copper, Zinc, Lead, Bismuth, Manganese, Cobalt, Nickel, Cadmium, Uranium, Cerium, and Lanthanum.

#### IRON.

Very rarely occurs native;—exists in *meteorites*, combined with nickel and cobalt. As an oxide, it is widely diffused throughout nature. The most abundant *ores* of iron, are the oxides and sulphurets, or *pyrites*. Some of the ores are magnetic, and some are not. Iron is extracted from its ores by roasting and then exposing to a high heat, along with charcoal; by this means the common *cast iron* is procured; this is converted into *soft* or *malleable* iron by exposure to a strong heat, while a current of air plays upon its surface; by this means the carbonaceous matter is burnt off, and the fusibility of the metal is diminished. *Steel* is a carburet of iron, found by exposing alternate strata of soft iron and charcoal to an intense heat; a direct union ensues, by which the iron acquires greater hardness.

*Prop.*—Iron has a peculiar gray colour—metallic lustre—not very malleable—quite ductile—the most tenacious of all metals—is a hard

metal—of a fibrous texture—sp. gr. 9·7—is very infusible—susceptible of the *welding* process—is attracted by the magnet—may itself be rendered magnetic by heating—does not oxidize in dry air at common temperatures;—heated to redness, it becomes covered with a scaly coating of the black oxide—burns vividly in oxygen—rusts when exposed to air and moisture—decomposes water at a red heat, evolving pure hydrogen, and giving rise to the black oxide. Symb. (Ferrum,) Fe.—Eq. 28.—It forms four compounds with oxygen.

*Protoxide*, FeO,—the base of the native carbonate and of green vitriol. It can hardly be isolated, from its great proneness to absorb oxygen, and to pass into the state of sesquioxide; the hydrate of the protoxide is formed when an alkali is added to a solution of the protosulphate; it is of a dirty green colour, and speedily becomes red by the absorption of oxygen.

*Peroxide*, (*Sesquioxide*)  $\text{Fe}_2\text{O}_3$ ,—occurs in nature under the name of *red hematite*;—made by dissolving iron in nitro-hydrochloric acid, and adding an alkali. *Prop.*—It is not attracted by the magnet;—forms reddish salts with most of the acids. It can easily be detected by the infusion of galls, which gives with it a bluish-black precipitate, the basis of ink,—by ferrocyanide of potassium, which throws down *Prussian blue*,—by sulphocyanide of potassium, which causes a blood-red colour.

*Black*, or *Magnetic Oxide*,  $\text{FeO} + \text{Fe}_3\text{O}_4$ ,—a mixture of the two former oxides;—occurs native—is one of the most valuable of the ores; it is the product of exposing iron to high heat. It does not form salts.

*Ferric Acid*,  $\text{FeO}_3$ ,—only recently discovered—obtained by heating together one part of peroxide of iron with four parts of dry nitre, by which the *ferrate of potash* is found; it is very difficult to isolate, on account of its extreme susceptibility to decomposition.

Iron forms *two* compounds with chlorine.

*Protochloride* FeCl,—formed by dissolving iron in chlorohydric acid and drying.

*Sesquichloride*,  $\text{Fe}_2\text{Cl}_3$ , formed by the combustion of iron wire in chlorine gas. There are also two *iodides*; the protiodide is used in medicine, made by digesting iodine in water with pure iron wire.

Sulphur unites with iron in several proportions.

*Protosulphuret*, FeS,—formed by heating iron and sulphur together; it has a blackish colour,—is attracted by the magnet. There is also a *Sesquisulphuret*,  $\text{Fe}_2\text{S}_3$ .

*Bisulphuret*,  $\text{FeS}_2$ , *iron pyrites*, exists native, has a yellow colour and a metallic lustre; is not magnetic.

*Magnetic iron pyrites*, is a native ore, consisting of a compound of the protosulphide and bisulphide (Stromeyer).

The most important salts of iron are the sulphates, the carbonate, and the nitrate.

*Protosulphate* of iron, *green vitriol*, prepared by dissolving iron in sulphuric acid. It is crystalline—of a beautiful green colour—very soluble—efflorescent. *Sesquisulphate* of iron,—made by action of nitric acid on a solution of the protosulphate; it has a buff colour, and is sparingly soluble. There is only one carbonate—the *proto-carbonate*; this is sometimes found native, and exists in chalybeate springs. There are two *nitrates*.

The best *tests* for iron, are those mentioned under the head of the sesquioxide.

## COPPER.

Occurs sometimes in native crystals; but, most commonly, as a sulphuret, from which the metal is extracted by roasting with charcoal.

*Prop.*—The only red metal except titanium; has considerable lustre; sp. gr. 8·6; is very ductile, malleable, and tenacious; undergoes but little change in dry air; but, when moist, it is converted into a subcarbonate. Symb. (Cuprum,) Cu.—Eq. 31·6. Copper forms two or three oxides.

*Dioxide* or *red oxide*,  $\text{Cu}_2\text{O}$ , occurs native, in octohedral crystals; may be formed by heating together the protoxide and copper filings. It forms colourless salts with bases, which, however, are very unstable, from their tendency to absorb oxygen.

*Protoxide* or *black oxide*,  $\text{CuO}$ , the basis of most of the salts of copper;—prepared by calcining metallic copper, by precipitating from any salt by an alkali, and by heating the nitrate. Colour varies from a dark brown to a black. There is also a *binoxide*. There are two *chlorides*, *iodides*, and *sulphides* of copper, similar in composition to the first two oxides.

The most important salts of copper are the *sulphate*, *nitrate*, *carbonates*, and *acetates*. The sulphate—well known in commerce, as *blue vitriol*—is formed by the action of sulphuric acid on copper. The carbonate occurs native, in the mineral *mallectite*. *Verdigris* is composed of one or more of the acetates of copper. The proper solvent of copper is nitric acid.

*Tests.*—Ammonia, in small quantities, throws down from a solution of the sulphate, the bluish-white hydrated protoxide; but when added in excess, it redissolves the precipitate, forming a deep blue colour. Ferrocyanide of potassium gives a fine reddish-brown ferrocyanide of copper. It is also precipitated upon iron or steel. Copper forms several important alloys, such as *brass*, with zinc; *bell metal*, with tin; *bronze*, with zinc and lead.

## LEAD.

Procured chiefly from the native sulphuret or *galena*, by roasting, which converts most of it into a sulphate; the sulphate and sul-

phuret reacting upon one another, produce sulphurous acid, and free lead.

*Prop.*—A soft, bluish metal; has a metallic lustre when freshly cut; somewhat malleable and ductile, particularly in the form of pipes; not very tenacious; sp. gr. 11.45; melts at 600° F. Exposed to moist air, it becomes coated with a film of the dioxide; also absorbs oxygen when heated in the open air. Symb. (Plumbum) Pb. Eq. 103.6. It forms four oxides.

*Dioxide*,  $Pb_2O$ , formed by heating dry oxalate of lead in a retort; it absorbs oxygen very rapidly.

*Protoxide*,  $PbO$ , the basis of the salts of lead, is prepared by exposing the gray film which collects on the surface of melted lead, and which consists of the protoxide and metallic lead, to a high heat, with the access of air; this constitutes the *massicot* of commerce; when partially fused by heat, it becomes *litharge*; in this state it contains some peroxide. It has a yellow colour, is insoluble in water, unites with acids, forming salts, from which it is precipitated by alkalies as a hydrate, and as *white lead* by alkaline carbonates.

*Peroxide*, *puce*, or *brown oxide*,  $PbO_2$ , prepared by the action of nitric acid or red lead, which converts it into the protoxide and peroxide. It has a flea-colour; is insoluble; by heat, it is converted into protoxide and oxygen.

*Red lead*, *minium*, or *red lead*,  $Pb_3O_4$ , or  $2PbO + PbO_2$ , considered to be a compound of the protoxide and peroxide; is formed by exposing lead to heat in the air, without allowing it to fuse. It is a heavy, brilliant red powder; decomposed, with the evolution of oxygen, by a strong heat; and converted into a mixture of protoxide and peroxide by acids. It is used as a pigment, and in the manufacture of flint-glass.

Chlorine forms with lead a compound known as *plumbum corneum*, or horn lead. Sulphur forms with lead the well-known *galena*, which occurs in cubical crystals. Iodine, bromine, fluorine, and phosphorus also form compounds with lead. The most important salts of lead are the *carbonate* and *acetate*; also the nitrate and sulphate.

*Carbonate of lead*, *White lead*,—is sometimes found in a native crystalline state; may be prepared by precipitating from any soluble salt of lead by means of an alkaline carbonate;—is manufactured by exposing sheet-lead in coils to the action of the vapour of vinegar, at the temperature of decomposing manure: the lead is oxidized, and then converted into a carbonate by the carbonic acid, which is derived from the decomposition of the acetic acid. It is a soft, white, very heavy powder, insoluble in water; much used as a pigment.

*Acetate of lead*, *Sugar of lead*,—made by dissolving litharge in acetic acid; occurs in colourless, transparent crystals; has a sweet taste; is very soluble in water, also in alcohol. There are several

*subacetates* of lead, made by boiling a solution of the acetate in litharge.

*Nitrate of lead*, prepared by the action of nitric acid on lead. Nitric acid is the proper solvent of lead;—it is soluble.

*Sulphate of lead*, prepared by the action of a soluble sulphate, on a solution of the acetate of lead; it is a very insoluble salt. Cold sulphuric acid has no action on lead; but when boiling, the lead is slowly oxidized at the expense of the acid. Hydrochloric acid has no action on lead.

*Tests.*—The alkaline carbonates throw down the insoluble carbonate; the soluble sulphates throw down the insoluble sulphate; and sulphuretted hydrogen or a soluble hydrosulphate, throws down the black sulphuret.

### ZINC.

Occurs in nature as a carbonate, (*calamine*), or as a sulphuret, (*zinc blende*.) It is procured from the former by heat and charcoal; and from the latter by a similar process, after roasting the ore; at a high temperature, the metal, being volatile, comes over by distillation.

*Prop.*—A bluish-white metal; has a crystalline texture; sp. gr. 7; brittle at common temperatures; malleable between 250° and 300°; very brittle at 400°; melts at 773°, and at a bright red heat it boils and burns with a brilliant green light, generating the oxide. It is called *spelter* in commerce, and is never quite pure; is slightly tarnished by exposure to the air. Symb. (Zincum) Zn.—Eq. 33.

*Oxide of Zinc*, ZnO;—prepared by burning zinc in the air, or by heating the carbonate. It is a white, insoluble powder, the basis of the salts of zinc.

*Chloride of Zinc*, ZnCl.;—prepared by heating metallic zinc in chlorine, or by dissolving zinc in hydrochloric acid, and drying. It is a white substance, has the consistence of butter, and hence called *butter of zinc*; very deliquescent, and soluble in water and alcohol.

The important salts of zinc, are the sulphate and the carbonate.

*Sulphate of Zinc, white vitriol*;—made by acting on zinc with dilute sulphuric acid; the water is decomposed, its oxygen going to the zinc, and the hydrogen escaping. It is a white, crystalline, soluble salt.

*Carbonate of Zinc*,—occurs native, and may be formed by double decomposition between any soluble carbonate and the sulphate of zinc.

### CADMIUM.

This metal is usually found associated with zinc, in the reduction of which from its ores, the cadmium, being more volatile, flies off.

*Prop.*—It resembles tin in colour; very malleable; very volatile;

sp. gr. 8.7; melts below  $500^{\circ}$ ; when strongly heated, it burns, forming the *oxide*.

#### BISMUTH.

Occurs both native, and in combination; may be procured pure by heating the subnitrate with charcoal.

*Prop.*—A crystalline metal, of a reddish-white colour and metallic lustre; when slowly cooled, it yields cubical crystals; fuses at  $476^{\circ}$ , and in close vessels sublimes unchanged; in the open air burns with a bluish flame, and is converted into the *oxide*; its proper solvent is nitric acid. It forms two oxides. Sp. gr. 10.—Eq. 71.

*Protoxide*,  $\text{BiO}$ ;—the basis of all the salts, has a yellow colour; obtained by heating the subnitrate.

*Peroxide*  $\text{Bi}_2\text{O}_3$ .—Bismuth unites also with chlorine and sulphur.

*Nitrate of Bismuth*;—made by dissolving the metal in nitric acid, and evaporating. This, when thrown into water, is decomposed into the soluble *supernitrate*, and the insoluble *subnitrate*, which subsides as a white powder.

The best *test* is the formation of the subnitrate.

#### MANGANESE.

Is found in nature as an *oxide*; procured from this by intensely heating with charcoal.

*Prop.*—A hard, brittle metal, of a grayish-white colour, very infusible, sp. gr.; about 8; forms *seven* compounds with oxygen, viz.: Protoxide,  $\text{MnO}$ , Sesquioxide,  $\text{Mn}_2\text{O}_3$ , Peroxide,  $\text{MnO}_2$ , Red oxide,  $\text{Mn}_3\text{O}_4$ , Varvicite,  $\text{Mn}_4\text{O}_7$ , Manganic acid,  $\text{MnO}_3$ , Permanganic acid,  $\text{Mn}_2\text{O}_7$ . The most important of these, to the chemist, is the peroxide, or black oxide, which occurs abundantly in nature. It is used in the arts, in the manufacture of glass; and by the chemist for procuring chlorine, bromine, and oxygen.

#### NICKEL AND COBALT.

These two metals strongly resemble each other: both occur in combination with arsenic. Nickel is found associated with meteoric iron, and is strongly magnetic. Cobalt is not so. Both have a white colour. Nickel is malleable; Cobalt is brittle. Nickel is employed in the arts, in the preparation of *German silver*—an alloy of copper, zinc, and nickel.

The best *test* to distinguish cobalt from nickel, is the fine blue colour communicated by the former to the flame of the blowpipe, when fused with borax.

#### URANIUM, CERIUM, AND LANTANUM.

These are very rare metals, and of no practical use. The latter, Lanthanum, was very recently discovered by Mosander.

## SECTION VI.

## ORDER III.—METALS WHOSE OXIDES FORM WEAK BASES, OR ACIDS.

This order includes Tin, Antimony, Arsenic, Chromium, Vanadium, Tungsten, Molybdenum, Columbium, Titanium, Tellurium, and Osmium.

## TIN.

Is found in nature as an *oxide*, from which it may be procured by heating with charcoal. The varieties known in commerce are *block* and *grain tin*.

*Prop.*—Has a white colour, silvery lustre, is very slowly tarnished by exposure to the air; very malleable, quite ductile, soft, and inelastic, and produces a crackling noise, when bent backwards and forwards; sp. gr. about 7; fuses at  $442^{\circ}$ ; heated to whiteness, it burns, and is converted into the peroxide. Symb. (Stanum) Sn.—Eq. 58. It forms three oxides.

*Protoxide*,  $\text{SnO}$ ;—formed by adding an alkaline carbonate to a solution of the protochloride; a white hydrated protoxide falls.

*Sesquioxide*,  $\text{Sn}_2\text{O}_3$ ;—has a grayish colour.

*Peroxide*,  $\text{SnO}_2$ ;—prepared either by precipitating by an alkali from a solution of the perchloride, or by the action of nitric acid on metallic tin. Very strong nitric acid has no effect on tin; but, if diluted, violent effervescence ensues from the escape of nitrous acid and binoxide of nitrogen, and the hydrated peroxide is produced; ammonia is also generated at the same time, the hydrogen being furnished by the water.

*Protochloride*,  $\text{SnCl}$ ;—made by dissolving tin in hot hydrochloric acid; occurs in crystals. It is much used as a deoxidizing agent.

*Perchloride*,  $\text{SnCl}_2$ , called the *fuming liquor of Libavius*;—made by heating the protochloride, or metallic tin, in chlorine; it is a very volatile, colourless liquid, emitting dense white fumes on being exposed to the air; it is used as a *mordant* in dyeing.

There are three sulphurets of tin—the *protosulphuret*, *sesquisulphuret*, and *bi-sulphuret*; the latter is sometimes termed *mosaic gold*.

*Test.*—Solution of chloride of gold throws down, with the protochloride of tin, the *purple of Cassius*.

## ANTIMONY.

Occurs in nature generally as a *sulphuret*, which, in commerce, is called *crude antimony*, while the pure metal is named *regulus of antimony*. It may be obtained from the sulphuret by heating it with iron filings.

*Prop.*—A bluish-white colour—crystalline structure—brittle—sp.

gr. 6·8 ;—at a high temperature it burns in the open air, the vapour condensing in white crystals of the sesquioxide, (*argentine flowers of antimony*;) it is acted upon by both nitric and hydrochloric acids. Symb. (Stibium) Sb.—Eq. 129. It forms three compounds with oxygen.

*Sesquioxide*,  $Sb_2O_3$ ,—prepared by burning antimony in the open air,—by precipitation from a solution of tartar emetic by means of an alkaline carbonate, or by the action of carbonate of potassa or soda on the sesquichloride, when put into water. It is a pale yellow powder—volatile—liable to absorb oxygen;—the basis of all the antimonial salts.

*Antimonious acid*,  $Sb_2O_4$ ,—made by heating the oxide in open vessels;—a grayish-white powder—insoluble—combines with alkalis.

*Antimonic acid*,  $Sb_2O_5$ ,—made by action of strong nitric acid in antimony; an insoluble straw-coloured powder; unites with alkalis, to form *antimonates*.

*Sesquichloride*,  $Sb_3Cl_2$ , (*butter of antimony*),—made by burning antimony in chlorine gas; a soft solid at common temperatures; when put into water, hydrochloric acid and the sesquioxide are generated, and the latter combined with some undecomposed chloride, subsides as the *powder of Algaroth*. There are one or two other chlorides.—There are several *sulphurets*, of which the most important is the native *sesquisulphuret*; it is a lead-gray substance, brittle and fusible. It may be made by melting sulphur and antimony together.

*Kermes mineral*.—Prepared by boiling sesquisulphuret of antimony in a solution of caustic potassa; a partial double decomposition ensues, by which an oxide of antimony, and a sulphuret of potassium are formed; the latter unites with undecomposed sulphuret of antimony to form a sulphur-salt, in which the sulphuret of antimony is the acid, and sulphuret of potassium the base. As the solution cools this double salt becomes decomposed, the sesquisulphuret of antimony subsiding along with a variable portion of potassa and oxide of antimony. This is the *kermes*, which may hence be considered as an *oxy-sulphuret*. The mother waters still contain some of the above sulphur-salt, together with potassa and oxide of antimony; and, on the addition of sulphuric acid, the sesquioxide and sesquisulphide are precipitated together, but without the potassa; this is the *golden sulphuret*.

The most important salt of antimony is *tartar emetic*;—made by boiling cream of tartar with the sesquioxide of antimony. It is a white, crystalline, soluble salt, which gives a brick-red precipitate (the sesquisulphuret) with sulphuretted hydrogen; it also yields precipitates with the alkalis, earths, tannic acid, &c.



## ARSENIC.

Is sometimes found native, but is generally procured from the native arseniuret of cobalt and nickel, by means of heat.

*Prop.*—A steel-gray colour; metallic lustre; very brittle; tarnishes in the air; sp. gr. 5·9; volatilizes by heat, and, if air be present, is converted into arsenious acid; its vapour has the odour of garlic. Symb. As.—Eq. 76·4. It forms two well known compounds with oxygen, *arsenious* and *arsenic* acids;—no basic compound.

*Arsenious acid, white oxide of arsenic, fly powder, As<sub>2</sub>O<sub>3</sub>*,—is always generated when arsenic is heated in the open air; that of commerce is derived by roasting the native ores of cobalt. It is quite transparent and glassy when first prepared, but becomes opaque by exposure; volatile at 380°; vapour is inodorous, and condenses on cool surfaces; not very soluble in water; reddens vegetable blues feebly; combines with bases, forming *arsenites*; it has an acid taste and is very poisonous.

*Arsenic acid, As<sub>2</sub>O<sub>5</sub>*,—made by dissolving arsenious acid in strong nitric acid, mixed with a little hydrochloric acid, and evaporating to dryness. It is sour to the taste; much more soluble in water than arsenious acid; forms *arseniates*; is isomorphous with phosphoric acid; when strongly heated, is converted into arsenious acid and oxygen.

There are three well known sulphurets of arsenic.

*Protosulphuret* or *Realgar*, AsS, occurs native;—may be made by heating together sulphur and arsenious acid; colour, ruby red.

*Sesquisulphuret* or *Orpiment*, As<sub>2</sub>S<sub>3</sub>, is also found native;—made by transmitting sulphuretted hydrogen through a solution of arsenious acid; colour, yellow,—called *king's yellow*.

*Persulphuret*, As<sub>2</sub>S<sub>5</sub>, made by action of sulphuretted hydrogen on a solution of arsenic acid; it resembles orpiment in colour. The sulphurets are poisonous.

Arsenic also unites with chlorine, iodine, &c.

*Arsieniuretted hydrogen*, As<sub>2</sub>H<sub>3</sub>, prepared by adding arsenious acid to the materials for generating hydrogen; colourless; odour of garlic; sp. gr. 2·6; burns with a blue flame, generating arsenious acid; a non-supporter of combustion; very poisonous when breathed; slightly soluble in water.

*Tests for arsenic.*—1. Ammoniacal nitrate of silver (made by adding ammonia to a solution of nitrate of silver, until the oxide of silver which is thrown down is nearly all dissolved); arsenious acid added to this, throws down the insoluble arsenite of silver of a yellow colour.

2. *Ammoniacal sulphate of copper*, (made by adding ammonia to a solution of sulphate of copper,) throws down with arsenious acid, the insoluble arsenite of copper (*Scheele's green*).

3. *Hydrosulphuric acid*, when transmitted through a solution of arsenious acid, precipitates the sesquisulphuret, (orpiment.)

4. The production of *arsienuretted hydrogen*.—By adding the matter containing arsenic to the materials for generating hydrogen, on burning a jet of this gas, and holding over it a piece of glass or porcelain, an *arsenical ring* is formed. None of the above tests can be relied on singly. The best method is to *reduce* the arsenic by means of heat and charcoal, (or black flux,) in a glass tube; by which means the *arsenical ring* may always be produced, and the peculiar odour of burning arsenic be detected. The proper antidote for arsenic is the *hydrated peroxide of iron*, in a moist state.

The remaining metals of this order are Chromium, Vanadium, Tungsten, Molybdenum, Columbium, Titanium, Tellurium, and Osmium. None of them are of practical importance except *chromium*, two salts of which are much used in the arts, viz. : *chromate of lead*, (chrome yellow,) and the *bichromate of potash*.

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## CHAPTER III.

### SALTS.

THE term *salt* was formerly restricted to a compound of an acid and a salifiable base; but this definition was necessarily vague, on account of the difficulty of always accurately defining what was an acid and what was a base. Formerly an acid was considered to be an oxidized body which has a sour taste, reddens litmus, and neutralizes alkalies. Subsequent discovery showed the propriety of extending this definition; for, first, the discovery of the hydracids proved that oxygen is not essential to acidity; and secondly, some compounds, owing to their insolubility, have neither a sour taste, nor do they redden litmus; yet they neutralize bases; thirdly, there are some acknowledged acids, as carbonic, hydrocyanic, &c., which are unable fully to destroy the alkalinity of potassa.

Chemists of the present day agree to call all such bodies *acid* which unite with potassa or ammonia, and give rise to bodies similar in constitution and general character, to the salts which sulphuric or some other admitted acid forms. For similar reasons, the present notion of what constitutes an alkaline or salifiable base, is that of a body which unites definitely with admitted acids, to form with them compounds resembling recognised salts.

There is a very important class of compounds, which, however, would not fall within the range of the above definition of a salt; and which yet have undoubted claims to be considered as such: they

comprise the chlorides, iodides, bromides, &c., and are named *haloid* salts, from a Greek word signifying *sea salt*.

The notion of a salt has been still farther extended. It is known that two metallic sulphurets occasionally unite together to form a compound called a *double sulphuret*. To such compounds Berzelius gave the name of *sulphur-salts*. They are precisely analogous in their composition to a common oxy-salt, as may be seen by simply substituting for the sulphur an equivalent quantity of oxygen. In these salts, the *sulphur-acid* is a sulphuret of some one of the electro-negative metals, as arsenic, antimony, tungsten, &c.; the *sulphur-base* is a sulphuret of an electro-positive metal, as potassium, sodium, mercury, &c.

It has also been found that the haloid salts will unite together, to form what is termed a *double haloid salt*; which also may be considered precisely analogous to an oxy-salt, the halogen element (chlorine, iodine, &c.), simply taking the place of oxygen.

By a *double salt* is meant one in which the same acid is united with two separate bases, as tartar emetic, (tartrate of oxide of antimony and potassa.)

Nearly all salts are solid at common temperatures; most are capable of crystallizing; their colour is variable; the soluble ones are more or less sapid; very few are odorous; they differ much in their affinity for water: some attract moisture from the air and become liquid; such salts are called *deliquescent*; they differ very much in their solubility in water, which is in the direct ratio of their affinity for water, and in the inverse ratio of their cohesion. In many salts water acts as a base, and is hence termed *basic water*.

As a general rule, every salt has its own distinct *crystalline* form, by which it may be recognised. Crystallization may be effected in various ways, as by solution and evaporation: the slower the evaporation, the larger and more regular the crystals; if the evaporation be made very rapid by heat, a confused crystalline mass is obtained. Fusion and slow cooling may sometimes be employed; thus crystals of sulphur and bismuth may be procured. A third condition under which crystals form, is in passing from the gaseous to the solid state, as in the case of iodine.

Many salts, in crystallizing, unite chemically with a definite portion of water, which belongs to the crystal, but not to the salt; this is termed *water of crystallization*. By a strong heat, all this water is expelled, and the salt is said to undergo the *watery fusion*. Such salts, when exposed to the air, are liable to part with a portion of this water, and crumble down into a powder; they are said then to be *efflorescent*.

Some salts, again, in crystallizing, enclose a portion of water mechanically within their texture; which, by its expansion, when

the salt is heated, causes it to burst with a crackling noise; this is termed *decrepitation*.

Atmospheric pressure exerts an influence on the crystallization of salts; if, for instance, a hot saturated solution of sulphate of soda be corked up in a bottle while the latter is full of vapour, the solution will cool down to the temperature of the air without crystallizing; but on admitting the air, crystallization commonly commences, and the whole becomes solid in a few seconds.

Crystals are of various forms: they are divided by crystallographers into *simple* and *compound*. By *cleavage* is meant that property of a crystal by which it admits of being split in certain directions.

Bodies are said to be *isomorphous* when they have the same crystalline structure, but a different chemical composition: thus arseniate of soda is isomorphous with phosphate of soda. On the other hand, the same substance may have, under different circumstances, two crystalline forms; in which case it is said to be *dimorphous*: sulphur and carbon are examples. The instrument employed to ascertain the angles of crystals is termed a *goniometer*.

## SECTION I.

### OXYSALTS.

This class of salts includes those, of which both the acid and base are oxides. It will be convenient to classify them according to their different acids.

#### SULPHATES.

Their solutions may always be recognised by yielding a white precipitate, (sulphate of baryta) with a solution of a salt of baryta. Heated in contact with charcoal or hydrogen they are converted into sulphurets, which, if moistened, yield the peculiar odour of sulphuretted hydrogen. They are almost all insoluble in alcohol. The sulphates of baryta, tin, antimony, lead and bismuth, are quite insoluble in water. Those of lime, strontia, mercury, silver, and a few others, are *nearly* insoluble; while all the other sulphates are soluble.

The most important sulphates are those of potassa, soda, magnesia, lime, baryta, iron, copper, zinc, and mercury.

The most important *double sulphates* are the different *alums*. Common alum is a double sulphate of alumina and potassa. It may be prepared from native *alum stone*, in which the materials exist ready formed, or from a direct union of its constituents.

There are other varieties of alum, in which the sulphate of potassa is replaced by sulphate of soda, or sulphate of ammonia;—also *iron*

and *manganese* alums, in which the sulphate of alumina is replaced respectively by the sulphate of iron, and the sulphate of manganese.

The *Sulphites*, *Hyposulphites*, and *Hyposulphates* are of very little practical importance.

## NITRATES.

These may be prepared by the action of nitric acid on metals,—on the salifiable bases,—or on the carbonates. As they are soluble salts, their acid cannot be precipitated by any reagent. They are distinguished by deflagrating with charcoal and other combustibles. When exposed to a high temperature, they are decomposed with the evolution of oxygen gas. If subjected to the action of sulphuric acid, they give off nitric acid fumes. When added to hydrochloric acid they form a solvent for gold leaf, by liberating the chlorine.

The most important nitrates are those of potassa, soda, ammonia, copper, mercury, and silver.

The *Nitrites* are comparatively unimportant.

## CHLORATES.

These are very analogous to the nitrates. They are all decomposed by a red heat into metallic chlorides and oxygen gas. They deflagrate with combustibles even more violently than the nitrates. They are nearly all soluble in water.

The most important salt of this class is the *chlorate of potassa*, which is useful to the chemist in the preparation of oxygen.

The *Chlorites* are chiefly remarkable for their bleaching and oxidizing properties.

The *Hypochlorites* may be produced by the action of chlorine gas upon salifiable bases. The most important of them is the *hypochlorite of lime*, the well-known bleaching powder, commonly called chloride of lime. It is prepared by exposing thin strata of recently slaked lime to an atmosphere of chlorine: the chloride of calcium and hypochlorite of lime are formed.

## IODATES.

These are compounds of iodic acid and a base. They bear a general resemblance to the chlorates, and may be recognised by the facility with which they are decomposed by deoxidizing agents, as hydrochloric, sulphurous, and phosphorous acids, which unite with the oxygen, setting iodine free.

The *Bromates* generally resemble the iodates.

## PHOSPHATES.

As regards this class of salts, it is to be remembered that there are three isomeric phosphoric acids, termed *tribasic*, *bibasic*, and *monobasic*, or *phosphoric*, *pyrophosphoric*, and *metaphosphoric* acids.

Each one of these modifications forms its own peculiar salts, the tests for which were spoken of under the head of Phosphorus. The most important phosphates are those of soda, lime, ammonia, lead, and silver.

#### CARBONATES.

These are distinguished by their facility of decomposition by any of the acids, with effervescence. All the alkaline carbonates are decomposable by heat, except those of potassa, soda, baryta, strontia, and probably lithia. All, except those of potassa, soda, and ammonia, are sparingly soluble in water; but are more or less soluble in an excess of carbonic acid. Several of the carbonates occur native, as those of lime, magnesia, soda, baryta, iron, copper, and lead.

The most important carbonates are those of potassa, soda, lime, ammonia, magnesia, baryta, iron, copper, and lead.

#### ARSENITES AND ARSENIATES.

These are salts of arsenious and arsenic acids respectively. The *arsenites* are all decomposed by a red heat; the arsenious acid being either dissipated in the form of vapour, or converted into arsenic acid.

The *arseniates* are not so easily decomposed, requiring usually along with heat the aid of charcoal or black flux.

#### CHROMATES.

The salts of chromic acid are mostly of a yellow or red colour, the latter tint predominating whenever the acid is in excess; they are valuable as pigments. The most important of the chromates are those of potassa and lead.

#### BORATES.

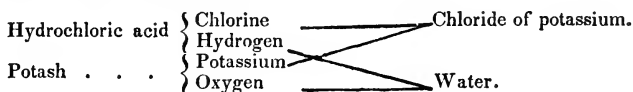
The salts of boracic acid are very easily decomposed. The most important one is the *biborate of soda*, or common borax. They may all be recognised by their solutions in strong alcohol, burning with a greenish flame.

## SECTION II.

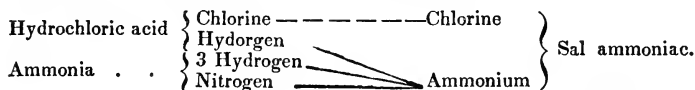
#### HYDROSALTS.

By this term is understood such salts, of which either the acid or base contains hydrogen. Formerly, this class of salts was much more extensive than it is at present, in consequence of the different views taken of the composition of the so called *muricates*, or *hydrochlorates*; but which are now generally spoken of as chlorides. Indeed, all the haloid salts are now considered as compounds of the halogen element (chlorine, iodine, bromine, &c.) with a metal, rather than as compounds of a hydracid with the oxide of the metal, which was the

former view. According to the present doctrine, when a hydracid is presented to any salifiable base, both are decomposed, water and a haloid salt of the metal being formed. Take hydrochloric acid and potash by way of example :



The only hydro-salts which are now at all recognised are the compounds of ammonia with a hydracid; though even these might be considered as haloid salts of the hypothetical metal *ammonium*. This will be evident by the following diagram :—



The most important of the ammoniacal salts are the *hydrochlorate*, commonly called sal ammoniac, and the *hydrosulphate*, formerly termed the *fuming liquor of Boyle*.

### SECTION III.

#### SULPHUR SALTS.

The sulphur salts are double sulphurets, just as the oxy-salts are double oxides; the sulphuret of one metal acting as an acid, while the sulphuret of another metal acts as a base. The sulphur salts are so constituted, that if the sulphur in both the acid and base was replaced by oxygen, an oxy-salt would result.

The principal *sulphur-bases* are, the protosulphurets of potassium, sodium, lithium, varium, strontium, calcium, and magnesium; and the principal *sulphur-acids* are the sulphurets of arsenic, tin, antimony, tungsten, molybdenum, tellurium, and gold, together with hydrosulphuric acid and bisulphuret of carbon. Kermes' mineral, an important antimonial medicine, is an example of a sulphur salt, being composed chiefly of sulphuret of antimony, united with sulphuret of potassium.

### SECTION IV.

#### DOUBLE HALOID SALTS.

These salts are composed of two simple haloid salts, one of which acts as an acid, and the other as a base, in a manner analogous to the double sulphurets. The principal groups consist of double chlorides, double iodides, and double fluorides.

When an oxide and chloride unite, they constitute a compound known by the name of *oxy-chloride*.

## PART III.

### ORGANIC CHEMISTRY.

#### GENERAL OBSERVATIONS.

ORGANIC substances, whether derived from the vegetable or animal kingdom, are chiefly remarkable for the complexity of their composition, and for the limited number of their elements. Only *four* elements are considered essential to the composition of organic matter, viz. carbon, oxygen, hydrogen, and nitrogen,—though others are occasionally met with, as sulphur, phosphorus, chlorine, sodium, &c.; altogether they do not amount to more than fifteen. There appears, however, to be no limit to the number of definite compounds which may be produced out of merely the four above-named essential elements, simply by a difference in their proportions and mode of arrangement.

In consequence of the complexity of organic bodies, they are generally very instable, being prone to decomposition whenever the restraining force is removed. The products of such decomposition are water, carbonic acid and ammonia; and if sulphur be present, sulphuretted hydrogen.

As a general rule, the more complex is the constitution of an organic body, the more liable is it to decomposition; but this tendency is much lessened if the elements are in such proportions as completely to *saturate* each other; thus in sugar, starch, and lignin, the proportions of oxygen and hydrogen are exactly sufficient to saturate each other, and to form water.

Vegetable organic matter is usually *ternary* in its composition, and is not so prone to decomposition as animal organic matter, which is generally *quarternary*. Both are invariably decomposed by heat.

*Isomeric* bodies are frequently met with among organic substances. By this term is meant bodies having the same chemical composition, but possessing very different properties; starch, sugar and gum are examples. Isomerism is believed to depend upon a *different arrangement* in the constituent atoms of a body,—their number remaining the same.



## SECTION I.

## OF COMPOUND RADICALS.

By the term *compound radical*, is meant a substance which, although containing two or more elements, acts precisely as a simple elementary body. The following are the most important of the admitted compound organic radicals, together with their chemical composition expressed in symbols.

	Formula.
Carbonic oxide, or protoxide of carbon, - - -	CO.
Cyanogen, or bicarburet of nitrogen, - - -	C <sup>2</sup> N.
Mellon, or sesquicarburet of nitrogen, - - -	C <sup>6</sup> N <sup>4</sup> .
Benzoile, benzule, or benzyle, - - -	C <sup>14</sup> H <sup>5</sup> O <sup>3</sup> .
Cinnamyl, or cinnamule, - - -	C <sup>18</sup> H <sup>8</sup> O <sup>3</sup> .
Salicyle, or salicule, - - -	C <sup>14</sup> H <sup>5</sup> O <sup>4</sup> .
Acetyl, or acetule, - - -	C <sup>4</sup> H <sup>3</sup> .
Formyl, or formule, - - -	C <sup>2</sup> H.
Amide, - - -	NH <sup>2</sup> .
Ethyl, or ethule, - - -	C <sup>4</sup> H <sup>5</sup> .
Methyl, or methule, - - -	C <sup>2</sup> H <sup>3</sup> .
Cetyl, or cetule, - - -	C <sup>32</sup> H <sup>33</sup> .
Glyceryl, or glycerule, - - -	C <sup>6</sup> H <sup>7</sup> .
Amyl, or amule, - - -	C <sup>10</sup> H <sup>11</sup> .
Mesetyl, or mesetule, - - -	C <sup>6</sup> H <sup>4</sup> .
Kacodyl, or kacodule, - - -	C <sup>4</sup> H <sup>6</sup> .

Besides these, there are some subordinate compound radicals. A few of the above radicals will be noticed now; the others will be spoken of when their compounds come under consideration.

*Amide* NH<sup>2</sup>, or amidogen. This compound radical is believed to be generated when ammonia is heated in contact with potassium or sodium; hydrogen is liberated, and a compound formed of amyde and the metal. When the amyde of potassium or sodium thus generated is put into water, this liquid forms ammonia by yielding up hydrogen to the amyde; and at the same time it converts the potassium into potash by giving up its oxygen. According to this view, ammonia is an amyde of hydrogen. Ammoniated mercury (white precipitate) is a compound of amyde and the bichloride of mercury.

*Carbonic oxide*, CO, has already been spoken of as a compound of carbon. By combining with carbonic acid, CO<sup>2</sup>, it constitutes *oxalic acid*, C<sup>2</sup>O<sup>3</sup>. The most important compounds of this radical are *carbamide*, *oxamide*, and *chloroxy-carbonic acid*, a compound of carbonic oxide and chlorine.

*Benzule* or *Benzyle*, C<sup>14</sup>H<sup>5</sup>O<sup>3</sup>,—the hypothetical radical of ben-

zoic acid, and of the oil of bitter almonds. By the addition of an atom of oxygen and an atom of water, it forms benzoic acid. By substituting an atom of hydrogen for an atom of oxygen, benzoic acid is converted into the oil of bitter almonds, or the *hydruret of benzule*. This hydruret does not pre-exist in the bitter almonds, but is the result of the reaction of two organic principles contained therein, denominated amygdalin and emulsin, or synaptase, with water.

Benzule forms a compound with amide called *benzamide*.

*Cinnamyl*,  $C^{15}H^8O^3$ , has much analogy with benzule. It is the radical of the *oil of cinnamon*, and of a few other compounds.

*Glyceryl*,  $C_6H_7$ , the compound radical of *glycerine*, the hydrated oxide of glyceryl, which is the base common to many oils and fats. Glycerine will be more fully spoken of under the head of Oils.

*Cetyl*,  $C_{32}H_{33}$ , an organic radical, which performs precisely the same part in spermaceti that glyceryl does in ordinary fats.

## SECTION II.

### VEGETABLE NON-AZOTIZED SUBSTANCES.

These embrace *Gum*, *Sugar*, *Fecula*, or *Starch*, and *Lignin*; and, according to Prout, they may be considered as *hydrates of carbon*.

#### GUM.

This is a proximate principle, which spontaneously exudes from various trees. It is distinguished from resin by being soluble in water and being insoluble in alcohol.

Guerin divides the gums into three classes:—1. *Arabin*, of which gum arabic is the type, soluble in cold water. 2. *Bassorin*, of which tragacanth is the type, which swells into a jelly, but does not dissolve in water. 3. *Cerasin*, from the gum of the cherry-tree; insoluble in cold, but soluble in hot water.

The *mucilage* of gum arabic differs somewhat from the mucilage of flaxseed: the former is precipitated by the *subacetate* of lead; the latter by the neutral *acetate*.

*Pectine*, or the jelly of fruits, seems closely allied to the gums. It forms *pectic acid*.

#### SUGAR.

This is found in various saccharine natural juices, as of the Sugar Cane, the Maple, the Beet, &c. There are several varieties of sugar.

*Cane sugar*,  $C_{24}H_{22}O_{22}$ ; prepared from the juice of the sugar-cane by boiling and evaporating; this constitutes *common brown sugar*; it is refined by dissolving in water, and removing the impurities by

means of coagulating albumen. The uncrystallizable portion is named *molasses*.

*Grape sugar*,  $C_{24}H_{28}O_{28}$ , exists in many vegetable juices, especially in grapes. Examples of it are seen in candied sweetmeats, and in raisins; it also occurs in the urine in *diabetes*. Grape sugar differs from cane sugar in several particulars: it is less sweet, less soluble, and does not form such regular crystals. Strong mineral acids have but little effect on grape sugar; the alkalis, on the contrary, produce a decided effect.

*Sugar of milk, lactine*,  $C_{24}O_{24}H_{24}$ ;—this is the sweet principle of milk: it is procured by evaporating whey. It undergoes fermentation, like other sugars, but is believed to be converted into grape sugar in the process.

*Mannite or Manna sugar*  $C_6H_7O_6$ ;—this differs from other sugars in not undergoing the vinous fermentation. There is also a sugar from *mushrooms* and *liquorice*.

#### FECULA, OR STARCH.

A very abundant proximate vegetable principle, abounding in roots, stems, and seeds. It is procured from flour or potatoes by the action of a stream of water upon them so as to wash of the insoluble particles of fecula.

*Prop.*—Insoluble in cold water, alcohol, or ether; appears to be a homogeneous substance, but if examined by the microscope, it is found to consist of granules, having a thin insoluble envelope; when starch is put into hot water, the envelope bursts, liberating the contents, which form with the water a gelatinous mass. The most delicate test for starch is iodine, which forms with it a blue colour.

The size of the granules of fecula varies very much, according to the source from which it is derived. Arrow-root, sago, and tapioca, are examples of pure fecula.

In the process of the germination of seeds, and of the fermentation of malt, the starchy matter of the grain is converted into a sweetish, gummy matter, called *dextrine*, and ultimately into grape sugar. The cause of this remarkable change is due to a peculiar principle found resident in the grain at that period, named *diastase*, which acts by *catalysis*,—itself undergoing no change.

Dextrine has the same composition as starch. It is used in the arts as a substitute for gum. Sulphuric acid also has the power of converting starch into sugar. Nitric acid converts it into oxalic acid.

#### LIGNIN, OR CELLULOSE.

This constitutes the basis of vegetables and of wood. It is procured from sawdust by dissolving it successively in water, alcohol, ether, dilute acid, and an alkaline solution. It has no taste, but may

be converted into dextrine and grape sugar by the action of strong sulphuric acid. In its composition it is isomeric with starch.

### SECTION III.

#### AZOTIZED VEGETABLE SUBSTANCES.

These include *Gluten*, *Vegetable albumen*, *Vegetable fibrin*, and *Vegetable casein*, or *Legumen*. They are sometimes called *vegeto-animal* principles, from their strong analogy with similar principles found in animals.

*Gluten*.—It owes its name to its adhesive property: to it is due the adhesiveness of wheat-dough. It exists chiefly in the seeds of plants, in combination with starch;—may be separated by washing away the starch from wheat flour. It is almost insoluble in water, but soluble in alcohol; gluey when moist, but yellow and translucent when dry. It is a highly nutritious substance. It is owing to it that the rising of wheaten bread is due; the carbonic acid which is formed by the fermentation of the yeast being entangled in the meshes of the gluten, and thereby imparting the cellular structure to the loaf.

*Vegetable albumen*, *Vegetable fibrin*, and *Vegetable casein* also exist in vegetables in combination with gluten. *Vegetable albumen* is coagulated by heat; *vegetable casein* is coagulated by acetic acid. The chemical composition of all these principles is nearly, if not quite identical, being  $C_{54}H_7N_{15}O_{21}$ , with some sulphur.

### SECTION IV.

#### OILS AND FATS.

Oils are divided into two classes, *fixed* and *volatile*; the former produce a greasy stain upon paper, which is permanent under the action of heat; the stain produced by the latter is removed by heat. There is no essential difference between oils and fats; the chief distinction is in their different degrees of consistency. All of them have more or less attraction for oxygen; some of them to such an extent as to produce spontaneous combustion of light substances moistened with them. This is very apt to be the case with *linseed oil*; from this results the division of fixed oils into drying and non-drying: the oils used in painting belong to the first class.

The parts of vegetables which contain most oils are the seeds; olive oil is obtained from the fruit itself.

The fixed oils have but slight odour or taste; whenever these qualities are found in a fixed oil, they are due to a volatile principle associated with it, as in the case of butter. They are all insoluble

in water, but slightly soluble in alcohol, with the exception of castor oil, but soluble in ether and in volatile oils.

Although oils appear to be homogeneous, they in reality consist of several proximate principles. Of these, the most solid one in animal oils is called *stearin*; in vegetable oils, *margarin*; the most liquid in both is named *olein*, or *elain*. These principles may easily be isolated by submitting the whole to boiling alcohol, which, on cooling, deposits the margarine and stearine, but retains the olein. The margarine may be then separated from the stearine by ether, and the olein from the alcohol by distillation. These three principles consist respectively of an acid, united with a base. The acid is named *oleic*, *stearic*, and *margaric*; the base is the same for each; it is called glycerine.

When any of the fixed oils or fats are mixed with an alkali, a change takes place denominated *saponification*, resulting in the formation of a *soap*; the several acids just mentioned quit the glycerine with which they were united, and combine with the alkali. Thus common soap, made by the action of potassa on fat, consists chiefly of a stearate of potassa. If a soap be decomposed by an acid, the particular fat acid of which the soap may have been constituted will be precipitated. The formation of the lead plaster is a true instance of saponification, the oleo-margarate of lead being formed, and the glycerine remaining in solution.

*Spermaceti*.—This substance is found in the cranium of a certain species of whale, in union with an oil. It has a crystalline structure, melts at 120°, is soluble to some extent in boiling alcohol, also in ether. It is saponified with difficulty, two substances resulting, called *ethal* and *ethalic acid*.

*Wax*.—This substance, whether procured from the bee, or from the pollen and leaves of flowers, is found to consist of two distinct principles termed *cerine* and *myricine*; these principles may be separated by boiling alcohol.

All the fixed oils are compounds of carbon, oxygen, and hydrogen.

*Volatile Oils*.—These are very numerous, and impart the peculiar odours to plants. They are procured from the various parts of plants by distillation with water, common salt being sometimes added to elevate the boiling point.

When pure, they are colourless, but they generally have a slight tinge; they have a powerful odour and strong taste; do not saponify; absorb oxygen when exposed to the air; are freely miscible with the fixed oils; are very slightly soluble in water; freely so in alcohol and ether. They consist of two proximate principles, analogous to those of the fixed oils, and named *stearoptin* and *eleaoptin*.

Some of the volatile oils consist solely of carbon and hydrogen, as the *oil of turpentine*; others, of carbon, hydrogen, and oxygen; and a few contain sulphur, as the oils of mustard, horseradish, &c.

*Camphor* is a solid volatile oil, having all the characters of the essential oils.

*Resins*.—These are generally found in vegetables associated with some volatile oil. Common rosin affords a good example; it is procured from turpentine, which is a compound of rosin and the volatile oil of turpentine. When turpentine is distilled, the oil passes off, leaving the rosin behind.

Resins are insoluble in water, but soluble in alcohol, and in volatile and fixed oils; they are inflammable, and yield on distillation carburetted hydrogen, and several other products; a moderate degree of heat imparts an adhesive quality to them. Some resins resemble fixed oils, in containing two principles, one being more soluble in alcohol than the other. Resins are also susceptible of saponification. Concentrated nitric acid acts upon resins with an explosive violence.

The most important resins, beside *rosin*, are *lac*, *copal*, *mastic*, and *dragon's blood*.

*Amber* is a fossil resin.

*Caoutchouc*, or *India rubber*, is an exudation from a tree, resembling both the volatile oils and the resins. It is peculiar in being *elastic*.

*Balsams*.—This term is properly used to express a native compound of resin, volatile oil, and benzoic acid, as in the balsams of Tolu and Peru. The name is also given to compounds of resins and volatile oils, as *copaiva*.

The term *Gum-resins* is applied to a class of vegetable substances, consisting of a mixture of gum and resin, with some other principles: they comprise some of the most valuable medicines, as *opium*, *gamboge*, *ammoniac*, *assafetida*, *myrrh*, *scammony*, &c.

## SECTION V.

### OF ETHER, ALCOHOL, AND SOME OTHER COMPOUNDS OF THE RADICAL ETHYL.

The radical ethyl has not been isolated; its composition is expressed by  $C^2H^5$ . Common ether is an *oxide of ethyl*,  $C^2H^5O$ ; and alcohol is a *hydrated oxide of ethyl*,  $C^2H^5O + HO$ . Consequently, the conversion of alcohol into ether only requires the removal of an atom of water. The rationale then of the action of sulphuric acid on alcohol, is merely to remove the water upon which the alcohol depended for its existence. There is hardly any acid with which a peculiar ether bearing its name has not been formed, such as *nitric ether*, *acetic ether*, *tartaric ether*, &c.

The oxide of ethyl, in consequence of being procured by the action of sulphuric acid on alcohol, was formerly called *sulphuric*

*ether*, the name which it continues to bear in commerce; it is also frequently known by the simple name *ether*.

*Prepared* by boiling together equal weights of alcohol and sulphuric acid, and receiving the products in a vessel surrounded by ice. Various other substances are generated at the same time, such as sulphovinic acid, oil of wine, sulphurous acid, and others. The ether obtained may be mixed with a little caustic potash, and redistilled by a gentle heat.

*Prop.*—Pure ether is a colourless, transparent, fragrant liquid; sp. gr. about  $\cdot 720$ ; boils at  $96^{\circ}$ ; very volatile and inflammable; burns with a white flame, generating water and carbonic acid. Its vapour has a sp. gr. of  $2\cdot 586$ . When mixed with oxygen, it explodes with violence by means of an electric spark. When ether is transmitted through a red-hot tube, it is decomposed into olefiant gas, light carburetted hydrogen and aldehyde. It is very soluble in alcohol; but only one part is dissolved in ten of water. It may be separated from alcohol by the addition of water, which unites with the alcohol. It is a solvent for oils and fats generally; but its solvent powers are inferior to those of either alcohol or water.

Regarding ether to be a compound of ethyl with oxygen, or an *oxide of ethyl*, it is found that this oxide is capable of uniting with the ox-acids, and forming with them compounds analogous to salts. All the halogen bodies, as chlorine, iodine, bromine, &c., unite directly with the radical of ether, just as they do with metallic radicals. The following are some of the ether compounds:

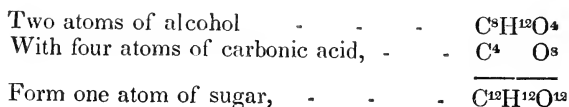
Ethyl, - - - -	$C^4H^5$
Oxide of ethyl, ether, - -	$C^4H^5O$
Hydrate of the oxide, alcohol, -	$C^4H^5O + HO$
Chloride of ethyl, - - -	$C^4H^5 + Cl$
Iodide of ethyl, - - -	$C^4H^5 + I$
Bromide of ethyl, - - -	$C^4H^5 + Br$
Nitrate of oxide of ethyl, -	$C^4H^5O + NO_5$
Hyponitrite of oxide of ethyl, -	$C^4H^5O + NO_3$
Oxalate of oxide of ethyl, -	$C^4H^5O + C_2O_3$ , &c.

These compounds of ethyl and its oxide are obtained from alcohol—the hydrated oxide—by the action of the corresponding acids, as on an ordinary metallic oxide.

*Hydrate of oxide of ethyl, Alcohol.*—This compound can only be obtained through the medium of the vinous fermentation.

When a solution of sugar, in connexion with some ferment, as yeast, is subjected to a temperature of  $70^{\circ}$  to  $80^{\circ}$ , an intestine movement commences, denominated *fermentation*; bubbles of gas escape, the liquor becomes turbid; but after a while it becomes clear, when the sugar is found to have disappeared, and its place is occupied by alcohol. Such a liquid will yield alcohol by distillation. The gas

which is generated and escapes is carbonic acid. The chemical change which is produced is the conversion of one atom of anhydrous grape sugar into two atoms of alcohol, and four atoms of carbonic acid.



In the process of fermentation, the yeast, or ferment, itself undergoes no change whatever; its action being merely that of *catalysis*.

The various kinds of fermented liquors, such as wine, cider, beer, &c., are made from the juices of different fruits, or from infusions of grain. These all contain sugar, and a fermenting principle, and hence will undergo the vinous fermentation, provided they be exposed to a proper temperature. The amount of alcohol contained in the fermented liquors varies from 3 to 20 per cent. By distilling any of the fermented liquors, the different *spirituous* liquors, or *ardent spirits*, are procured; these contain about 50 per cent. of alcohol; and by a second distillation, they yield the commercial alcohol, or *rectified spirit*, which has a density of  $\cdot 835$ , and which yet contains about 14 per cent. of water.

Pure or *absolute* alcohol cannot be obtained by any number of distillations, unless quicklime, chloride of calcium, or sulphuric acid be employed at the same time, to combine with the water.

Pure alcohol is colourless and limpid; has a sp. gr. of  $\cdot 793$ ; is inflammable, burning with a pale bluish flame, and yielding water and carbonic acid; boiling point,  $173^\circ$ ; unites with water in all proportions; also with ether; has powerful solvent powers; it has never been frozen by the most intense cold.

The process of making bread is an instance of the vinous fermentation: the yeast added to the dough, converting a small portion of its sugar into carbonic acid and alcohol. The gas thus liberated, forces the tough and adhesive mass into bubbles; these still further expand by the heat of the oven, which at the same time dissipates the alcohol.

*Chloride of Ethyl—Hydrochloric Ether.*—This is prepared by the action of hydrochloric acid on alcohol, the products being collected in a cold receiver; or else alcohol may be added to the materials for generating hydrochloric acid, viz., common salt and sulphuric acid. The rationale is precisely similar to that of hydrochloric acid on a metallic oxide.

*Prop.*—A colourless limpid liquid, very volatile, of a penetrating aromatic odour; sp. gr.  $\cdot 874$ ; boils at  $52^\circ$ ; soluble in 10 parts of water.



*Bromide of ethyl*—*Hydrobromic ether*;—a very volatile liquid, heavier than water,—of a penetrating odour and taste.

*Iodide of ethyl, Hydiiodic ether*;—very closely resembles the last.

*Sulphuret of ethyl*;—a colourless liquid, of a disagreeable alliaceous odour; boils at  $163^{\circ}$ .

*Cyanide of ethyl*—resembles the last.

*Sulphate of oxide of ethyl*—*Sulphovinic acid*,  $C^4H^5O$ ,  $2SO_3 + HO$ .—Sulphuric acid forms no *neutral* compound with the oxide of ethyl. Sulphovinic acid is the *acid* sulphate of ethyl. It is formed by the action of strong sulphuric acid in alcohol, as in the preparation of ether; on cooling, it is diluted with water, and neutralized with chalk, which throws down sulphate of lime; the *sulphovinate of lime* is afterwards deposited in crystals: from this, sulphovinic acid may be obtained by the action of dilute sulphuric acid. It is a sour liquid, very apt to be decomposed into alcohol and sulphuric acid; forms *sulphovinates* with bases, which are soluble.

*Phosphate of oxide of ethyl, or Phosphovinic acid*, is a compound very analogous to the foregoing.

*Nitrate of oxide of ethyl, Nitric ether*.—This compound has only lately been prepared. It is formed by the action of nitric acid on alcohol, with the addition of urea; the latter substance being requisite, to prevent the formation of hyponitrous ether. It has a density of  $1.112$ ;—is insoluble in water;—has an agreeable sweet taste.

*Hyponitrite of the oxide of ethyl, Hyponitrous ether, Nitrous ether*.—This is best prepared, according to Liebig, by the action of hyponitrous acid, derived from nitric acid on starch, on alcohol, and condensing the product. A better method—that of Dr. Hare—is to act upon hyponitrite of soda by sulphuric acid and alcohol; the process being conducted in a refrigerated receiver. It is a pale, yellow liquid, very volatile, possessing an exceedingly agreeable odour and taste; boils at  $62^{\circ}$ ; sp. gr.  $.947$ . It is the active principle of *sweet spirits of nitre*, which consist of hyponitrous ether dissolved in alcohol.

In the same way we have *Carbonic Ether, Oxalic Ether, Acetic Ether, Formic Ether, &c. &c.*

## SECTION VI.

### ORGANIC ACIDS.

*Acetic acid*,  $C^4H^3O^3 + HO$ .—The hypothetical organic radical of this acid is *Acetyl*,  $C^4H^3$ ; its hydrated protoxide is named *Aldehyde*,  $C^4H^3O + HO$ ; and its hydrated peroxide, *Acetic acid*.

*Aldehyde* is a clear, colourless liquid, of an ethereal odour; has a density of  $.790$ , and boils at  $72^{\circ}$ .

*Acetic acid* is formed in two ways: by the oxidation of alcohol,

and by the destructive distillation of wood. Various fermented liquids when exposed to the air become *sour*, that is, their alcohol unites with the oxygen of the air, giving rise to vinegar. The formula for alcohol is  $C^4H^5O + HO$ . If to this we add four atoms of oxygen, we have  $C^4H^6O^2 + 4O$ , which gives the formula of hydrated acetic acid,  $= C^4H^3O^3, HO + 2HO$ .

The vinegar of commerce is chiefly made from wine or cider. The acid from wood is procured by distilling hard wood in close vessels: acetic acid is found among the products which come over; this requires redistillation and some subsequent treatment. This variety is termed *pyroligneous acid*.

The strongest acetic acid is prepared by distilling anhydrous acetate of soda with concentrated oil of vitriol. Crystals of hydrate of acetic acid are formed, which may be drained from the more fluid portion. At the temperature of  $63^\circ$  these crystals fuse into a limpid liquid, of a density of 1.063, possessing the pungent smell and taste of vinegar, and capable of blistering the skin. It is soluble to any extent in water and alcohol. Its vapour is inflammable. The water, which is essential to the constitution of acetic acid, is *basic*, and can only be replaced by some metallic oxide; *anhydrous* acetic acid, in a separate state, is unknown.

The *acetates* are all soluble salts; those of silver and mercury are least so. The most important acetates are the acetate and subacetate of lead, acetate of ammonia, (spirit of Mindererus,) and acetate of copper (*verdegris*).

*Acetone*, or *pyroacetic spirit*, is a volatile, colourless liquid, which is produced when any of the metallic acetates are subjected to a destructive distillation. It has a density of  $792^\circ$ , and boils at  $132^\circ$ ; it is very inflammable, burning with a bright flame.

*Citric acid*,  $C_{12}H_5O_{11} + 3HO$ .—This acid is found in the fruits of the genus *citrus*, including the lemon, sour orange, citron, and lime; also in several others, in combination with malic acid. It may be procured by saturating lemon juice with chalk, and then decomposing the citrate of lime by means of sulphuric acid. The citric acid crystallizes on evaporation. It forms colourless prismatic crystals, very soluble in water, of a very sour taste. The three atoms of water which it contains are essential to its constitution.

*Malic acid*,  $C_5H_4O_8 + 2HO$ , derives its name from the apple, in which fruit it largely exists. It may be procured by saturating apple juice with lime, and decomposing the malate of lime by sulphuric acid. It is a deliquescent acid, without colour, and an acid taste. It is bibasic.

*Lactic acid*,  $C_6H_5O_5 + HO$ , derives its name from the word *lac*, the Latin for milk. It is the acid which exists in sour milk. It has lately been shown to be the product of a peculiar fermentation called *viscous*, by which the sugar of milk is converted into lactic acid. It

is owing to the generation of this acid, that milk, when kept, becomes *curdled*,—the acid which is formed coagulating the casein. It is monobasic.

*Tartaric acid*,  $C_8H_4O_{10} + 2HO$ .—This is the acid of grapes, tamarinds, and several other fruits, in which it exists combined with potassa. The tartaric acid of commerce is prepared from the *tartar* or *argol*, an impure acid tartrate of potash, which is deposited from the grape-juice during the process of fermentation. The argol, when purified and deprived of its colour, constitutes *cream of tartar*. The acid is obtained from this salt by saturating it with carbonate of lime, by which it is converted into a tartrate of lime, and a tartrate of potassa; the latter is separated from the former, which is insoluble, by filtration; the tartrate of lime is then decomposed by sulphuric acid. It forms colourless, transparent crystals, freely soluble in water, of a sour taste. As it is bibasic, it requires two equivalents of a base to form with it a *neutral* salt; hence, the salts which it forms with a single atom of a fixed base, have an acid reaction, and require the presence of an atom of basic water. Thus, the salt heretofore known as bitartrate of potash (cream of tartar) must now be considered as an *acid tartrate of potash and water*. This salt forms small transparent crystals; it is tolerably soluble in boiling water, sparingly so in cold water; has an acid reaction and sour taste.

There is also a neutral tartrate of potash, called *soluble tartar*, which contains two equivalents of the base united to one of acid.

*Tartrate of potash and soda*,—*Rochelle salts*;—made by neutralizing a solution of cream of tartar with carbonate of soda. It forms large prismatic, transparent crystals, freely soluble in water. Acids precipitate cream of tartar from its solution.

*Tartrate of antimony and potassa*,—*Tartar emetic*;—made by boiling sesquioxide of antimony in a solution of cream of tartar; the excess of acid unites with the base. Tartar emetic crystallizes in octohedrons with a rhombic base; very soluble in boiling water; has an austere metallic taste. Its solution is decomposed by both acids and alkalis; the former throws down a mixture of cream of tartar and oxide of antimony; the latter, the oxide. Sulphuretted hydrogen precipitates the sulphuret of antimony. Tartaric acid is distinguished by forming with any salt of potash the well-known cream of tartar.

Heat converts tartaric acid into *pyrotartaric acid*.

*Tannic acid*,  $C_{18}H_5O_9 + 3HO$ . This is the astringent principle found in many vegetables, as the oak, gall-nut, &c.; it is generally associated with gallic acid. It is best procured by pouring commercial sulphuric ether on coarsely powdered galls, and allowing it to percolate slowly. The water, which always exists in combination with common ether, dissolves out the tannic acid, while the ether

takes up the gallic acid and other matters ; hence the liquid which has passed through will consist of two distinct strata, the lower one, which is a concentrated aqueous solution of tannic acid, and the upper ethereal solution. The latter having been carefully removed, the tannic acid may be obtained by evaporation. It has a light yellowish colour, of a porous, feathery texture ; has a very astringent but not bitter taste ; very soluble in water, less so in alcohol ; insoluble in pure ether ; has an acid reaction.

Tannic acid yields with the sesqui-salts of iron a deep bluish-black precipitate ; it also precipitates the solution of tartar emetic, nitrate of silver, sulphate of copper, and acetate of lead ; with gelatin it forms a dense whitish compound—tannate of gelatin, the basis of leather.

The variety of tannin yielded by kino, catechu, and krameria, gives a *greenish*-black precipitate with the salts of iron.

*Leather* is made by soaking hides, which have been deprived of their hair, for a considerable time in an infusion of oak-bark : the tannin which it contains combines with the gelatin of the skins.

*Gallic acid*,  $C_7H_5O_3 + 2HO$ , is usually found combined with tannic acid. It is believed to result from the action of the oxygen of the air upon tannic acid. It is not so soluble in water as tannic acid, nor does it precipitate gelatin, but it yields with sesqui-salts of iron a bluish-black compound.—*Writing ink* is a tanno-gallate of iron.

The remaining vegetable acids are of less importance ; the most interesting of them are :

*Formic acid*—the acid of ants ;—prepared from sugar or starch by the action of sulphuric acid and peroxide of manganese. It somewhat resembles acetic acid.

*Benzoic acid*,—oxide of benzule,—exists in the various balsams. It is best procured from gum benzoin by sublimation. It is in the form of white crystals, very light and feathery ; exhales a fragrant odour, not due to the acid itself, but to some of the volatile oil ; it forms *benzoates*.

*Meconic acid*,—exists in opium combined with morphia and codeia. It is characterized by forming a blood-red coloured compound with a sesqui-salt of iron.

## SECTION VII.

### THE VEGETABLE ALKALIES—VEGETO-ALKALIES.

The vegeto-alkalies, or *alkaloids*, constitute a peculiar group of compounds. They are met with in various plants, always in combination with an acid, which, in many cases, is itself peculiar in its nature, not occurring elsewhere in the vegetable kingdom. They

are generally insoluble in water, but dissolve in hot alcohol. Their taste in solution is usually intensely bitter, and their action on the animal economy very powerful, in consequence of which they are of the greatest value as medicines, containing, as they do, the most active properties of the plants in which they are respectively found. They all contain nitrogen, and are complicated in their constitution, having high combining numbers.

The number of these bodies is very large; only the most important will be here noticed.

*Morphia*,—the active principle of opium;—exists in it as a *meconate*; procured from an infusion of opium by means of ammonia which throws down the morphia, leaving the meconate of ammonia in solution. It forms small shining crystals, which are colourless; nearly insoluble in water; soluble in hot alcohol; forms soluble salts with the acids, the most important of which are the *sulphate*, *muriate*, and *acetate*.

*Narcotina*,—exists also in opium; it is separated from the other principles by boiling ether, which yields it on evaporation.

*Codeia*,—exists in *opium* as a *meconate*; forms colourless crystals, rather more soluble in water than morphia. Codeia forms salts with the acids.

Other principles found in opium are *Paramorphia* or *Thebain*, *Pseudomorphia*, and *Narceia*, besides *Meconic acid*, which has already been alluded to.

*Quinia* and *Cinchona*,—the active principles of Peruvian bark;—exist in it in combination with *kinic acid*; procured from an infusion of bark by the action of quicklime, which combines with the kinic acid, liberating the alkalies; these are then to be taken up by boiling alcohol, and decolorized by animal charcoal.

Quinia occurs as a whitish powder; it does not crystallize. Cinchona is in the form of minute crystals. Both are very insoluble in water, but dissolve in boiling alcohol. Their most important salts are the *sulphates*, which are soluble in water.

*Strychnia* and *Brucia*, alkalies existing in the *Strychnos nuxvomica*, St. Ignatius' bean, and false *Angustura* bark: they are associated with *igasuric acid*.

*Veratria*,—the alkaline active principle of the *Veratrum sabadilla*, and of the *Veratrum album*, or white hellebore.

*Emetia* is the alkaline principle of ipecacuanha. *Colchicina*,—the active principle of the *Colchicum autumnale*. *Solania*,—the alkali of the *Solanum dulcamara*. *Caffeia*, or *Theine*,—the active alkaline principle found both in coffee and tea.

We have also *Atropia*, from belladonna; *Aconitia*, or *Aconitine*, from aconite; *Daturia*, from stramonium; *Coneia*, from hemlock; *Nicotina*, from tobacco, &c., &c.

Besides the foregoing vegetable alkaline principles, there exist a number of *neutral* principles in plants, possessed of very active properties. Some contain nitrogen, and some do not. The most important of them are *Phloridzin*, *Salicin*, *Asparagin*, *Gentianin*, *Elaterin*, *Cathartin*, *Quassin*, *Lupulin*, *Ergotin*, &c., &c.

## SECTION VIII.

### ANIMAL COMPOUNDS.

*Protein and its compounds.*—The most important protein compounds are *Albumen*, *Fibrin*, and *Casein*.

*Albumen* exists in eggs and the serum of the blood,—being combined in the latter with soda: the white of an egg affords a good example of it. It is not soluble in water, unless a little alkali be present; coagulates by heat, acids, creasote, alcohol, and electricity; it gives precipitates with most of the metallic salts, particularly *corrosive sublimate*, for which it is the best antidote.

It is composed of carbon, oxygen, hydrogen, nitrogen, sulphur, and phosphorus;—or supposing *protein* to be represented by Pr., the formula for albumen would be,  $Pr + P + S_2$ .

*Fibrin* constitutes the chief portion of muscular flesh; it is also an important constituent of the blood, in which it exists in the *soluble* state. It may be procured either from muscle, or preferably, by whipping freshly drawn blood with a twig; the fibrin adheres to it in long white filaments. Its characteristic is its spontaneous coagulation; it is in consequence of this tendency that blood coagulates when drawn from the body. Its composition is very nearly identical with that of albumen,—containing one equivalent less of sulphur. Albumen is converted into fibrin, in the living body, in the process of organization. Its proportion in the blood is liable to variation by disease.

*Casein* is found in milk, and is the basis of cheese. It closely resembles albumen, but differs from it in not being coagulable by heat. In composition it is nearly identical with the two foregoing substances, but it contains no phosphorus.

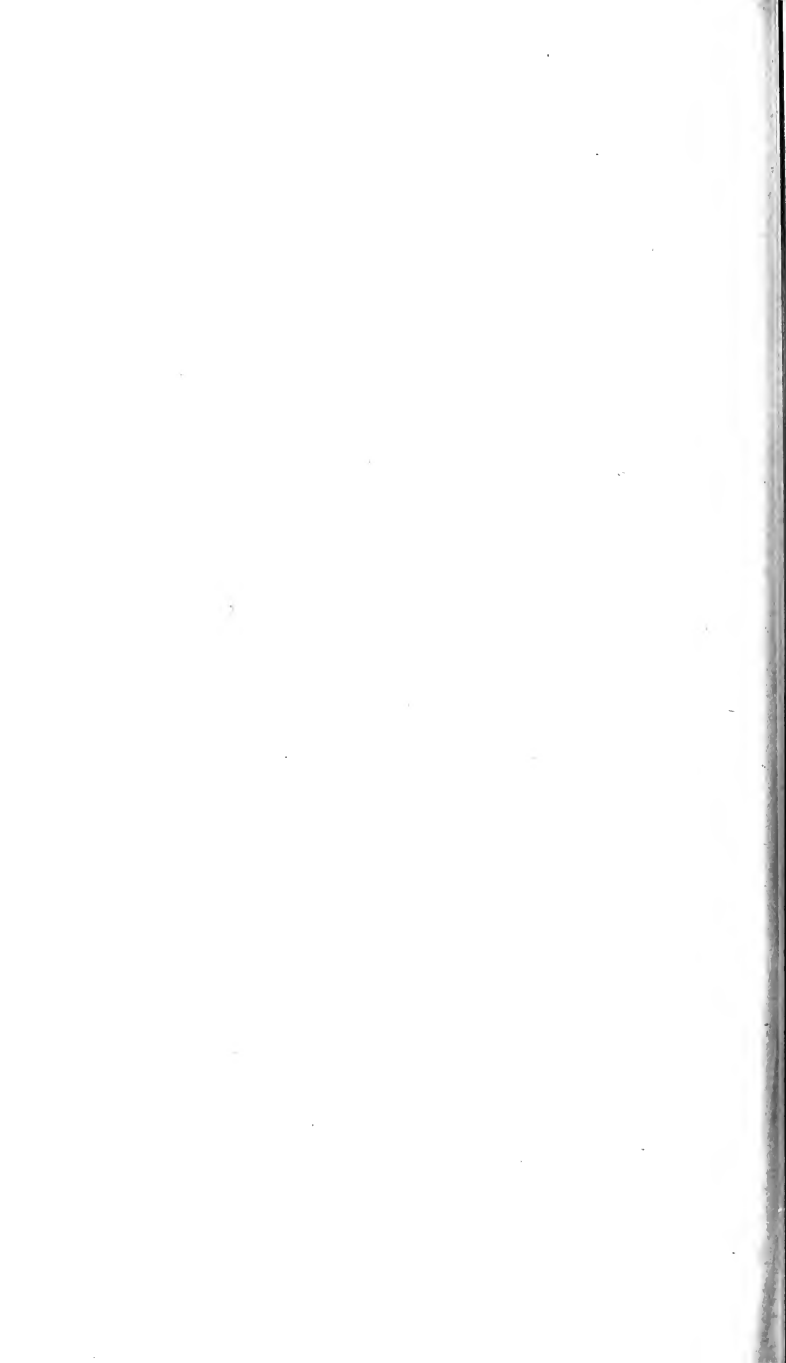
From either of the above three compounds, protein may be procured, by dissolving them in an alkaline solution, and then precipitating by an acid.

*Gelatin* and *Chondrin*.—These principles constitute the bases of skins, tendons, cartilage, and fibro-cartilage, &c. Any of these, when boiled for a long time in water, yield a jelly, which, on cooling, solidifies into *gelatin* or *glue*. *Isinglass* is the dried swimming-bladder of the sturgeon. *Chondrin* is very analogous to gelatin:

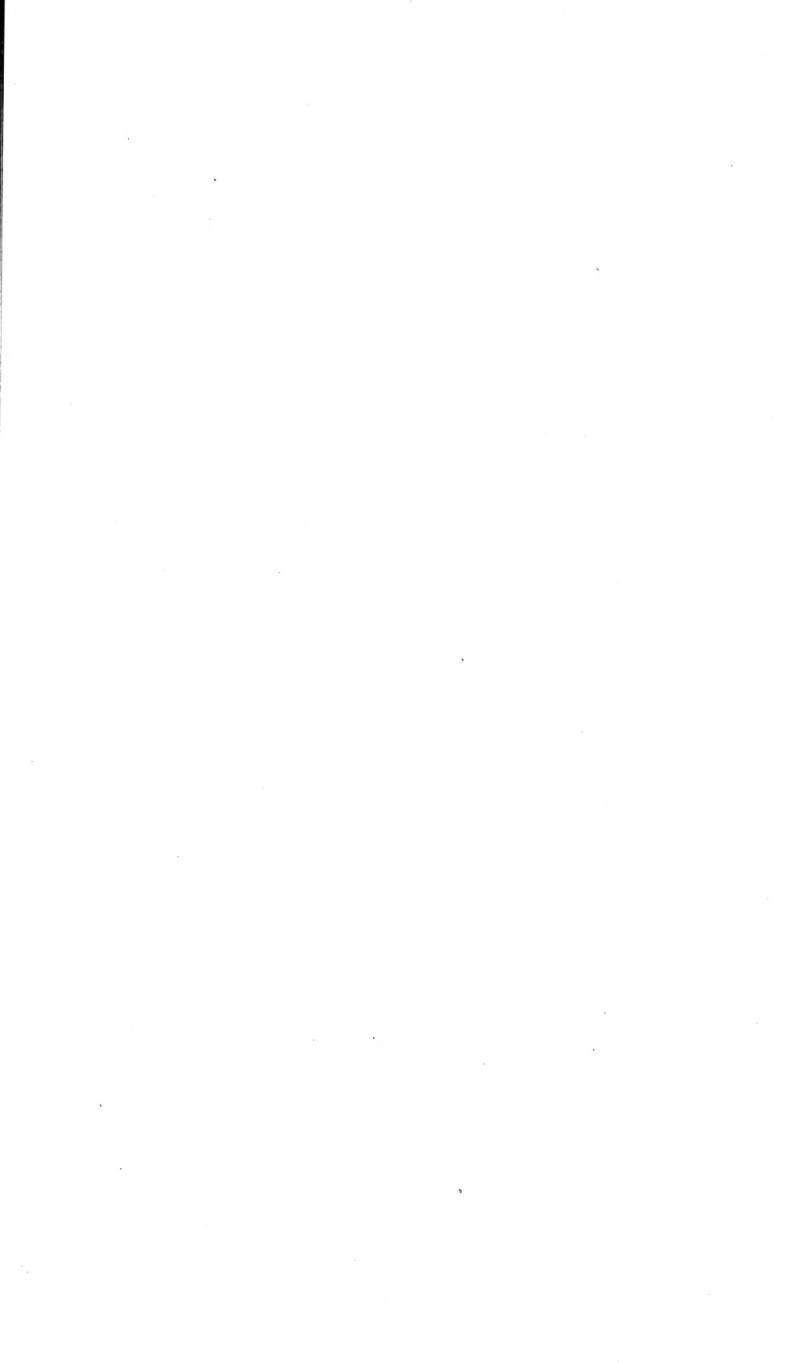
it is procured in the same manner, from *cartilage*. Both are soluble in hot water. Gelatin is characterized by giving a precipitate with tannic acid,—*tannate of gelatin*.

The different solids and fluids of the body all contain various interesting principles, as for example, *blood, urine, chyle, bile, bones, nerve-substance, &c.*; but the space here allowed will not permit an examination of them. In fact, they more properly come under the division of **PHYSIOLOGY**, to which the student is referred for an account of them.

THE END.









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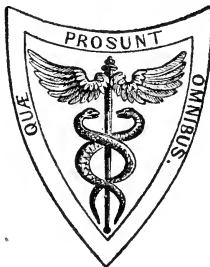
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PHILADELPHIA:

LEA & BLANCHARD.

1848.

Entered, according to Act of Congress, in the year 1848,  
BY LEA & BLANCHARD,  
In the Clerk's Office of the District Court for the Eastern District of  
Pennsylvania.

C. SHERMAN, PRINTER,  
19 St. James St.

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\* In the preparation of this part, the authors have had in view the Manual of Dr. Meade.

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# PRACTICE OF MEDICINE.

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## FEVERS.

FEVER signifies an acute affection of the system, in which all the functions are more or less deranged; the most striking phenomena being sensorial or nervous irregularity, increased frequency of pulse, increased heat, and disinclination for food.

The most *common signs* of fever, are shivering, followed by heat of skin, restlessness, and thirst; headache, flushed face, and quick pulse; general aching, and debility of the body.

There are very many varieties of fevers; the first grand distinction is into the *idiopathic* or essential, and the *symptomatic*.

By an *idiopathic* fever is meant one which *arises without any obvious local cause*; not being produced by or dependent upon disease of any particular organ of the body.

By a *symptomatic* fever is meant one which depends upon or is caused by inflammation, or other local disease.

Idiopathic fevers are often *accompanied* by inflammation;—thus inflammation of the mucous membrane of the throat accompanies scarlatina; inflammation of the cerebral membranes, or lungs, or intestinal mucous membrane, may go together with typhoid; hence some eminent physicians have persuaded themselves, that typhoid is not an idiopathic fever, but that it is symptomatic of a local inflammation.

But, in a symptomatic fever, the local inflammation begins first—in an idiopathic fever, on the contrary, the feverish symptoms begin first, and may continue some time before any local disease appears, even if it appear at all.

Idiopathic fevers are most commonly caused by some poison which gets into the blood. Their chief kinds are, the intermittent, remittent, continued, and exanthematous; each of which kinds has many varieties.

Symptomatic fevers may be of an acute inflammatory type, or hectic, or typhoid. We may observe here, that an intermittent fever

is sometimes symptomatic of disease in the urethra, and remittent fever of worms and accumulations of sordes in the alimentary canal.

#### CLASSIFICATION OF FEVERS.

- |                              |                        |
|------------------------------|------------------------|
| 1. Intermittent.             | 7. Vaccine disease.    |
| 2. Remittent.                | 8. Chicken pox.        |
| 3. Yellow fever.             | 9. Measles or rubeola. |
| 4. Typhoid or enteric fever. | 10. Scarlatina.        |
| 5. Typhus.                   | 11. Erysipelas.        |
| 6. Small pox or variola.     | 12. Plague.            |

Of several of these there are varieties, as, for instance, we may have inflammatory, or congestive intermittents or remittents. Some are propagated by contagion, and are hence called *contagious*; some have the property in common that they are attended with an eruptive affection, and are denominated *eruptive*, or *exanthematous fevers*. These are, in many instances, interchangeable terms; most contagious fevers being exanthematous, and most of the exanthemata contagious. Each, however, is distinct individually.

#### INTERMITTENT FEVERS, OR AGUES.

These are characterized by febrile paroxysms, recurring at stated times, and by the absence of fever between the paroxysms.

*Causes.*—They are commonly produced by a subtle atmospheric poison, which has received the name of *malaria*, or *marsh miasma*. It has been said that this poison is produced by the putrefaction of vegetable substances; but it seems that a certain amount of heat and moisture are sufficient, without any vegetable matter. Thus it is very abundant on many sandy soils, where there is no vegetation at all; and—it must be noticed, that it does not proceed from lands which *are* inundated, so much as from those which *have been* flooded and *are* drying. It is more virulent in hot climates than in temperate—in low situations than in high; the upper stories of a house being much more healthy in aguish districts than the lower. It is carried about by winds, but interrupted by trees; and is always more dangerous by night than by day. It is far more likely to attack persons exhausted by fatigue, intemperance, or illness, than the healthy: these, therefore, are predisposing causes. Cases sometimes occur, which proceed obviously from some temporary irritation, such as the introduction of instruments into the urethra, indigestible food in the stomach, worms in the intestinal canal, &c.

*Varieties.*—The three most common varieties are—

1. The *quotidian*, in which the fit comes on every day, generally in the morning, and lasts about ten or twelve hours.
2. The *tertian*, which comes on alternate days, generally about noon, and lasts till evening.
3. The *quartan*, which comes on once in three days, usually in

the afternoon. It has the longest cold fit, but the shortest paroxysm altogether. There are also *double quotidians*, having two paroxysms every day. *Double tertians*, having a paroxysm every day, but at different hours. Sometimes there are two paroxysms on one day, and none the next; this is called a *duplicated*, or *doubled tertian*. The *triple tertian* has two paroxysms on one day, and one on the intervening. In *double quartans*, out of three days, two have each one paroxysm, and the other none. Of all these varieties, the *double tertian* is the only one which often occurs.

A distinction is made between the *interval*, and the *intermission* of an ague. The interval, is the space between the beginning of one paroxysm, and the beginning of the next; which in the tertian is forty-eight hours; the intermission, is the space from the *end* of one paroxysm, till the beginning of the next: in other words, the time when the patient is free from the disease; which in the tertian is about forty-two hours. This is also called *apyrexia*. The *type* of the fever has a reference to the length of the interval. Besides the varieties mentioned above, there are *quintans*, *sextans*, *octans*, &c., but they are very rare.

*Seasons of occurrence.*—The *quotidian* commonly occurs in spring; the *tertian* at the end of summer, and beginning of fall; the *quartan* later in the fall.

*Symptoms.*—An ague fit consists of three stages:

1. The *cold stage*.—This begins with chilliness and constriction of the whole body; the nails are blue; the rings drop off the fingers; the skin is rough (*cutis anserina*), and there are violent shiverings, and chattering of the teeth; head-ache and back-ache, quick, small pulse, oppression at the precordia, and sometimes vomiting. After these have lasted some time, there comes the

2d, or *hot stage*, beginning with flushes of heat, which gradually increase, till the skin becomes very hot and dry, the face flushed, the temples throbbing, and the pulse full and hard. After a duration of from three to eight hours, comes the

3d, or *sweating stage*.—Perspiration begins on the head and face, and becomes profuse all over the body; and the urine deposits a copious lateritious sediment. Now, in uncomplicated cases, the patient feels well, but weak, till the next recurrence of the fit. Sometimes one of the stages is wanting, as for instance the cold stage. This form is called a *dumb ague*. Sometimes the fever is wanting, or has neuralgic pains substituted for it. The sweating stage is also sometimes absent, or is supplied by copious urination, or diarrhœa.

*Treatment in ordinary cases.*—First of all, give a grain or two of calomel with an aperient, so as to clear the bowels. If the stomach is very foul, an emetic may be used, though it is not essential.

Then, *during the paroxysm*. During the cold stage, warm drinks of tea, or wine-and-water, if the patient be feeble, or addicted to its

use; hot foot-baths; warm bed; frictions of the spine. During the hot stage, cool drinks; and after the sweating, let the skin be rubbed dry with warm towels.

When the fit is over, begin with some *antiperiodic remedy*, to prevent its recurrence. The best is *quinine*, of which from two to four grains should be given every four hours, in solution with a few drops of dilute sulphuric acid, tincture of orange-peel, and water. Under some circumstances, it may be necessary to administer the whole dose, either immediately before or after the paroxysm; as, for instance, when the apyrexia is exceedingly short, as in the quotidian. Upon the whole, however, it is best, if possible, to introduce it into the system gradually.

The remedy should be continued in gradually decreasing doses, for ten days or a fortnight after the last fit, as the complaint is very apt to return.

If the quinine is rejected by an irritable stomach, it may be injected into the rectum in solution in distilled water, with a drop or two of laudanum; or a blister be applied to the epigastrium, and the surface be dressed with a strong solution.

If the quinia cannot be procured, or if it does not produce good effects, the next best remedy is *liquor arsenicalis*, in doses of ℞ v.—x. ter die. Other remedies are, willow bark, piperine, sulphate of zinc, ammonia, sulphate of copper, and all the vegetable bitters and astringents; but they are much inferior in virtue to the quinine.

*Opium* given in a full dose sometimes puts off the fit, if given just before it is expected; and it is also of great use to shorten the *hot stage*; but not of much service in the cold.

*Bloodletting*, in the *cold stage*, was recommended by Dr. Macintosh, but in ordinary cases is now repudiated by most physicians. It may, however, be necessary in the violent agues of hot climates, when there is great internal congestion, or delirium and cerebral excitement.

The great congestion in the abdominal veins which occurs during the cold stage, is very apt to produce enlargements and induration of the liver, and especially of the spleen, the tumour formed by which is commonly called *ague cake*; and the obstruction to the venous circulation caused by these is liable to induce dropsy.

#### REMITTENT FEVERS.

*Syn.*—*Bilious fever.*—*Bilious remittent fever.*

In this form of fever, the febrile phenomena evince striking exacerbations and remissions, one paroxysm occurring in the twenty-four hours. It is caused by some atmospheric poison. It is most common in the middle and southern sections of the United States, although it occurs in all parts lying between the northern lakes and

the Gulf of Mexico. The localities that it most frequents are the valleys of streams, the borders of lakes and ponds, the neighbourhoods of marshes, and the western prairies. The seasons in which it occurs are the summer and autumnal months.

*Symptoms.*—For several days previous to the *invasion*, the patient complains of uneasiness at the epigastrium, lassitude, pains in the back, limbs, and head, and restlessness at night. The invasion is attended by coldness of the surface, and frequently by shivering; this coldness is soon superseded by heat, by febrile flushes, or by alternations of heat and cold, by nausea, and occasionally by vomiting. The pains in the head, back, and limbs, now become aggravated; the mouth is clammy and dry; the tongue white or loaded; the surface very hot and parched; the face flushed; and the pain of the head attended by a feeling of distention and throbbing, often passing into delirium. The pulse is full, hard, and frequent; thirst is urgent; the bowels constipated; and the urine scanty and high-coloured. There is usually more or less epigastric tenderness, with nausea, and often with vomiting. These symptoms generally continue from about ten or twelve to eighteen hours, when perspiration breaks out; the pulse falls in frequency and strength; delirium disappears, and the irritability of the stomach subsides: there is merely a remission or abatement, but no intermission of the febrile symptoms. The remission is exceedingly variable in duration, in some cases not lasting more than two or three hours, in others a whole day; being shorter or longer, according as the type of the fever may be quotidian or tertian. Another paroxysm then occurs, running the same course and ending in like manner, each successive exacerbation becoming, generally, more severe and protracted, and each remission less decided.

The symptoms become now more violent. The remissions disappear; the skin becomes dry and harsh, or moist and clammy; the pulse small and irregular; the tongue black and crusted; and the vomiting, and pain at the epigastrium, more constant. In the most unfavourable cases, yellowishness of the skin occasionally supervenes. The bowels become irritable, the evacuations being watery, greenish, and, at last, almost black. The urine is scanty and high-coloured, or sometimes of a yellowish-brown colour. The headache is intense, accompanied often by vertigo, tinnitus aurium, and delirium.

The disease may run on thus for a time varying from the seventh to the fifteenth day, when it either declines with a profuse perspiration, a diarrhœa, or a general subsidence of all the symptoms, or else it runs on to a fatal termination. Sometimes it terminates in an intermitting; at others in a continued fever.

*Bilio-inflammatory remittent fever.*—This form differs but slightly from the foregoing in its symptoms and course. Violent

determination to the brain characterizes the commencement of reaction in this variety; and inordinate affection of the liver and mucous surface, the more advanced stages.

*Congestive, or Malignant remittent.*—This is one of the severest and most fatal of endemic fevers. As its name implies, the disease is of a malignant type from the commencement. The great danger here is, that when the patient is raised, perhaps with great effort, out of the paroxysm, the practitioner may regard it as incipient convalescence, and neglect the precautions necessary to ward off the next, which may prove fatal.

*Anatomical characters.*—Inflammation of the stomach and bowels is perhaps the most frequent lesion. The glands of Brunner are often much developed, but Peyer's glands are unchanged. The membranes of the brain are sometimes inflamed, and sometimes there is congestion. The liver is often enlarged, more or less softened, and, according to Dr. Stewardson, of a bronze or slate colour. The spleen is also enlarged and softened.

*Complications.*—*Gastro-duodenitis* is among the earliest complications of remittents; in the more advanced stages, *dysentery* occasionally comes on. Diseases of the *liver* and *spleen* are common attendants on remittents. *Determination of blood to the brain* often occurs early in the more severe forms. In temperate climates, remittents are frequently associated with *bronchial* or *pulmonary affections*.

*Treatment.*—In the *mild form*, before reaction comes on, and when there are no indications to forbid its administration, an *emetic* is generally very useful. After its full operation, a large dose of *calomel*, or calomel and opium, may be given, and an action be produced on the bowels by *purgatives* and cathartic enemata. These means being repeated until morbid secretions and fæcal accumulations are removed, *bark* or *quinine* may be prescribed, if the remissions are distinct, and there be no signs of cerebral or gastric inflammation. When a paroxysm of great violence has been subdued, and there is danger that the next may prove fatal, recourse should be had to the sulphate of quinia, no matter how short or imperfect the remission may be. The quantity must be sufficient to bring the system under its influence before the next paroxysm. The remedy should be continued until two daily paroxysms have been prevented; after which the patient may be considered safe. In some cases, where the patient's strength will admit of it, *moderate bleeding*, in the stage of excitement, will shorten the disease, and render the remissions more perfect. During reaction, in the early exacerbations, frequent doses of *James' powder* with *calomel*, or *tartarized antimony*, given in repeated doses, will oftentimes promote a favourable termination. The effervescing draught is considered by some authors as particularly applicable to bilious remittent fever. When



given *cold*, it corrects the nausea and vomiting better than any thing else. If it gripes, a little laudanum may be added to it. The neutral mixture, and the spirit of Mindererus are also highly recommended. Cold sponging is often very refreshing to the patient, but should be discontinued if he complain of chilliness. Any complications that may be present will require distinct treatment, according to the organs that are affected.

#### INFANTILE REMITTENT FEVER.

This disease usually attacks children from nine or ten months to twelve or thirteen years old. It generally arises from errors in diet, and accumulation of morbid matter in the *primæ viæ*. It may also arise from obscure miasmata. Writers in the three last centuries imputed this fever to worms, hence the term "*worm fever*;" but the presence of worms is rather a complication than a cause of the affection.

*Symptoms.*—This affection commences gradually; the bowels being irregular, generally costive, but occasionally relaxed and irritated. The child remains feverish and drowsy towards evening, but generally seems pretty well in the morning. The appetite is variable; the pulse ranges from 100 to 140; and the tongue is loaded. After these symptoms have lasted for several days, a distinct chill or rigor is sometimes observed; vomiting ensues; and a more violent paroxysm of fever, drowsiness, flushed cheeks, and shooting pains through the abdomen and head, follow. The child constantly picks its lips and nose; and occasionally stiffness of the neck, great sensibility of the general surface, and tenderness in the course of the spine, are observed. In the more advanced stages, the ingesta are either thrown off unchanged, or passed undigested from the bowels. In very young children, *convulsions* come on; in those of more advanced age, *delirium* often attends the night exacerbations. This is the most common form of the disease.

*Acute variety.*—This form may occur rather suddenly. The bowels are irregular, commonly costive; the evacuations are morbid and offensive; the urine turbid, pale, or milky; and the tongue is loaded, especially at the base. Fever supervenes, and is ushered in by rigors or chills, the child being hot and restless at night. During the exacerbations, the child is drowsy; and if it sleeps, moaning, starting, and even screaming, or incoherence, are observed; sometimes with vomiting, there is flatulent distension of the abdomen, accelerated breathing and cough. The face is usually flushed; the abdomen and palms of the hands hotter than other parts of the body; and the pulse varies from 120 to 160, according to the age. Occasionally the paroxysm terminates in a slight perspiration, which is often partial; the child falls into a quiet sleep, and the pulse sinks in frequency.

*Diagnosis.*—In infantile remittent fever, the cerebral symptoms do not appear until near the close of the disease; in hydrocephalus, they invariably occur before the end of the first week, and oftentimes sooner. The acceleration of the pulse, the remissions and the diarrhœa, which are always constant symptoms of infantile remittent fever, will serve to distinguish it from acute hydrocephalus, in which the bowels are always constipated from the commencement of the disease, and the pulse occasionally slow.

*Chronic form of remittent.*—This form either makes its approach insidiously or follows the acute. The child wastes, the abdomen enlarges, the breath is offensive, and the strength fails. The tongue is white or loaded, but moist, and has often a strawberry-like appearance; the bowels are generally costive, and the evacuations are always unhealthy. The pulse is usually about 100 in the day, but rises to 140 in the evening. There is generally one exacerbation in the twenty-four hours, and it seldom appears before evening, lasting until morning, and terminating in sweats. If the disease be not removed, tympanitic distention of the abdomen, emaciation, harsh discoloration of the skin, enlarged mesenteric glands, chronic diarrhœa, and lientery, supervene.

This affection is liable to be mistaken for chronic inflammation of the pia mater in children.

*Treatment.*—If the affection be acute, and the child strong, *leeches* should be applied to the epigastrium, *calomel* and *James' powder* ought to be given at night, and a mild aperient draught in the morning. If the bowels are not evacuated by these means, an enema should be given; equal parts of castor oil and oil of turpentine in water-gruel form the best enema in these cases. The calomel and James' powder should be repeated every night, or on alternate nights; and a purgative mixture be given in the morning. When the evacuations have been improved by these means, mild tonics may be employed; of these, the *infusions of cinchona, cascarilla,* and of *valerian*, form the best; *stimulating liniments*, and other *counter-irritants*, should be applied to the abdomen. The *foot-bath*, some mustard flour being added to the water, will be found useful at bed-time. Small doses of *sulphate of quinine* may be exhibited; and if the disease assume the adynamic form, small doses of *chlorate of potass.* in an infusion of *valerian* or of *cinchona* may be given with advantage. *Change of air*, especially to a dry and elevated situation, should be recommended. Warm clothing, frictions of the surface, and light, but nourishing diet, are also very beneficial. During the complaint, farinacea, and weak broth, are the most suitable food. Where the disease has produced mesenteric obstruction, small doses of *iodide of potassium* may be exhibited. When convalescence is established, the *iodid. ferri* will be found a useful tonic.

## HECTIC FEVER.

*Hectic fever* is a remittent fever, *rarely, if ever, idiopathic*, but depending upon some local source of irritation, especially if attended with an exhausting discharge; perhaps arising from the absorption of diseased secretions.

*Symptoms.*—Hectic fever is attended with great and increasing debility, a weak, quick, and rather hard pulse, hurried respiration on any exertion, and increased heat of the skin. The exacerbations, which are at first slight, soon become more evident, particularly in the evening; are preceded by a slight or marked chill; are attended by increased heat, which is most evident in the hands and face, the skin being at first dry; and terminate in a free, profuse perspiration, especially the evening paroxysm, which subsides in this manner early in the morning. The bowels are at first costive, but soon become relaxed, and *colliquative* diarrhœa comes on: the urine is various; generally it is pale, and does not deposit; more rarely, it is high-coloured, and yields a lateritious sediment. While there is general pallor of the surface, the cheeks present what is very aptly styled the “hectic blush.” As the disease advances, the whole frame becomes emaciated; the eyes are sunk in their orbits, but are brilliant and expressive; the ankles and sometimes the legs are œdematous, and the sleep is feverish and disturbed. At last, the diarrhœa and colliquative sweats become more abundant, the respiration more hurried, and the debility so great that the patient expires while making some slight exertion.

*Treatment.*—This must essentially depend on the cause or pathological state which occasions the hectic fever. Where there is disease of the digestive mucous membrane, the treatment consists in strict attention to the diet, in improving the condition of the secretions, in the administration of mild tonics, and the occasional exhibition of saline refrigerant diuretics, and diaphoretics. Gentle astringents, mineral acids, &c., are useful. Of the acids, sulphuric given in infusion of roses is to be preferred. Anodynes in the form of conium, hyosciamus, and humulus or opium are occasionally given.

## PERNICIOUS FEVER.

*Syn.*—*Congestive fever.*—*Pernicious intermittent.*—*Pernicious remittent.*—This term should be restricted to an affection, in which there is great and sudden prostration or depravation of the nervous power, or, to use a customary phrase, in which the *innervation* is extremely and most dangerously defective or deranged. (Wood.)

This modification of miasmatic fever may be intermittent, remittent, or continued. It is only, however, when of two or three days duration, that it can be called continued, for if the disease persist, it will almost certainly become paroxysmal. Most frequently it is inter-

mittent; and although often a quotidian, is more frequently tertian in its type.

*Symptoms.*—In some cases the organic functions are most affected; then the evidences of disease are presented chiefly in the organs of digestion, respiration, circulation, calorification, and secretion. In other cases the blow falls upon the animal functions, then the brain is the organ most affected. Of the organic functions, sometimes one is selected in preference to the rest. Thus the force of the morbid cause appears to fall, in some instances upon the heart, in others, upon the alimentary canal, in others again, upon the surface of the body, either in its function of secretion or calorification.

Sometimes it approaches like an ordinary intermittent, at others, with its own peculiar features. It may occur at any hour of the day or night.

When the disease is fully formed and exists primarily in the organic functions, the face and hands are of a livid paleness, the features shrunk and expressive of alarm, the skin contracted and shrivelled like a washerwoman's, the extremities, the trunk, and sometimes even the breath are cold. The surface is, at times, moistened with a clammy perspiration, or bathed in a profuse sweat. The tongue is pale and cold, sometimes dry, sometimes unaltered; there is epigastric tenderness, with great internal heat and intense thirst. Nausea and incessant vomiting are present, with constipation, or the reverse. In the latter case the discharges consist of bloody serum, sometimes of blood, either coagulated or not. The respiration is characteristic, the breathing consists of deep sighs, and with two inspiratory efforts to one expiration. Sometimes it is hurried, irregular, and panting. The pulse is small, irregular, sometimes corded, but oftener feeble, fluttering, and sometimes intermittent. It is almost always frequent, amounting to as much as 120 or even 160 in the minute. With all these symptoms there is great restlessness, the patient attempting to rise from his bed to reach the door or window.

The duration of the paroxysm varies; sometimes it will extend over two or three days, mingled with attempts at reaction, sometimes it will last but a few hours, and then reaction comes on, though in no degree equal to the preceding depression, and the patient seems as if about to be restored to health. At other times a slight degree of fever remains; it is only a remission that has taken place.

If not arrested, the same train of symptoms recurs the next day or the day after with increased violence, the second paroxysm often proving fatal, though sometimes a third occurs, before death takes place.

Sometimes the whole force is spent upon the heart, then the prominent phenomena are those of excessive prostration of the circulation. In some cases coldness is the prominent symptoms; in others an

ordinary intermittent paroxysm runs its course and ends in profuse and exhausting perspiration, during which the pernicious symptoms appear. When the animal functions are affected the paroxysm usually begins with drowsiness, loss of memory, confusion, gradually passing into deep coma, or an apoplectic state with stertorous respiration. Pulse full, and either faster or slower than in health. Sometimes convulsions are present. In some cases coma is preceded by delirium.

*Cause.*—The cause is undoubtedly the same as that of ordinary intermittents and remittents. What it is that gives rise to its peculiar character is unknown; probably a more intense action of the poison, or a greater susceptibility to its influence. Its localities differ from those of ordinary bilious fever; while the latter occupy the table lands, the pernicious fevers prevail especially in the low lands skirting the rivers.

*Prognosis.*—Exceedingly unfavourable; three-fourths of the cases, when not properly treated, die. Sometimes whole settlements are swept off by the disease. If seen during the first or second paroxysm the danger may be averted.

*Treatment.*—The first indication is to bring about a reaction as speedily as possible. One of the most obvious remedies is artificial heat; sinapisms to the extremities and abdomen, or along the spine, and frictions with turpentine or cayenne pepper should be used. Opium is useful for its stimulating and anti-emetic properties, and for its influence in arresting alvine discharges; it is best administered in substance, but should not be used when there is any affection of the brain, as shown by active delirium or stupor. Internal stimuli should also be administered; of these the sulphate of quinia is the best, and may be given even in the paroxysm before reaction. It should be used, however, in decided doses, and may be employed in any prostrate case, in which it can be borne by the stomach. Another remedy decidedly called for is calomel, and it may be advantageously joined with both quinia and opium. The internal administration of cayenne pepper is also of great benefit; it may be taken in five grain doses. The proportions of these remedies must vary to suit the circumstances; so also must the articles employed. If these means fail to bring about reaction, wine or brandy may be given: cold affusion is also recommended, but it should not be carried too far. When coma is present, blood should be taken by cups, or from the arm, if admissible. The treatment in the intermission or remission should be the same as in ordinary intermittent, excepting that the sulphate of quinia should be given in much larger doses. From 30 to 60 grains should be taken from the beginning of one paroxysm to that of the next.

## YELLOW FEVER.

*Synonymes.*—*Typhus Icterodes.*—*Bulam Fever.*—*Vomito negro.*—*Vomito prieto.*

This is a disease of warm climates, occurring mostly during the summer months, and ceasing on the appearance of frost. It is met with chiefly in towns upon the seaboard, or upon streams emptying into the ocean.

*Symptoms.*—The attack may or may not be preceded by prodromic symptoms, very often coming on without any warning, and occurring in the midst of ordinary health. It is generally ushered in with a chill, and severe pains in the back and limbs. After febrile reaction has been established, the skin is hot and dry, the respiration hurried, the face flushed, the eyes red and watery, and the conjunctiva much injected. There is a sense of uneasiness, sometimes tenderness at the epigastrium, accompanied by nausea and vomiting. The tongue is at first moist and covered with a yellowish-white fur; there is also extreme thirst. The pulse ranges from the natural standard to 120 or even 140. Sometimes it is unnaturally slow; either extreme is significant of great danger. Sometimes there is delirium and prostration; at others, the mind is clear, and the muscular strength unimpaired. The bowels are ordinarily costive, and when discharges are obtained, they are commonly unhealthy in character. As the disease advances the pain in the limbs becomes more intense, especially in the lower extremities, the calves and front of the legs. This stage is called by some authors *the stage of invasion*, and lasts from a few hours to three days; the shorter the duration, the more violent, generally, is the disease.

After this comes the stage of remission, or, as it is sometimes called, *the stage without fever*. All the symptoms abate, and the patient seems to be convalescent; there are symptoms present, however, by which the experienced are warned of the continuance of the disease. The epigastrium is even more tender upon pressure, the skin becomes yellow or orange colour, the urine assumes a yellow tinge, and the pulse sometimes sinks as low as 40 in the minute. After a short calm the stomach assumes its former irritability, and the peculiar substance called *black vomit* is ejected. The tongue is dry, brown, and chapped. The patient becomes more and more prostrated; there are, at times, passive hemorrhages, at others, suppression of urine, or retention. The pulse becomes more and more feeble, the respiration sighing, the matter ejected from the stomach is brought up without effort, and discharges of the same matter take place from the bowels. This stage is sometimes called *the stage of collapse*. Sometimes, instead of collapse, symptoms of reaction set in, which are always to be regarded as a salutary effort of nature,

sometimes terminating in health, sometimes, however, running on to extreme exhaustion, or assuming a typhoid form.

*Anatomical characters.*—The *membranes of the brain* are often found injected, and serum effused into the ventricles. The *stomach* usually presents traces of inflammation, having its mucous coat either reddened, thickened, softened, or eroded. The peculiar matter called black vomit, is now generally believed to be blood altered by admixture with the acid secretion of the stomach. The *liver* is altered in colour and consistence. According to Dr. J. Hastings, U. S. N., it resembles old boxwood in colour, and is much harder than natural. Sometimes it is dry and anæmic, though rarely inflamed. It varies in colour from a lemon yellow to a straw colour, and in consistence, from being soft and friable to positive induration.

*Cause.*—Speculation is rife as to the cause of this disease. There is no doubt that it is as specific as that of small pox, though of its precise nature nothing definite is known. Heat and filth, alone, are not able to produce it; neither are marsh miasmata, independently of other causes. Strangers are more liable to it than long residents, and whites more than negroes. Among the predisposing causes are exposure, intemperance, fear, and sudden changes of weather.

*Diagnosis.*—At first it is not easy. As the disease advances, however, the severe pains in the back and lower extremities, the peculiar injection of the conjunctiva, the excessive irritability of stomach, the yellowness of the skin, and finally the black vomit, are enough to diagnosticate the disease.

*Prognosis.*—Generally regarded as unfavourable, though much depends upon the person attacked, the character of the epidemic, and the severity of the symptoms. Symptoms of great prostration are very unfavourable, and a total suppression of urine is a certainly fatal sign. *Strangury*, however, is regarded as a favourable sign.

*Treatment.*—Early in the disease, before there is much irritability of stomach, an emetic is of great service, particularly if the stomach be loaded; it should only be used, however, under these circumstances. *Bloodletting*, to be of service, should be employed early, and even then, not unless called for by the violence of the symptoms and the state of the pulse. *Mercurials* are, on all sides, declared to be of great service in this disease. They should be administered first with a view to their cathartic action, and then to their *specific influence, as rapidly as possible*. *Febrifuge medicines* are also called for; of these perhaps none is so good as *ice* given internally, together with cool sponging externally; the latter with caution. Ice also often allays the excessive irritability of the stomach. To the same end the effervescing draught may be employed, and sinapisms or leeches externally. If the pain in the head is very great, cups or leeches may be employed, together with cold applications to the part. In the *second stage*, the febrifuge and depleting remedies

should be suspended, *except the mercurials*, to which may be added the acetate of lead, with a view of diminishing the inflammation of the stomach, and also for its astringent properties. Blisters may also be applied to the epigastrium, and the raw surface sprinkled with acetate of morphia.

In the *third stage* cordials and stimulants are demanded. Sulphate of quinia, infusions of bark, or serpentaria, carb. of ammonia, capsicum, turpentine, wine whey, or brandy and water, may be administered. External stimulants, as frictions, sinapisms, hot baths, &c., may also be found beneficial. The apartment should be kept well ventilated, and all excrementitious matters removed.

#### TYPHOID FEVER.

*Syn.*—*Common continued fever.*—*Enteric fever.*—*Typhus mitior.*—*Nervous fever.*—*Abdominal typhus.*—*Mucous fever.*—*Enteromesenteric fever.*—*Follicular enteritis.*—*Dothinerteritis.*

*Symptoms, course, &c.*—The disease is sometimes preceded by prodromic symptoms. There is a sense of weariness, languor, and general uneasiness, slight headache on rising in the morning, dullness of intellect, irregular flushes of heat, or chilliness, slight acceleration of pulse, furred tongue, and a disposition to diarrhœa. These symptoms may last from several days to a week or more, after which the disease is established by the occurrence of a chill followed by the ordinary phenomena of fever.

The disease being fairly established, there is increased frequency of pulse, ranging from 90 to 110 or 120; the latter usually in females; as a general rule the pulse is under a hundred. There is headache, with a dull, heavy expression; pain in the back and limbs; restlessness and insomnia; epistaxis, and yellow watery diarrhœa.

As the disease advances these symptoms become aggravated, the pulse is more frequent and strong; the skin hot and dry; the tongue dries, and becomes red at the tip and edges: there is pain in the right iliac region, with a gurgling sound upon pressure; tympanitis is also present, and there also appears about this time, symptoms either of bronchitis or pneumonia.

About the seventh or ninth day, if the surface of the abdomen be examined carefully, there will be discovered upon it a number of small, round, red spots, disappearing upon pressure, these are called the *rose-coloured spots*, or *taches rouges*, and constitute a characteristic eruption. At the same time a crop of vesicles will also be detected upon the neck and thorax, called *sudamina*.

All the symptoms at this period are aggravated, delirium supervenes, with ringing or buzzing sounds in the ears, followed by dullness of hearing or deafness. The eyes are injected, the tongue becomes incrustated with a black coating, which often cracks and peels off,



leaving the raw surface exposed, and the teeth are covered with sordes. The pulse becomes more feeble and frequent, there is a low muttering delirium, and sometimes twitching or spasm of the muscles. As the patient becomes more feeble he slips down to the foot of the bed; there are involuntary evacuations, hemorrhage from the bowels or other mucous surfaces, with petechiæ and vibices upon the skin. This is the usual course of the disease when it terminates unfavourably. If the disease is to terminate favourably, the symptoms abate, the countenance brightens, the tongue cleans, the pulse lessens in frequency, and the evacuations become more healthy. It often happens that at this time the emaciation becomes more evident than it was before.

Sometimes in the course of the second week, the patient is seized with intense pains in the abdomen, vomiting of green, bilious matters, a small fluttering pulse, syncope, constipation, and coldness of the extremities. The cause of these symptoms is perforation of the intestine, and escape of its contents into the cavity of the peritoneum, producing inflammation. It occurs most frequently in the mild forms of the disease, and is almost uniformly fatal.

*Anatomical characters.*—There is scarcely an organ of the body that may not be the seat of some anatomical lesion. Those which are considered characteristic of this fever, however, are *thickening, hardening, softening, and ulceration of the glands of Peyer*; the condition varying with the stage of the disease. *Enlargement, softening, and ulceration of the mesenteric ganglia*, more especially those corresponding with the morbid patches in the intestine, and, according to some writers, ulceration of the solitary mucous follicles of the ileum.

Other lesions met with are, ulceration of the pharynx and epiglottic cartilage; softening of the spleen, sometimes of the liver and kidneys; hepatisation of the lungs; softening of the heart; and sometimes inflammation of the meninges of the brain with effusion. The blood drawn in this disease is generally deficient in fibrine, and is said by some authors to contain an excess of blood-corpuscles; this is doubtful.

*Cause.*—On this point little is definitely known. It attacks all classes, rich and poor, though it is often generated where a number of persons are crowded together, with unwholesome, or insufficient food, and confined and vitiated air. It cannot be said either to be contagious, since it is very seldom if ever communicated in isolated cases.

*Age* is a predisposing cause. It rarely attacks those beyond thirty. Strangers are more liable than long residents, and males than females. It may occur at any season, but most commonly in the autumn and winter. It rarely occurs more than once, hence, perhaps, its comparative infrequency in the aged.

*Diagnosis.*—By the slowness and insidiousness of the attack; by

the diarrhœa; the dusky hue of the countenance; the epistaxis; the gurgling in the right iliac fossa; the tympanitis; the rose-coloured eruption; the stupor or delirium; the appearance of the tongue; and lastly, by the duration of the disease, and the peculiar musty smell when the skin is dry, and acid smell when it is moist.

*Prognosis.*—Not even the mildest cases can be looked upon as free from danger, and on the other hand there is no condition so low, no symptom so fatal, that death should be considered inevitable. Among the unfavourable symptoms, are constant delirium, a belief on the part of the patient that nothing ails him, a sudden shifting of position on the elbows, deep coma, stertorous respiration, great subsultus, rigidity of the limbs, profuse diarrhœa, or hemorrhage from the bowels, great prostration and frequency of the pulse, and excessive tympanitis. The favourable symptoms have been already mentioned.

*Treatment.*—This should usually be commenced by some mild laxative, such as a small dose of sulphate of magnesia, castor oil, rhubarb and magnesia, or a seidlitz powder, according to the nature of the case. The practitioner should always bear in mind the diarrhœa, or the tendency to it, and avoid all irritating and drastic cathartics. The next thing is to obviate febrile symptoms. This may be done by venesection, when the pulse is full and strong, and there is sanguineous determination to the brain. The protracted duration of the disease, must also here be borne in mind, and no blood drawn unless imperatively demanded. Leeches, or cups to the head, and to the right iliac fossa, may be advantageously employed, where there are evidences of congestion in the first, or of inflammation, as evinced by pain and tenderness, in the second locality.

Diaphoretics are useful throughout the whole course of the disease.

#### TYPHUS FEVER.

*Syn.*—*Typhus gravior.*—*Spotted fever.*—*Jail, camp, and ship fever.*—*Petechial fever.*—*Putrid fever.*

*Symptoms.*—Before the attack the patient often exhibits certain premonitory symptoms. He is low-spirited and languid; loses his appetite, and he feels ill without knowing why. There are usually at the same time sharp pains in the head, back, loins, and lower extremities. Violent shivering is often the immediate precursor of the disease; sometimes, however, the cold stage is so slight as scarcely to be noticed.

The febrile condition, when fairly established, is generally well marked. The skin is hot and dry, and of the heat of that pungent, biting character called *calor mordax*. The pulse is full, frequent, and possessed of some degree of strength, but is easily compressed. The tongue is moist, and covered with a yellowish-white fur. Some-

times there is nausea and vomiting. The bowels are costive, and no stools are procured without medicine. The aspect of the patient is peculiar; the countenance is of a dusky hue, with injection of the eyes; the features are fixed and inexpressive, or expressive only of apathy and indifference.

As the disease advances the symptoms augment in violence; the heat of skin increases, the pulse rises in frequency, and diminishes in force, ranging generally from 120 to 150, or 160. The respiration is frequent, and, according to Gerhard, feeble and imperfect at the back and lower part of the chest, which is also dull on percussion. At a period ranging from the *fourth* to the *eighth* day, a peculiar eruption appears upon the surface, not confined, however, to any particular locality. It varies in colour from a dusky reddish-brown to purple or black. It is not elevated above the surface, neither does it disappear upon pressure. It is *petechial* in character. Sudamina are rare in this disease. The tongue becomes dry, brown and cracked; the urine scanty and highly coloured; the dejections, when procured, black and offensive; a peculiar *ammoniacal* odour is exhaled from the body; the nervous symptoms become more prominent, there is dizziness, confused vision, tinnitus aurium, and sometimes deep stupor, which becomes characteristically more profound as the disease advances. Sometimes violent delirium (typhomania) takes the place of stupor; the patient is sleepless or restless, with the sensation of utter prostration and helplessness. Should no improvement take place the disease passes on to the last stage, that of prostration. The patient lies insensible, or in a muttering delirium, with subsultus tendinum, floccitation, hiccough, involuntary evacuations, and extreme insensibility of the surface, till at length death approaches silently and without violence.

Sometimes a critical discharge takes place from some organ and the patient begins to convalesce, which is generally, however, by slow degrees, and under the influence of supporting remedies.

*The duration of the disease* varies, sometimes, in mild cases, terminating on the seventh day, sometimes running out to three weeks or more. Death rarely occurs before the second week.

*Anatomical characters.*—There is only one constant lesion, (and it is questionable whether it can be considered entirely characteristic,) that is, the want of coagulability in the blood, and the petechial eruption; all the other lesions may be considered incidental. No disease is discovered in the glands of Peyer, unless in some few cases, in which there is a complication with typhoid fever. A very fatal form of typhus fever prevailed among the black population of Philadelphia, in the fall of 1847. Many died at the onset of the disease. A number of post-mortem examinations were made but the results were uniform in but few particulars. The blood was fluid and uncoagulated, resembling the settlings from claret wine. Petechiæ were not

confined to the skin, but were numerous in the muscles and deep seated cellular tissue. The skin, fasciæ, muscles, and cartilages were often turgid with bile. There was great congestion of the liver, lungs, and brain. Thickening of the arachnoid, and effusion beneath it, were common appearances. Another common lesion was an effusion of blood in spots of variable size between the under surface of the dura mater and the outer lamina, or parietal layer of the arachnoid.

Andral mentions two cases of this kind, and considers them rare. In one it was the result of an injury, and in the other the result of chronic inflammation of the membranes of the brain.

*Causes.*—Crowding together a number of persons in badly ventilated and filthy apartments; the persons so situated are capable of communicating the disease to others, although they may not have it themselves. Contagion is also a cause of this disease, though not a very powerful one where cleanliness and ventilation are duly attended to. Depressing influences of any kind are also capable of producing it: sex has little influence upon it; it is more common after 35 than before this age, and it is rare in infancy. It prevails at all seasons, and in all climates, though perhaps more in the winter, and in the temperate and cold climate.

*Of the nature of the disease* little is known. The probability is, that a poison is absorbed which at once depresses the powers of the nervous system, and vitiates the blood.

*Diagnosis.*—The peculiar hue of the countenance, with suffusion of the eyes; the dark tongue, the sordes upon the teeth, the peculiar eruption, the constipation, the characteristic odour, and the collapse of the last stage, mark the disease. The differential diagnosis between it and typhoid fever, with which it is often confounded, is presented in a tabular form.

#### TYPHOID FEVER.

Usually endemic; rarely epidemic.  
Not contagious.

Young adults and children most liable.  
Age of greatest liability under 25.  
Best age for recovery from 15 to 25.

Attacks strangers chiefly.  
Seldom ends before the 21st day.

Has no well-marked remissions.

Epistaxis common.  
Diarrhœa a frequent accompaniment;  
tympanitis.  
Pulse usually under 100.

#### TYPHUS FEVER.

Epidemic usually.  
Certainly contagious; may be communicated by those unaffected.

Spares no age but infants.  
Age of greatest liability over 25.  
Less fatal in early than in advanced life.

Attacks all residents.  
Ends sometimes by critical discharges from the 7th to the 14th day.

Remission after the 3d, 7th and 14th day generally, and after marked exacerbations.

Epistaxis very rare.  
Costive usually until the 2d or 3d week;  
abdomen flat.

Pulse usually over 100.

Has a musty smell when the skin is dry; acid, when moist.	Ammoniacal odour, whether the skin is dry or not.
Characteristic eruption appears about the 7th or 8th day.	Eruption characteristic, appears earlier, and is more abundant.
Sudamina from the 10th to the 15th day.	Sudamina are rare in this disease.
Petechiæ are rare in this disease.	Petechiæ and vibices are common.
Has a constant anatomical lesion.	Has no constant lesion.
Has bronchitis commonly in the second week.	Pneumonia of posterior part of lungs more common.
No crisis by sweat, but a gradual recovery.	Crisis by sweating in nearly every recovery.
Occurs mostly in the fall and winter.	Occurs mostly in winter and spring.
Second attacks are rare.	Second attacks do occur.

*Treatment.*—A large well-aired room; frequent changes of linen; ablution of the patient's body; removal of all unnecessary carpets and curtains; and the instant removal of all evacuations, are measures desirable both to mitigate the patient's disease, and to prevent it from infecting his attendants. The chloride of lime may be scattered about the floor.

The treatment of fever, according to the best modern physicians, should be *expectant*; that is, the symptoms should be watched and relieved as they arise, but no violent efforts should be made to cut the disease short.

In the first stage, if there is much nausea and gastric disturbance, a mild *emetic* of ipecacuanha may procure relief.

The bowels should be cleared out by an active *aperient* at the outset; say three grains of calomel, with rhubarb, and be kept open by milder doses; viz. hyd. c. cret., followed by castor oil, or an injection.

*Mercury*, gently given, so as to touch the gums, has seemed of service in some epidemics, but not in others.

The hair should be removed; and the head be bathed with cold lotion as long as there is much headache, and as long as it is *agreeable to the patient*. If there is *great general heat* of skin, the whole body may be sponged with tepid water.

*Bloodletting* should never be practised from mere routine, but be reserved to combat any local inflammation that may arise.

If the headache is very intense, with great heat, flushed face, and wild delirium, a *small* bleeding in the erect posture; or rather a few leeches, or the loss of a little blood by cupping from the neck, will be advisable. Profound coma should be treated by a large blister to the shaven scalp.

Great dyspnœa, with other signs of inflammation in the chest, must be combatted by a cautious cupping, followed by a blister, or mustard poultice; and small doses of *senega*.

If the type of the fever is very *low*, and there is great feebleness, it will be necessary to give good *beef tea*, and small quantities of *wine*

from an early period; and this need not hinder leeches from being applied to combat any local congestion.

The use of *opium* in fever is nearly the same as that of *wine*. The general rule is to give *opium*, when nervous excitement exceeds vascular action, where there is much delirium, and sleeplessness, with a feeble pulse. In some cases it is right to give a good dose at once; in others, to feel the way cautiously with small doses. In some cases of excitement, in young subjects, *opium* may be given in small doses, gr.  $\frac{1}{4}$ , with tartar emetic, gr.  $\frac{1}{8}$ , (*Vide Graves' Clinical Medicine*.)

*Opium* and *wine* may be known to do good in fever, if they make the skin and tongue moist, the pulse fuller and slower, and if they allay nervous excitement, and produce sleep.

The state of the bladder should be inquired into every day; and the bed be kept dry and clean. Any spots that seem likely to ulcerate, should be washed with brandy, and protected with soap-plaster.

To conclude: the chief indications in the treatment of typhus and typhoid fever are, to nurse the patient carefully through it; to allay excitement; to prevent local inflammation; and to support the strength.

#### RUBEOLA (*Measles*).

This is a contagious fever, with eruptions and catarrh.

*Symptoms*.—*1st day*. Alternate shivering and heat, anxiety, lassitude, sense of pain and weight across the forehead and eyes, and dullness, with a disposition to sleep. The pulse becomes accelerated, the skin hot, the surface of the tongue white, and its points and edges of a bright red. Epigastric tenderness, with nausea, is frequently present, and sometimes there is vomiting.

*2d day*. All the symptoms are aggravated; the eyes become red and watery; there is coryza, with frequent sneezing; the throat is a little painful; and in very young children there is stupor, and sometimes convulsions.

*3d day*. A still further aggravation of all the symptoms is evident; the eyes become more inflamed; the eyelids appear tumid; a dry and frequent cough; dyspnoea; a feeling of tightness across the chest, and pain in the head, precede the appearance of the eruption.

*4th day*. *Appearance of the eruption*.—The eruption first begins to appear in the form of small circular spots, on the forehead, chin, nose, cheeks, and around the mouth, and extends itself successively, within a day or two, to the neck, chest, and limbs. In general, the small spots are succeeded by larger ones, and the final arrangement of the patches is usually in a *semicircular* or a *crescentic form*. The red tint of the eruption assumes its greatest intensity on the face on the *fifth day*.

When the eruption is fully developed, the frequency of the pulse, heat, thirst, redness of the eyes, and coryza disappear, or are much alleviated; the nausea and vomiting also subside. About the sixth day, the watchfulness disappears, the cough and dyspnœa being the only symptoms that remain. On the third or fourth day of the eruption, the spots become pale, and gradually assume a yellow tint; and when the redness has disappeared, the epidermis becomes detached in small furfuraceous scales.

In children with a *delicate skin*, the eruption sometimes appears on the third day; but in those with a *thick, brown skin*, it may not be developed before the fifth day.

In measles, the mucous membranes are very apt to be affected; generally, the membrane of the trachea, bronchi, fauces, nostrils, and eyelids, is principally affected, but sometimes that of the stomach or bowels principally suffers, producing nausea, vomiting, or purging. At other times, the membranes of the brain are implicated, inducing convulsions, stupor, or coma.

The *prognosis is unfavourable* when the child is very young, when the eruption appears before the third day, or when it suddenly disappears. A leaden hue of the spots, petechiæ, or excessive dyspnœa are also unfavourable signs. The *prognosis is favourable* when the gastro-pulmonary symptoms are slight, the progress of the disease is regular, and when the skin is moist after the appearance of the exanthema.

The *sequelæ of rubeola* are, bronchitis, pneumonia, pleuritis, cæcolitis, diarrhœa, or ophthalmia.

*Treatment.*—When the gastro-pulmonary symptoms are slight, the treatment merely consists in keeping the patient in a mild temperature, on spare diet, and giving mild laxative and diaphoretic medicines. If the soreness of the throat be very troublesome, the inhalation of the vapour of warm water is useful.

As a general rule, all inflammations that precede, accompany, or follow rubeola, when severe, should be treated as though that exanthema was not present. Should pneumonia, or laryngitis, set in, the treatment according to the above rule should be on the general principles laid down for the removal or alleviation of these affections. If the eruption disappears suddenly, the treatment must depend upon the cause producing this effect. If it is induced by the sudden development or increase of an internal inflammation, the attention must necessarily be directed to the immediate subduing of the inflammatory action. Secondly, if the recession depends on cold, the warm or vapour bath should be had recourse to. Diarrhœa frequently comes on during the convalescence, and, if not too severe, is useful in checking a tendency to thoracic disease; should it, however, proceed too far, small doses of Dover's powder, and the occasional use of the warm bath, will be found useful. A common sequela of

measles is, a short hoarse and barking cough, which has a great deal of the croupy sound, but is not attended with dyspnoea. It readily yields to counter-irritants.

#### SCARLATINA.

This is a contagious fever, particularly affecting the skin and mucous membrane of the throat. About the second day of the affection, the whole surface of the body presents *little red points*, which are soon followed by patches of a *deep scarlet colour*, serrated at their edges, which become confluent, and terminate by desquamation on the fifth or sixth day.

Scarlatina occurs under three forms—Scarlatina simplex, *S. anginosa*, and *S. maligna*.

#### SCARLATINA SIMPLEX.

The precursory symptoms of this form are, general debility, nausea, shiverings, followed by flushes of heat and thirst. On the *second* day of the febrile symptoms, *little points*, at first of a light red, then becoming deeper, appear in great numbers on the face, neck, and chest. In the course of twenty-four hours, similar spots appear on the body, lips, tongue, palate, and pharynx. On the *third* day, most of the interstices which had been left are covered with large dotted patches, having serrated edges. In this stage, the pulse is full and frequent, the tongue is covered with a creamy coat, through which the red and elevated papillæ appear. This produces the peculiar appearance of the organ to which the term *strawberry-like tongue* is applied. The skin is much hotter in this form of exanthema than in any other. The scarlet colour is of a *deeper tint* on the groins, buttocks, and folds of the joints, than in other situations.

About the *fifth* day the interstices between the patches become larger, the scarlet colour less vivid, and slight desquamation takes place on the neck, temples, and chest. On the *sixth* day, the character of the disease becomes less distinct; and on the *eighth* and *ninth* days, desquamation from the surface of the hands, feet, and the different regions of the body, takes place.

#### SCARLATINA ANGINOSA.

*Symptoms.*—This form commences with more intense fever, and a sense of stiffness of the neck and inferior maxilla. On the *second* day, the pharynx is inflamed, deglutition is difficult, the amygdalæ become swollen, and the mucous membrane presents a vivid red appearance. In the *S. simplex*, the pharynx presents an exanthematous blush, but there is no effusion; in this form, however, a quantity of thick, viscid fluid, sometimes of a whitish-yellow colour, but more generally, caseous-like matter, is thrown out on the amygdalæ, pharynx, and anterior pillars of velum. During the *second*,



*third*, and *fourth* days, symptoms of gastro-enteritis are present; the tongue is of a bright red colour; there is nausea, vomiting, diarrhœa, or constipation, dry cough, quick and vibrating pulse, and occasionally epistaxis. The eruption, which appears on the *third* day, is not so generally or equally distributed as in the former affection. It also sometimes disappears suddenly, frequently on the day after its appearance, and returns again after an uncertain period of time. The entire duration of this form is longer than in simple scarlet fever, and its order of appearance, and that of its desquamation, are not so regular.

## SCARLATINA MALIGNA.

*Symptoms.*—This form comes on like the scarlatina anginosa, except that the symptoms are of a graver type even on the first accession. Sometimes, in fact, the patient is stricken dead by the poison in a very few hours before any eruption or local symptoms come on. The eruption does not present a scarlet appearance, but is more of a livid hue, and frequently interspersed with petechiæ. It is irregular in its first appearance, and it may disappear and reappear several times. In this form of scarlatina, the pulse is small and irregular, the teeth and tongue are covered with brown or black incrustations, the eyes are much injected, and the vision is confused; the respiration is laborious, and the breath is fœtid; the pharynx is covered with thick, viscid mucosity, and there is often sloughing of the surface of the amygdalæ. Convulsions and coma are frequent concomitants of this affection in children, while delirium and deafness attend this form in the adult.

The appearance of numerous petechiæ, of abundant diarrhœa, of difficult respiration, or of persistent coma, announce the approach of death.

The *sequelæ* of *scarlatina* are, anasarca, ophthalmia, otitis, bronchitis, enteritis, orchitis, and cynanche parotidea, in adults; affections of the sub-maxillary and inguinal glands, &c., in children.

*Treatment.*—In *scarlatina simplex*, when the bowels are constipated, mild purges may be employed. Rest in bed, spare diet, cooling acidulous drinks, and, where the surface of the body is extremely hot and burning, cold sponging, are the means principally to be relied on.

In *scarlatina anginosa*, and *maligna*, the treatment must be the same in its *nature* as that of continued fever, but be varied to meet the symptoms. If there is violent cerebral excitement, or inflammation of the throat, a few leeches may be applied; but if the powers of life are low, it may be necessary to give wine, beef-tea, &c., from the very commencement. The *throat* always requires great attention. Therefore the patient, if able, should assiduously use a gargle containing muriatic acid, or chloride of soda, and should

inhale the steam of vinegar and water; and if not able to do it himself, the same liquid should be copiously injected through the nose and mouth from an elastic bottle. The bowels should be regularly cleared by mild aperients and enemata. The citrate of ammonia, given in a state of effervescence, is an excellent medicine in most cases. Cool sponging is of service when the heat of the surface is steadily high; but in malignant cases it is to *wine* that the practitioner has chiefly to look for the safety of his patient.

The internal and external use of chlorine throughout this disease is highly recommended by some authors. It may be used either in the form of the aq. chlorinii f ʒss, aquæ font. f ʒviij, and syrup. f ʒj; a tablespoonful of the mixture being given every hour or two. Or it may be given in the form of a solution of chlorate of potassa, in the proportion of a drachm to a pint of water, and used ad libitum. It may also be used as a gargle to the throat. When pseudo-membranous or gangrenous patches are observed in the fauces, and the colour of the membrane is dark-red, an infusion of capsicum is an excellent application. The sulphate of zinc, or nitrate of silver, is also useful under similar circumstances. When the sloughs are offensive, the fætor may be often corrected by a creasote gargle, or a gargle of pyroligneous acid in solution.

*Belladonna* is sometimes used as a *preventive*. It may be given in a solution made by dissolving three grains of the extract in a fluidounce of distilled water, of which *three drops* is the dose for a child under one year, increasing it one drop for every year.

During convalescence, the patient should be protected from cold, and ought occasionally to employ tepid baths, and frictions to the surface.

#### ERYSIPELAS.

This is an exanthematous fever affecting the skin or the subcutaneous cellular tissue, or both. It arises from an animal poison, and is not contagious; but there are some minor varieties that ought rather to be called *erythema*, that are caused by disorder of the digestive organs or of the general health.

There are two chief varieties of it:—the *simple*, which affects the skin, and ends in vesication and œdema; the *phlegmonous*, which affects the subcutaneous cellular tissue likewise, and causes unhealthy suppuration and sloughing.

#### SIMPLE ERYSIPELAS.

Erysipelas always begins with shivering, nausea, and other signs of fever, and derangement of the stomach. The skin of the part affected becomes slightly swollen, and of a red colour; there is acute pain, with a sensation of burning heat, but no throbbing, as in phlegmon. The redness disappears on the slightest pressure,

and reappears immediately on its removal. In some instances, small miliary vesicles appear, in others bullæ or phlyctenæ are observed. The most favourable termination is in resolution, in which case the epidermis is thrown off in small scales. It occasionally assumes an *erratic* form, and sometimes it terminates by *metastasis* to some of the internal organs.

## PHLEGMONOUS ERYSIPELAS.

In this form the redness is very vivid, and diminishes in intensity from the centre to the circumference. The cellular tissue being implicated in this affection, produces swelling, hardness, and a burning pain. This affection may terminate in resolution; but should it proceed to suppuration, and measures are not employed to allow of the exit of the pus, abscesses will form, and the cellular tissue between the muscles will become implicated. The abscesses and sinuses thus formed, will gradually burst externally, when a quantity of gangrenous masses, mixed with fœtid pus, will be discharged. The constitutional symptoms in this case indicate that much mischief is going on. The pulse becomes quick and hard, and the tongue brown; encephalitis, meningitis, or gastro-enteritis, may come on, and the patient sinks under diarrhœa, with low muttering delirium and coma.

## ŒDEMATOUS ERYSIPELAS.

This is the name given to *simple erysipelas* affecting loose cellular parts. The skin is smooth and shining; and pits on pressure. This affection often induces gangrene, the skin being deprived of its supply of blood through the distension of the cellular tissue; the accession of this is announced by acute pain, a red and shining skin, with sometimes a livid or leaden hue. The genitals in women, the scrotum in men, and the infiltrated limbs of hydropic patients, are the most usual seats of the œdematous erysipelas. *Erysipelas of the head and face* is generally of the simple or œdematous variety; and is the form which the disease assumes, when there is no wounded part for it to fix upon. It is very dangerous, as the contiguous irritation is liable to cause inflammatory excitement, or effusion within the cranium.

*Treatment.*—When the surface of the inflamed part is of a deep or florid red, tense, and very hot; the pulse hard, full, or strong; the head much affected, and the papillæ of the tongue erect and excited, both general and local *bloodlettings* are requisite, especially in unbroken constitutions, in persons not addicted to drinking to excess, and very early in the disease. Local depletion by *leeches* or *incisions*, will often be sufficient, except the patient be of a phlogistic habit.

At the outset, an *emetic* may often be administered with advantage;

at all events a dose of *calomel* and *James' powder* at night, followed by a cathartic draught in the morning.

When the functions of the different discerning and excreting glands have been properly restored, *tonics* and *alteratives* should be employed; of the former class, the preparations of cinchona are those most recommended. *Cold applications* have been recommended by several writers; this practice, however, is not always safe, and should not be adopted when the persons are of broken-down constitutions, or advanced in life, or in erysipelas of the head. Warm poppy fomentations are much safer. Mr. Higginbottom has recommended the application of *nitrate of silver*, in substance, or in strong solution; it should be applied either to the inflamed surface and the adjoining integuments, or only to the healthy skin surrounding the affected part; it should raise the cuticle, or it will fail in isolating the disease.

In the *phlegmonous* form, *free incisions* should be employed early, before the matter burrows deep, and causes much constitutional irritation. Permanent and diffusible stimuli should be used, and if there is much restlessness, opium should be exhibited, unless there is a tendency to coma. Free incisions, followed by poultices, are the most efficient means in this case, as they tend not only to allow of the escape of matter which acts as a foreign body in the system, but also to relieve the tension of the parts, and to destroy the inflammatory orgasm in them. Bleeding from the incisions should be carefully watched, as it is sometimes profuse; and it may, if uncontrolled, or unaccompanied by a sufficiently restorative treatment, especially in drunkards and those of broken-down constitutions, be attended by dangerous consequences. If the affection has been neglected until sloughing has occurred, before incisions have been made, lint dipped in oil of turpentine, or in equal parts of it and Peruvian balsam, should be applied, and covered by warm poultices.

#### VARICELLA (*Chicken Pox*).

*Symptoms.*—Varicella is a contagious fever, attended by vesicles or pustules, which dry up from the fourth to the seventh day of their formation, generally leaving small red spots, but rarely cicatrices on the skin. In general, the invasion of varicella is preceded by slight fever, which lasts from twelve to forty-eight hours. In some cases, however, all the symptoms of violent gastro-intestinal irritation are present—acute pain in the epigastrium, nausea, vomiting, &c.; this state will continue for three or four days.

On the *first* day of the eruption, small, red, oblong, flat spots appear; and on the *second* day, a prominent vesicle is observed at the centre of them, containing a fluid of citron hue. The *third* day, the colour of the fluid is yellowish. On the *fourth* day the vesicles

diminish in size, and shrivel at their circumference; and on the *fifth*, a small crust, adherent to the skin, is formed at their centre. On the *sixth* day, small yellowish and brownish crusts occupy the place of the vesicles; on the *seventh*, or *eighth*, the crusts fall off, leaving on the skin red spots, without depression, which remain for some days.

This is the usual type of this disease; but sometimes it assumes a *pustulous* form, in which case the accompanying symptoms are more severe, and the disease assumes, to some extent, the characters of small-pox. This form has been divided into three kinds, which, differing in the external characters of the pustules, and in the progress of the eruption, have received the names of *conoid*, *globulous*, and *umbilicated* pustulous varicella. Pustulous varicella has been, and may readily be, confounded with variola, some believing that it is an imperfect form of that disease.

The external characters which distinguish varicella from variola are—

1. The shorter duration of the vesicles, or pustules in varicella.
2. The small red spots of varicella, on the first day of their appearance, feel to the finger like a *flat* seed; on the contrary, in the same stage, the elevations of small-pox give the sensation of touching a *round* seed, and the sanguineous injection is much greater.
3. In varicella, the serosity, or pus, fills the vesicles, or pustules, on the first or second day of the eruption; in variola, the formation of the serosity is slower, and only takes place at the *summit* of the pustules.
4. Lastly, in varicella, the eruption is not so simultaneous as in small-pox; some vesicles and pustules appearing in the former, at the same time that the desiccation of others has commenced.

*Treatment.*—When varicella is distinct and apyretic, the treatment is very simple; the patient should remain in bed in a temperate atmosphere, have a mild purge, ought to be placed on low diet, and abstain from animal food for a few days, and should partake freely of diluent drinks. Tepid baths may be employed during convalescence.

#### VARIOLA.

This is a contagious eruptive fever, affecting at the same time the gastro-pulmonary mucous membrane and the skin. It shows itself externally from the third to the fourth day of the febrile invasion. At first it is *papular*, it then becomes *vesicular*, and next *pustules* are formed, which at first are *pointed*, and then become *umbilicated*. This affection terminates, after from twelve to fifteen days' duration, in desiccation and scabbing, small irregular cicatrices remaining.

Variola is commonly divided into the distinct and confluent forms. In the *distinct*, the pustules are few and thinly scattered over the

whole surface of the body. In the *confluent*, the pustules are numerous, and are more or less united by the close approximation of their edges.

Variola presents *four stages*—1st, that of *incubation*, or the *latent period*; being that which intervenes between the inception of the poison and the first appearance of symptoms; 2d, of *invasion*; 3d, of *eruption*; 4th, of *desiccation*.

The latent period varies from *six to twenty* days.

On the *first day* of the *invasion* there are more or less prolonged shiverings, alternating with flushes of heat, and loss of appetite. On the *second day*, there is nausea, epigastric tenderness, thirst for cold acidulous drinks, a quick pulse, and hurried respiration. Children are frequently seized with convulsions in this stage. The tongue is loaded with a whitish or a yellowish fur, and its point is red. There are pains in the head, back, loins, and limbs. These symptoms continue for *three or four days*.

On the *fourth day of the invasion*, the *eruption* appears in small isolated spots on the lips, face, neck, chest, abdomen, and limbs. On the *fifth day*, the spots become more numerous, and their summits become *vesiculous*. On the *sixth and seventh days*, *vesico-pustular* spots are observable on the skin, and sometimes on the mucous membrane of the mouth, pharynx, and eyelids. In the intervals between the pustules, the skin becomes red, and the subjacent parts swollen. On the *eighth day*, the eruption is perfectly pustular, having central indentations. The pustules being more numerous on the face than on other parts, it becomes hot, painful, and tense. *Secondary fever* now comes on, and on the *ninth and tenth days* the central indentation disappears, and the pustules become *orbicular* in form. On the *eleventh and twelfth days*, the pustules burst, and *desiccation* commences. The crusts or scabs, now fall off, those on the hands being detached a day or two later than those on other situations. A thick ropy salivation is established during the more advanced stages of this eruption. After the scabs have fallen off, *circular spots* of a red-brown colour are seen on the skin, and there are always small irregular cicatrices, which sometimes become the seat of furfuraceous desquamation.

In *confluent variola*, all the symptoms are of a more grave type. The cerebral and gastric complications are more intense, there being persistent vomiting, and either delirium or convulsions. These affections may cause the death of the patient before the appearance of the eruption. The eruption, which is commonly *simultaneous*, and seldom *successive*, occurs about the *second or third day*, rarely on the fourth, and still more rarely on the fifth.

The pustules are less prominent, and more aggregated, than in simple variola, and their edges run into one another. They are more numerous on the face than other parts; and in fact, when

crusts begin to form, the whole face is covered, as it were, with a mask. This incrustation falls off from about the fifteenth to the twentieth day. Towards the termination of the suppuration, and the commencement of desiccation, some patients fall into a state of coma, and die within twenty-four or thirty-six hours. When the incrustation first falls off, no cicatrices are remarked on the skin; furfuraeous scales are, however, soon thrown off, which leave such cicatrices and ulcerations as completely disfigure and alter the expression of the countenance.

During the progress of the disease, pustules are seen in the mouth and pharynx, on the edges of the eyelids, and on the transparent cornea. This structure ulcerates, but is rarely perforated. The cornea frequently remains opaque in its whole extent after this disease.

It is during the secondary fever, which is very violent in the confluent small-pox, that most danger is to be apprehended. Out of 168 deaths, recorded by Dr. Gregory, 27 occurred on the eighth day of the eruption (eleventh day of the disease). Thirty-two died in the first week, 97 in the second, and 21 in the third. In the first week death seems to be caused by an overwhelming malignancy of the poison, oppressing the brain, and causing coma; in the second week, from affections of the respiratory passages; and in the third from debility.

*Treatment.*—When the disease is *distinct* and slight, it will be sufficient to keep the patient in pure air, in a large room, and at a mild temperature, and to open the bowels. The skin may be sponged with tepid water, if its temperature is very high. In the confluent small-pox, the treatment is often not so simple; but requires to be varied to meet the symptoms that arise, just as in fever. Great restlessness, wakefulness, and delirium about the eighth or ninth day are generally benefited by opiates. If the pulse is feeble, broths and wine are required; especially if the pustules do not fill out.

During the *secondary fever*, which generally sets in about the eleventh day of the disease, aperients, opiates, and nourishing diet should be given.

Great dyspnoea requires a blister to the chest.

The intolerable itching is best allayed by smearing the eruption with cold cream.

Various measures have been proposed, in order to prevent the *pitting* and disfigurement occasioned by this horrid disease. Pencilling the pustules with lunar caustic; opening each of them; covering the face and hands with an ointment composed of litharge and mercurial ointment; keeping the patient in perfect darkness, have each been recommended; but with very doubtful success. They should all be tried before the eruption becomes vesicular.

## VACCINATION.

The real nature of this excellent means of preventing the small-pox seems to be, that it is a kind of small-pox, modified and rendered milder by passing through the constitution of some of the domestic animals. It appears that if the cow be inoculated with small-pox matter, the disease, which the animal exhibits in consequence, is the same which is familiarly known as the cow-pox, and which, if communicated to the human subject, gives the same amount of protection, against a subsequent attack of small-pox, as an attack of that disease would.

As a *general rule*, the exanthemata occur only once during life. But late experience shows that this rule is liable to many exceptions, since there is no kind of exanthema, which has not been known to occur twice in the same subject, and this is especially the case with small-pox. The protecting influence, therefore, of vaccination (if it can wear out, as is asserted by some authorities), should be renewed at intervals, at and after puberty.

## RHEUMATISM.

Rheumatism is an inflammation of a peculiar character, affecting the fibrous structures primarily, but liable to implicate also the serous or synovial membranes in their vicinity. It causes intense pain, and effusion of serum or lymph, but very seldom, if ever, causes suppuration or gangrene.

Its *proximate cause* or *real nature* seems to be an accumulation in the blood of certain acid and other excrementitious matters, that ought to be eliminated by the skin and kidneys.

It generally attacks the fibrous tissue around the *large* joints; and a distinction is to be made between *fibrous* and *synovial* rheumatism. The former attacks the fibrous, ligamentous, and muscular structures in the neighbourhood of the joints, without affecting the synovial membranes much; the latter (or *rheumatic gout*, as it is sometimes called) implicates the synovial membrane, causing effusion and considerable swelling of the joints.

Rheumatism may be *acute* or *chronic*.

Acute rheumatism is a disease of early life, often affecting children. Its usual *exciting* cause is exposure to wet and cold, combined with muscular fatigue.

The most severe form of acute rheumatism is called *rheumatic fever*. There is a very high degree of fever; full jerking pulse; thickly furred tongue; profuse sour perspiration; scanty and high-coloured urine, depositing a copious lateritious sediment. Together with these constitutional symptoms, there is great pain in several of the larger joints, increased excruciatingly by pressure or motion; and slight redness and swelling. This inflammation is very apt to shift



from joint to joint, (by *metastasis*, as it is technically called,) and most especially is it liable to affect the pericardium, and the lining membrane of the heart.

*Treatment.*—If the patient is young and robust, and the fever very violent, venesection may be employed;—if employed it should be done *early* and *decidedly*, for a repetition of bleeding is not well borne, although the blood is buffed to the last; and too much bleeding is apt to induce metastasis to the heart.

The next remedy deserving of notice, is that which is commonly known as Dr. Chambers' plan of treatment, and which consists in producing a large flow of secretions from the liver and intestines. Five or ten grains of calomel are given at bedtime every other night, and followed in the morning with a black draught; and this is repeated twice or thrice till a copious secretion has been produced from the liver and bowels.

After this, diuretics and colchicum, alkalies, diaphoretics, and calomel and opium may be administered in conjunction, with almost equal claims on our confidence. The grand secret seems to be, to ensure a free discharge of all the secretions, from skin, bowels, and kidneys. The general plan is, to give a dose of calomel and opium at bedtime, and a saline draught of liq. am. acet. with vin. colchici twice or thrice during the day. When the acuteness of the fever has abated, and the urine is clearing, great benefit may be derived from bark combined with ammonia. Pain at night may be allayed by opium. Prof. J. K. Mitchell, who regards this as a disease of *spinal* origin, has had much success in the acute form by the application of cups to the spine, in the neighbourhood of the affected part.

*Chronic Rheumatism* is of two kinds. One has a nearer affinity to the acute; it is aggravated by heat and stimulants, and is best treated by clearing out the liver, and securing a free action of the kidneys and skin; and at the same time taking care that the diet consists of nutritious and digestible substances, not disposed to acidity.

The iodide of potassium is also extremely serviceable in these cases of *subacute* rheumatism, in doses of three grains ter die, with an alkali, and a bitter. It causes a great flow of urine, in which it may be detected by the proper tests.

The other variety, which is very common in elderly people, is benefited by stimulants, especially by warmth, friction, ammoniated tincture of guaiacum, &c.

#### GOUT.

Gout is a constitutional disease, characterized by a superabundance of lithic acid in the system, which is deposited from the urine, and concretes around the joints in the form of what are called *chalk-stones*; which really consist of lithate of soda.

Gout is generally a disease of advanced life, and seldom occurs till after puberty. It is liable to be brought on by sedentary habits, and indulgence in animal food and wine or malt liquors.

It presents many resemblances to rheumatism, but differs in the following points:—1. Rheumatism affects chiefly the young or middle aged; gout, the elderly. 2. Rheumatism prefers the larger joints; gout, the smaller, and especially the feet and hands. 3. Gout is attended with more obvious disorder of the digestive organs; the pain is of a more burning character, and the swelling greater and more vividly red.

*Symptoms.*—After suffering some time from premonitory symptoms, such as irritability of temper, loss of appetite, and various anomalous aches and pains, there comes on (often suddenly in the night) a very severe burning, aching, wrenching pain in the ball of the great toe, or some other joint of the hand or foot; at the same time there is shivering, followed by feverish heat, thirst, foul tongue, scanty urine depositing lithic acid, and confined bowels. The pain usually remits towards morning, but occurs again for several days, till the fit is over, and then the cuticle of the inflamed part desquamates, with violent itching.

After the fit is over, the patient feels better in his health than he had done for some time before. But without great care, another fit comes after some months; and the disease becomes established in paroxysms, which almost every time recur at a less interval and more severely; till at last in some cases the disorder becomes *chronic* and *habitual*. The joints affected, return to their usual pliability after the first few attacks, but gradually become stiff and crippled, and deposits of *lithate of soda* are formed in the cellular tissue.

Besides these evils, gouty persons are liable to various anomalous and dangerous affections of internal organs. Sometimes they are seized with pain of a cramp-like character in the stomach, with coldness and deadly sickness;—sometimes with extreme pain of the heart, palpitation and dyspnoea;—sometimes with furious delirium and headache, or coma; and as these symptoms are relieved by the appearance of gout in the foot, it is evident that they arise from the gouty poison; and such attacks are often called *misplaced gout*. If such symptoms come, upon the gout leaving the extremities, the case is said to be one of *retrocedent gout*.

Gouty people are also liable to inflammations of the eye, lungs, and other parts, which are very stubborn when treated with common remedies, but yield generally to colchicum.

*Treatment during an acute attack.*—The indications are to free the system from superabundance of lithic acid, by low diet and increasing the secretions; and to allay pain.

The first point is to act well on the bowels by calomel, followed by senna draught, and any other warm purgative. The diet should

be merely tea and toast, water gruel, &c. The affected part should be bathed frequently in tepid water. Then colchicum may be given combined with alkaline diuretics or diaphoretics. Ten grains of bicarbonate of potass, three drachms of liq. am. acet. and ℥xv—xx. vini seminum colchici in a draught every six hours; or a fluid drachm of acetum colchici, with twenty grains of carbonate and a drachm of sulphate of magnesia, in a draught thrice a day are favourite forms. But the great object should be, at the same time, or before giving the colchicum, to unload the liver and kidneys, and to avoid causing the nausea and faintness which are the poisonous effects of the drug, and which are by no means accessory to its curative effects. The patient should not be weakened by too much purging.

During the interval, the patient should observe such a course of life as would prevent the formation of much lithic acid, and cause it when formed, to be oxydized, and so converted into *urea*, which is much more soluble and easily eliminated from the system.

The diet should therefore be abstinent, to the exclusion of too much animal food and wine. Animal food in excess at once supplies the pabulum for lithic acid; whilst alcoholic liquors, and other articles of diet in excess abstract the oxygen which ought to convert it into urea. Plentiful exercise in the open air is good, as the most ready means of *burning* up effete and excrementitious matters; but *great fatigue* is always liable to bring on the gout. Plenty of liquid may be taken, to hold the lithic acid well in solution; and vegetables and most fruits (if they agree with the stomach) are wholesome from their containing an alkali. The bowels should be regularly kept open; and a pill containing one grain of blue pill, one of acetous extract of colchicum, and three of colocynth, is often prescribed, and of great use. Acidity in the stomach, moreover, should be combated by alkalies and magnesia; and if the urine becomes loaded, small doses of vin. colchici, with tartarized soda (*sodæ potassio-tartras*), should be administered; for the acid of the salt is digested, and the alkali passes off with the urine.

For the *chronic gout*, the great points are to improve the tone of the digestive organs, open the bowels, and keep up the strength without heating the system. The iodide of potassium in doses of gr. ij. ter die with a light bitter infusion; the dec. Aloes c. with sodæ carb.

For sudden attacks of gout in the stomach, heart, &c., the indications are to put the feet in hot mustard and water, to apply mustard poultices to the epigastrium, and to give some warm stimulant internally. These may be followed, as soon as the symptoms permit by a dose of calomel and opium, succeeded by a laxative to remove the offending matter from the stomach and bowels.

## DISEASES OF THE THORACIC VISCERA.

### ANGINA LARYNGEA (*Laryngitis*).

(*Inflammation of the lining membrane of the larynx.*)

*Symptoms.*—Acute laryngitis may vary from the production of but a slight hoarseness, without stridulous breathing, and with little or no fever, to a violent irritation of the mucous membrane and subjacent cellular tissue of the glottis, epiglottis, and upper portion of the larynx, which, by inducing œdema, may cause death by suffocation. The developed stage of this disease is generally preceded by a sensation of irritation, heat, and tickling in the throat, pain in the region of the larynx, increased by pressure, and cough. General febrile excitement comes on, the respiration is stridulous, the voice becomes hoarse, sometimes descends into a whisper, and in extreme cases there is complete aphonia. Violent coughing comes on in paroxysms, during which the face becomes swollen and livid, the eyes turgid and prominent, and there is more or less cerebral disturbance. There is often dysphagia, and the drinks are returned through the nose; in some cases, the epiglottis may be felt swollen, turgid, erect, and on inspection is seen red and shining. The cough, which is at first dry, is afterwards attended with the expectoration of a thin and acrid secretion, which, should the case proceed favourably, becomes bland, viscous, and transparent, and gradually changes to a yellow.

Should the disease progress to a fatal termination, all the symptoms become aggravated; the mucous membrane of the larynx becomes swollen, and the rima glottidis is so contracted as not to allow sufficient atmospheric air to pass to the lungs; hence, there is great dyspnœa, with violent action of the respiratory muscles. As the rima becomes more contracted, the difficulty of breathing increases, the patient sits up in bed, tosses about his limbs, his eyes are prominent and tearful; and he dies apparently exhausted by his efforts; or, if a strong person, in a convulsive struggle. When the disease terminates more slowly, it is supposed that death is produced by blood which is not duly aërated circulating in the brain.

*This disease may be mistaken for* foreign bodies in the larynx, acute pneumonia, pleuritis, acute pericarditis, tumours pressing on the larynx, hysteric spasm, &c.

*Morbid appearances.*—The mucous membrane lining the larynx, and particularly the glottis and epiglottis, is red and injected; this appearance is either in spots, or diffused to a greater or less extent. It is also somewhat tumefied, and presents a viscid or puriform fluid on its surface. When the disease has been protracted, the redness disappears, and the membrane becomes thickened; small ulcerations are occasionally observable in these cases, particularly at the sides of the glottis.

*Treatment.*—In the earliest stage of this disease bleeding should be employed, and repeated, if it be requisite. Where bleeding is performed, it should not be carried to syncope. Leeches may be applied to the sides of the throat, or cups to the nucha. Warm fomentations are also of great service. Calomel, opium, and tartar emetic may also be given, but if the disease does not yield, *tracheotomy* is the only resource. Blisters to the throat are inadmissible in the early stages.

Before giving a prognosis, and performing the operation, it is requisite to ascertain what is the state of the lungs; for the chance of success from opening the trachea will be much less, if the lungs are diseased.

Sometimes the disease affecting the glottis is not so much acute inflammation, as *œdema*, the result of a low degree of vascularity. Tracheotomy and purgatives are the chief resource.

#### CHRONIC DISEASE OF THE LARYNX

May consist of *chronic inflammation* and *thickening*: of *ulceration*, *common*, and *sypilitic*, disease of the *cartilages*, and *morbid growths*. Ulceration is very common in consumptive patients.

In cases of chronic inflammation or ulceration, attended with husky voice, and irritating cough, and tenderness, the regular application of a few leeches, the very gentle administration of mercury; or sometimes *swabbing* the upper orifice of the larynx with solution of lunar caustic, may be of use. But if dyspnœa and choking cough increase, the safest plan is to open the larynx, whereby spasm of the glottis is prevented, and the part being at rest is more likely to get well.

#### CROUP.

*Symptoms.*—Three stages of this affection have been noticed by the best authors—1st, *the invading, or catarrhal*; 2d, *the developed, or inflammatory*; 3d, *the stage of albuminous exudation, with threatening suffocation*.

*First stage.*—In the *catarrhal stage* there are slight febrile symptoms, consisting chiefly of alternating chilliness and heat, and in more acute cases the skin becomes hot, the pulse accelerated and

hard, and the countenance flushed; the child is either dull or in excited spirits; there is generally more or less pain in the head. In other cases, in addition to these symptoms, those of common catarrh are present; in some instances, the cough may be slightly resonant, but the respiration is not stridulous.

*Second stage.*—The duration of the catarrhal stage is very variable; it may continue but for two or three hours, or may last as many days, when the *inflammatory* stage sets in. The fever now increases rapidly; the respiration becomes difficult and sonorous; the cough may be either loud, dry, and clangous, as if passing through a brass tube; or it may resemble the barking of a young puppy. The inspiration is dry, hissing, and slow, and produces a sound similar to that which would be caused by forcing a piston down a dry pump. In most cases, the sympathetic fever runs very high; the skin is hot and burning; the pulse is frequent and hard; the face flushed, sometimes covered with perspiration; the bowels are constipated; and the urine is scanty, highly coloured, and generally albuminous. The head is now commonly thrown backwards; and the child, either by its speech or attitudes, expresses a feeling of anxiety, with pain and constriction about the trachea and larynx, which are often tumefied externally. These symptoms, with the exception of the hoarseness of the voice, quickness of the pulse, peculiar cough, and sibilous inspiration, evince distinct remissions during the day.

*Third stage.*—The cough, which was at first dry, or attended with a scanty muco-sanguineous expectoration, now becomes husky and suffocative, and is frequently attended with abortive efforts to excrete what is felt in the trachea; the sense of suffocation is increased, and the fits of coughing are accompanied by the expectoration of a glairy mucus, containing shreds of the adventitious membrane. As the disease advances, there is total absence of any distinct remissions; the pulse becomes accelerated, small, weak, and irregular; and the cough is less frequent, less audible, but suffocative. If a fatal termination is approaching, the patient tosses about in great distress; seizes on objects around him, and grasps them convulsively for a moment; throws his head back; seizes his throat, as if to remove some obstacle to respiration; makes forcible efforts to expand the lungs; and, after a variable duration of such sufferings, seldom above twenty hours, dies, either with signs of convulsive suffocation, or those of complete exhaustion of vital energy. Such is the course of the severe form of croup, when left to nature, or when unchecked by treatment.

In some *slight forms*, hoarseness, with a hard, ringing cough, succeeded by a crowing or stridulous inspiration, present chiefly in the night, and remitting during the day, are the only symptoms; the

respiration and pulse being but little disordered in the intervals, and the febrile symptoms not very acute.

*Physical signs of croup.*—Croup is to be recognised by the sudden hoarseness, with fever, followed by the characteristic croupy cough, dependent on albuminous exudation from the mucous membrane of the trachea and bronchi. When the disease extends to the bronchi, the respiration about the sternum, which is naturally bronchial, becomes sibilant and whiffling; but it is sometimes difficult to distinguish from a similar rhonchus which generally, also, has its seat in the trachea. The clearest physical sign of inflammatory tracheal croup is, the detachment and expectoration of the albuminous concretions formed in the air-tubes.

*Morbid appearances.*—The mucous membrane lining the larynx, upper part of the trachea, and sometimes even the larger divisions of the bronchi, exhibits a greater or less degree of swelling and redness; it is sometimes covered by a *false membrane*, of a pale yellow or grayish colour, the thickness of which is greater in the larynx and trachea than in the bronchi. The false membrane of croup corresponds exactly with the form of the canal which it covers; its consistence is about that of boiled white of egg, but this usually diminishes towards its extremities, so that it becomes sometimes, in these situations, scarcely more solid than the thick phlegm of catarrh. The false membrane is sometimes separated from the mucous membrane by a viscid or puriform fluid; at others, it adheres more or less intimately, according to the degree of inflammation, and also its proximity to the glottis. Those who die of croup generally exhibit a high degree of congestion of the lungs, and also of the cerebral vessels.

*Treatment.*—The medical man is seldom called in during the first stage of this disease, as the symptoms are often so slight as not to attract much attention. When, however, the child is seen in this stage, by judicious interference, the attack may be either cut short, or very much modified in its subsequent severity. The patient should be confined to his room, all stimulating diet forbidden, and an antimonial emetic immediately prescribed. After the vomiting, the child should be kept in bed, the bowels ought to be freely acted upon, tepid diluents should be given, and small doses of ipecacuanha be persisted in. A hot poultice may also be applied to the throat.

But when the inflammatory stage has become developed, the treatment must be bold and decisive, for the life of the patient depends on what is done within the first six or eight hours of this disease. If croup be not accompanied by a strongly-marked asthenic diathesis, or does not occur in very young infants, the treatment of this stage ought to commence with one or two bleedings from the arm. Some authorities in this country recommend the abstraction of blood from the jugular vein. In very doubtful cases, and where the disease has

made much progress, it would seem preferable rather to omit bleeding than to destroy, by injudicious depletion, the powers requisite for the separation and excretion of the false membrane. In weak children, leeches to the throat may supersede the necessity for venesection. Although this is the general practice, it would be advisable to adopt the suggestion of Dr. Farre, which is, not to apply leeches over the larynx, but rather along the line of the clavicles, as they often induce an œdematous state of the skin or ecchymoses, which occasion a stiffness of the parts, and add to the suffocating feeling of the patient.

Two methods of treatment are strongly advocated in this disease, the one being the *mercurial*, the other the *antimonial*; some eminent practitioners recommend the former, others, and, those who have paid most attention to this disease, the latter. Dr. Copland recommends, immediately after depletion, *calomel* and *James' powder*; from three to five grains of the former, and two to three of the latter. This powder may be repeated every second, third, or fourth hour, until two or three doses have been taken. After the first dose, the child should be put into a tepid bath, and be allowed as much tepid diluents as the stomach will bear, in which carbonate of soda may be dissolved, and which may be rendered agreeable with syrup. If the powders, given to the extent now mentioned, have not acted upon the bowels, castor oil, or some other purgative, should be administered.

The treatment of croup by means of tartarized antimony is as follows: The exhibition of this medicine should commence from the very first period of the treatment: and Dr. Stokes advises, "that the medicine should be so exhibited as to produce free vomiting at least once in every three quarters of an hour." This treatment should be persisted in for several hours, when, according to circumstances, the quantity of the antimony may be diminished. The solution employed by Dr. Stokes contains one grain of the salt to the ounce of distilled water, and of this a dessert-spoonful is given every quarter or half an hour, according to its action. Dr. Cheyne, who first introduced this powerful remedy in croup, observes—"In very few cases have I known the child survive the second stage of croup; and in all these the children recovered while using a solution of tartarized antimony. Emetics I had repeatedly given in the second stage of croup, but *in these cases the patients were kept sick for two or three days, with scarce any interval.*"

In the advanced stage, where there is feeble respiration, a weak and sinking pulse, pallor of the countenance, &c., stimulants and derivatives must be employed. It has also been recommended to give such medicines as will act on the mucous follicles of the affected part, causing them to throw out a fluid between the mucous and adventitious membrane, and thus promote the separation of the latter.



The preparations of *squill*, *ammoniacum*, and *senega* are amongst those commended. Coxe's hive syrup is one of the best remedies in this disease. Blisters may be applied between the shoulders, or on the sternum, *but never on the neck*, for the reasons stated when alluding to the application of leeches; and, further, because it may be necessary to open the air-tube, in which case we should have to cut through the inflamed skin.

The operations of laryngotomy and tracheotomy have been performed in croup, where no other chance is left; the latter is the operation which has been attended with most success.

## SPASM OF THE GLOTTIS,

Or *spasmodic croup*, as it is sometimes very improperly called, is very different from the preceding disease. It consists in a sudden choking fit, caused by a spasm of the muscles that close the glottis. There is no fever, nor any morbid appearances about the throat; the disorder is purely functional. It occurs to children, especially during the irritation of teething or weaning. The child suddenly loses its breath, tosses up its arms, turns bluish about the mouth, and when it recovers its breath makes a long crowing inspiration. This complaint is often fatal.

During the fit, the best remedy is to sprinkle a little cold water on the child's face; in the intervals the bowels must be opened, the diet rendered light and digestible, and the child put into the best possible state of general health. Very small doses of prussic acid with an alkali are sometimes of service.

Before entering further into a description of the diseases of the respiratory apparatus, a tabular view of the thoracic regions, in relation to the signs of auscultation, &c., is presented to the reader. (It is desired that full credit should be given to *Meade's Manual*, from which the appended table, somewhat modified to suit the American text-books, was drawn.)

## REGIONS OF THE CHEST.—(Figs. 1, 2, 3.)

a. Anterior.	}	1. Supra-clavicular,
		2. Clavicular,
		3. Infra-clavicular,
		4. Mammary,
		5. Infra-mammary,
		6. Upper sternal,
		7. Lower sternal.
b. Posterior.	}	8. Upper scapular,
		9. Lower scapular,
		10. Infra-scapular,
c. Lateral.	}	11. Inter-scapular.
		12. Axillary,
		13. Infra-axillary.

*Tabular View of the Thoracic Regions, in relation to the Signs of Auscultation, &c. Modified from MEADE'S MANUAL.*  
(See Figs. 1, 2, 3.)

Regions.	Fig.	Situation.	Natural Sound on Percussion.	Interior Corresponding Parts.	Signs most commonly produced there by Disease.
1. supra-clavicular.	1				
2. Clavicular.	1	Clavicles.	Clear. Very clear towards the sternum; clear in the middle; dull close to the humerus.	{ Apices of the lungs.	{ Dulness on percussion in phthisis; generally most on one side.
3. Infra-clavicular.	1	From clavicle to the fourth rib.	Very clear.	Superior lobes of the lungs.	Irregular dulness on percussion, diffuse bronchophony, impaired respiration, and afterwards, cavernous rhonchus and pectoriloquy, in phthisis.
4. Mammary.	1	Between the fourth and eighth ribs.	Very clear; particularly by mediate percussion. In women, a clear sound can be obtained through the mammæ only by mediate percussion.	Middle lobes of the lungs; large bronchi in the upper part, near the sternum; the heart, generally covered by the lungs, in the lower part of the left region.	Rhonchi in catarrh; more rarely phthisical symptoms. On the left side, dulness on percussion in hydropericardium and enlargement of the heart; increased impulse in hypertrophy, and increased sound of pulsation in dilatation of the heart; constant bellows or rasp sound in valvular disease.
5. Infra-mammary.	1	Between the eighth ribs and the margin of the cartilages of the false ribs.	Dull on the right side; on the left irregularly dull, or unnaturally resonant.	The liver on the right, and the stomach on the left side, covered only on the upper part by the thin margin of the anterior inferior lobes of the lungs.	Crepitant rhonchus in incipient pneumonia. Extinction of respiration in advancing pleurisy.—Dry crepitation in interlobular emphysema.

6. Superior sternal.	1	Upper two thirds of the sternum.	Very clear.	Large bronchi - Margins of the middle lobes of the lungs.	Bronchial rhonchi in catarrh. Only half the sternum dull on percussion in hepatization, the whole dull in extensive liquid effusion, of one side.
7. Inferior sternal.	1	Lower part of the sternum and ensiform cartilage.	In the upper part clear; rather less so in fat persons. Below, sometimes more dull; sometimes tympanitic.	Above, margins of the lungs; below, the heart, liver, and sometimes the stomach.	Signs of diseases of the right side of the heart; dullness on percussion in effusion, or fat, in the pericardium, enlarged heart, &c.
8. 9. Scapular.	2	The scapulæ and the muscular ridge below them.	The pectoral resonance can be elicited from this region only by mediate percussion.	Middle posterior lobes of the lungs.	Catarrhal signs. Ægophony in pleurisy. Bronchophony in pneumonia.
10. Infra-scapular.	2	Below the inferior angles of the scapulæ and border of the serrati, to the level of the 12th vertebra.	Clear on the upper portion, by striking on the angles of the ribs, or by mediate percussion. Below, dull on the right, and tympanitic on the left side.	Base of the lungs. The liver encroaches on the right, and the stomach on the left side.	Crepitant rhonchus and bronchophony in incipient pneumonia and œdema; ægophony in pleurisy; and dullness on percussion in both.
11. Inter-scapular.	2	Between the inner margin of the scapulæ.	Pretty clear by mediate percussion, or when the arms are crossed, and the head bowed forwards. The spinous processes of the vertebræ sound well.	The roots, and inner parts of the posterior lobes of the lungs.	Catarrhal signs. In the upper part, sound of respiration never destroyed in effusions into the pleura. In the lower portion, sometimes ægophony in pleurisy, crepitation and bronchophony in advancing pneumonia. Signs of diseased bronchial glands.
12. Axillary.	3	In the axillæ above the fourth ribs.	Very clear.	Upper part of the lateral lobes of the lungs. Large bronchi.	Dullness on percussion, cavernous rhonchus, pectoriloquy, &c., in phthisis. Catarrhal rhonchi.
13. Infra-axillary.	3	Between the fourth and eighth ribs at the sides.	Very clear; unnaturally so, in emphysema of the lung.	Middle of the lateral lobes of the lungs.	Dullness on percussion in advanced pleurisy; and on the right side, from enlarged liver. Ægophony in advancing pleurisy; crepitant rhonchus, and bronchophony in advancing pneumonia.

Fig. 3.

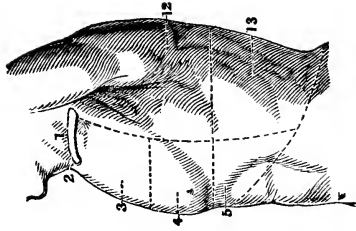


Fig. 2.

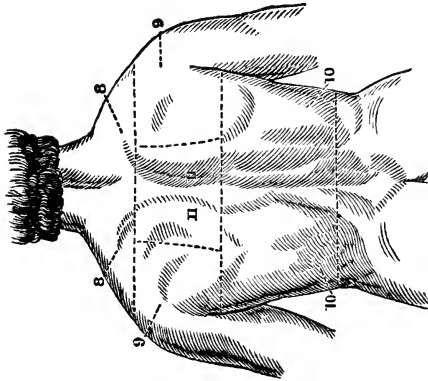
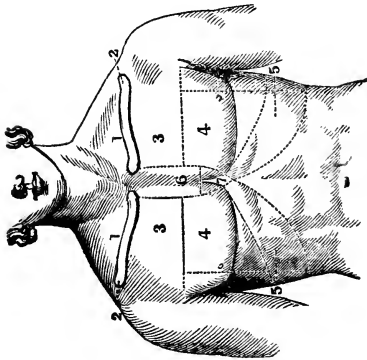


Fig. 1.



## BRONCHITIS.

*Bronchitis* is an inflammation with altered secretion of the mucous membrane of the bronchi. There are several varieties of this disease, arising from its extent, or from the state of the constitution, or complications with which it is associated. It may present itself under three forms—viz., the primary, secondary, and complicated. The *primary* form is that in which the first morbid influence seems to be exerted on the respiratory mucous membrane, and in which any fever present must be regarded as symptomatic. In the *secondary* variety, on the other hand, the disease depends on the pre-existence of some other malady; especially disease of the heart, fever, and the exanthemata. The *complicated* form accompanies other diseases of the lung,—such as pneumonia, pleuritis, pulmonary hemorrhage, tubercle, &c.

According to the habit of body and vital energy of the patient, and the extent to which the inflammatory action advances along the bronchial tubes, *acute primary bronchitis* may be subdivided into three forms:—1st, common catarrhal bronchitis, in which the larger bronchi and trachea are affected, constituting catarrh; 2d, sthenic, or true bronchitis, which is of a highly inflammatory character, and in which the mucous and sub-mucous tissues of the smaller bronchi are also affected; and, 3d, asthenic bronchitis, where, owing to depressed vital energy, the inflammation assumes a low type, and is attended with excessive secretion.

## COMMON CATARRHAL BRONCHITIS.

*Symptoms.*—This is the most common form of the disease, and is commonly known as *severe cold*. It seems to affect the whole surface of the respiratory mucous membrane; from the nose, and frontal sinuses, downwards. It is evidently a constitutional disorder; and begins with shivering, headache, and feverishness, with pain and weight in the frontal sinuses (*gravedo*), and dryness, irritation of the Schneiderian membrane, sneezing, and snuffling, (*coryza*.) Then follow slight sore throat and hoarseness, and the irritation extends down into the chest. But in some instances the irritation commences primarily in the trachea and large bronchi, and is attended at first with a sense of roughness, and a constant desire to clear the throat. This is accompanied, or succeeded by titillation of the larynx, exciting a dry, hard cough; hoarseness, with a sense of tightness across the chest; and sometimes pain on coughing or on making a deep inspiration, and soreness and heat behind the sternum, and between the shoulders, which are the great signs of bronchial irritation. The constitutional symptoms are, great lassitude, pains in the back and limbs, cold chills, quick pulse, dry skin, and high-coloured urine. The cough, which was at first dry, is soon attended with the

expectoration of a somewhat saline, glairy, thin fluid. If the disease be of a mild type, the expectoration, in two or three days, becomes thicker, more abundant, tenacious, and less irritating; and as amendment advances, the sputum increases in quantity, but is more opaque, tenacious, and deeper coloured, being frequently greenish-white. With these changes, the constriction, pain, and soreness, are mitigated: the pulse becomes less frequent; the skin cooler and moist; and the urine less scanty, paler, and deposits a sediment.

#### STHENIC, OR TRUE BRONCHITIS.

*Symptoms.*—This form of bronchitis may succeed the catarrhal, if neglected. It is ushered in by chills, or sometimes complete rigors; which are soon followed by quickened and laborious respiration; oppression of the chest; sometimes a dull pain on coughing; quick, full, and often strong pulse; pain in the forehead, back, and limbs; foul, loaded tongue; constipated bowels, and high-coloured urine. As the disease progresses, the frequency of the pulse, the cough, expectoration, and general febrile symptoms increase, as well as the tightness and soreness of the chest. Sometimes there is a very sharp, though transient, pain extending over the whole chest, particularly after fits of coughing. When the cough is violent, the patient feels also pain and weakness about the attachments of the diaphragm, along the borders of the false ribs, and in the back. The febrile and other symptoms are aggravated towards night, which is generally sleepless and disturbed. In extreme cases of this affection, collapse, with diminished expectoration, purple lips, orthopnœa, quick, depressed pulse, cold perspirations and extremities, with threatening suffocation, occur early.

#### ASTHENIC BRONCHITIS.

(*Peripneumonia notha, or Suffocative Catarrh.—Bronchorrhea.*)

The disease which has received these names is an extensive inflammation of the bronchial mucous membrane, in a weak constitution with very great secretion of mucus. This copious secretion is the great source of danger.

“There are four cases,” says M. Laennec, “in which catarrh may become suffocative—1, in old persons; 2, in persons affected with œdema of the lungs; 3, in the dying; 4, the acute catarrh may sometimes assume this character even in adults and children.

“1. *In old persons.*—This affection, which is almost always mortal, occurs principally in winter, and in consequence of the super-vention of an acute catarrh on a chronic mucous catarrh, or phlegmorrhagy. It is liable to occur to old people with diseased heart, and with chronic catarrh, if they catch cold. If of any continuance, œdema of the lungs supervenes and hastens the fatal termination.

“2. *With œdema of the lungs.*—Œdema of the lungs is almost always accompanied by phlegmorrhagy, which may readily become suffocative, from the accumulation of fluid in the bronchi, especially in weak and old subjects.

“3. *In dying persons.*—The last agony, in almost all diseases, is accompanied by a copious tracheal rattle, and consequently by a real suffocative catarrh, except in those cases wherein the rattle is owing to the presence of blood in the bronchi. Œdema, or yet more commonly a sero-sanguineous congestion of the pulmonary texture, accompanies the flow of fluid into the bronchi; and it is to this circumstance that the infiltration of the posterior parts of the lungs, observable in almost all dead bodies, is to be attributed.

“4. *Acute suffocative catarrh of adults and children.*—This is very rare in adults; in young children it is more common, and is often in them confounded with croup. It is recognised by the tracheal rattle perceptible by the naked ear, and by the imminent suffocation, and frequent lividity of the face. The stethoscope detects, over the whole chest, a loud mucous (and very liquid) rattle, and a very frequent and usually irregular action of the heart. This disease is acute catarrh, affecting the whole, or a very large portion of the mucous membrane of the lung; its duration is from twenty-four to forty-eight hours, or at most, some days; at the end of which time the patient either dies, or expectoration commences, and puts an end to the suffocation, and the disorder then follows the progress of a simple catarrh.”

#### OF THE SPUTUM IN BRONCHITIS.

In the first stage of bronchitis, the cough is dry, and as long as the cough continues so, the bronchitis must be considered as still at its commencement. At the end of a time, the length of which varies according to individual peculiarities, and according as the patients are or are not subjected to proper treatment, each fit of coughing is followed by the excretion of a clear, transparent, serous or watery mucosity, which is at first slightly saline, but afterwards becomes tasteless. As the disease advances, the matter expectorated is a glairy mucus, like white of egg; when it is poured from one vessel into another, it is observed to flow in one mass of extreme tenacity.

When the patient is attacked with violent fits of coughing, accompanied by considerable heat within the chest, as also by marked distress and general anxiety, the expectorated matter acquires remarkable viscosity, and resembles a little the jelly-like sputa of acute pneumonia. When the bronchial inflammation is accompanied by much fever, the viscosity of the sputa becomes also greater during the febrile paroxysm, so much so, that an inexperienced practitioner may mistake it for that of pneumonia; on the cessation of the paroxysm, however, the sputa will be found to have lost their visci-

dity. At other times, every species of expectoration is suppressed during the paroxysm; which indicates an increase of irritation of the mucous membrane. Some patients present, towards the end of the perspiration which terminates the paroxysm, a copious expectoration of thick, opaque sputa, such as is observed in the last stage of bronchitis; but this is only a temporary state, and the patient soon expectorates anew a clear limpid mucus, as before the febrile exacerbation. The sputa, in this stage, are frequently marked with some streaks of blood, arising from small vessels which are ruptured in the midst of an effort to cough. The blood is then *mixed* with mucus, but it is not *combined* with it, as happens in the reddened sputa of pneumonia. It often happens that in the midst of the transparent mucus, there are found, in greater or less numbers, small clots of a dull white; they do not come from the lung, but appear secreted in the pharynx and posterior part of the mouth, by the numerous cryptæ with which the mucous membrane of these parts is supplied. These clots have been erroneously considered as portions of pulmonary tubercles, and consequently as one of the pathognomonic signs of phthisis.

As long as the sputa present the appearance above described, the symptoms of bronchial irritation do not improve; but according as the inflammation proceeds towards resolution, the sputa change their character. The mucus which forms them gradually loses its transparency; it is mixed with opaque, yellow, white, or greenish masses, which, scanty at first, continually increase, and ultimately constitute the entire sputa. Such an expectoration is ordinarily accompanied by marked remission in the different symptoms of bronchial inflammation.

#### PHYSICAL SIGNS OF BRONCHITIS.

Dr. Latham and Dr. Watson, have, with characteristic good sense, cleared away the phraseology and minute subdivision, which have overloaded the phenomena of auscultation. They now recognise two great divisions of morbid respiratory sounds; the *dry* and the *moist*. The dry are caused by the obstruction of the bronchial tubes by a swelling of their lining membrane, or by plugs of tough mucus. The moist are caused by the presence of liquid—whether mucus or blood, through which the air passes in bubbles in its entrance into and exit from the lung. The dry sounds are called *rhonchus*, when grave or deep because situated in the larger tubes; and *sibilus*, when of an acute whistling character because situated in the smaller tubes. The moist sounds are called *crepitus*; which may be *large* or *small*, according to the size of the tube in which it occurs.

The first physical signs of bronchitis (and these sometimes are present before the cough comes on, and while the local feelings only



indicate a coryza, or a raucity and dryness in the throat) are of the *dry* kind; sometimes a small *whistling* or *hissing*: sometimes like the prolonged note of a violoncello, and sometimes the cooing of a dove. When the membrane begins to secrete, the sounds above mentioned gradually disappear, and are replaced by *moist* or *crackling* ones produced by the successive formation and rupture of bubbles in the air tubes. It sometimes happens that, during the course of a bronchitis, we suddenly cease to hear, in a certain extent of the lung, either the natural sound of the pulmonary expansion, or the crepitation. In this same part where the ear no longer hears any murmur, the chest when percussed retains its usual sonorousness. The explanation is, that the tube leading to a considerable portion of lung has been temporarily blocked up by mucus; but it may often be cleared by a vigorous cough. This at once distinguishes bronchitis from almost all other affections of the lungs. Thus, though percussion gives no direct result in this disease, its employment is of importance in the particular diagnosis. For example, if a person has had a severe cough, fever, hurried and difficult breathing for some days, and the chest still sounds well, the great probability is, that the disease is bronchitis.

*Morbid appearances.*—After a mild and recent bronchitis, there is found some redness in a circumscribed portion of the mucous membrane; particularly towards the termination of the trachea and commencement of the bronchi. If the inflammation has been more intense, the redness extends to a greater number of tubes; and to some of the smaller ramifications. It frequently occurs that this redness is exactly limited to the bronchi of only one lobe; it is the bronchi of the upper lobe which appear more particularly disposed to become inflamed. The red colouring of the bronchi sometimes presents itself in the form of a fine injection, which seems to exist simultaneously both in the sub-mucous cellular tissue and in the mucous membrane itself; sometimes vessels are no longer distinguished, but only a number of small red points, crowded together, and collected round each other; sometimes there is observed a uniform red colour. Frequently the redness exists only at intervals, in the form of bands or separate patches, which constitute, as it were, so many circumscribed inflammations, between which the mucous membrane is white and healthy—a form of inflammation similar to that so frequently observed in the intestines. When the inflammation is chronic, the mucous membrane generally loses its bright redness; it presents a livid, purple, brownish tint. It is very remarkable, that in persons presenting all the symptoms of an inveterate chronic bronchitis, with puriform expectoration, the mucous membrane of the air tubes is scarcely of a rose colour, or is sometimes even perfectly white through its whole extent. According to Bayle, *this white state of the mucous membrane is not rare in pulmonary*

*catarrh.* The other changes remarked in chronic bronchitis are, thickening, softening, but rarely ulceration, of the mucous membrane; in chronic cases, dilatation of the bronchi. In only two instances has M. Andral detected ulcerations in the bronchi.

*Dry catarrh.*—This name is given by the French to a not uncommon variety of bronchitis; in which there is great dyspnœa, and intense congestion of the membrane, with sibilus or dry sounds; but the ordinary secretive stage is very slow to come on. It is also known by the name of *bronchial congestion*, and often follows the inhalation of acrid vapours.

*Treatment.*—In *simple catarrhal bronchitis*, confinement to bed; inhalation of steam; an aperient; a warm bath; a few grains of Dover's powder with a little antimony at bed time; some demulcent for the cough; and low diet, are usually sufficient.

When acute bronchitis occurs in a robust habit, a moderate bleeding is decidedly indicated; but, as in other mucous inflammations, we must regard general depletion more as a means for reducing the febrile excitement, and preparing the patient for local treatment, than for cutting short the disease. The bowels should next be attended to, and freely acted upon by mild aperients. After general bleeding and purgatives, local depletion will be found extremely beneficial; and Dr. Stokes recommends "that in severe cases the patient should be cupped under the clavicles, or between the scapulæ, or a number of leeches be applied under the clavicles, or into the axillæ." After moderate depletion, it will be right to use some antiphlogistic remedy;—and as mercury is not so beneficial in inflammations of mucous as of serous membranes, *tartar emetic* is to be preferred. It should be given in small doses at regular intervals—say gr.  $\frac{1}{4}$  4tis horis in solution with a drachm of syr. papaveris and some distilled water, and be continued until it causes nausea, and lowers the heart's action. In some cases, after the system is brought under its influence, the disease yields suddenly; the oppression and wheezing cease, the cough becomes trifling, the lividity disappears, the pulse falls, and the respiration, with the exception of a slight crepitation, which is occasionally heard, is healthy, pure, and equal. In others, a copious secretion is produced, with great relief.

Some practitioners prefer *ipeacuanha* as less likely to purge and weaken. Emetics are extremely useful in bronchitis, particularly in the *asthenic form*, and in the *sthenic variety* after bleeding; in children, their exhibition is attended with the best results. For children, *ipeacuanha* should be preferred; for aged persons, the sulphate of zinc; and, for the robust adult, tartarized antimony.

When the inflammatory action and febrile heat have been subdued, blisters are of much service, and may be applied either between the shoulders or on the breast. A large warm poultice to the chest is also useful, especially for children.

Stimulating expectorants and tonics are now given with decided benefit. Amongst the first class, are included senega, the balsams, ammoniacum, squill, and myrrh; and in the second, improved regimen, wine, bark, serpentaria, the preparations of iron, &c. In bad cases of bronchitis, in addition to the internal treatment, counter-irritants should be persisted in for some time. The counter-irritants most employed are, blisters, tartarized antimony ointment, croton oil, the acetum cantharidis, and pitch plasters containing either cantharides or tartarized antimony. Dr. Stokes recommends a stimulating liniment, which, when applied to the chest daily, keeps up an erythematous state of the skin.\* He considers that this liniment not only acts beneficially by its counter-irritating properties, but that the ingredients are absorbed by the surface, so as to act on the mucous membrane as direct stimulants.

In *asthenic bronchitis*, with copious suffocative secretion, our greatest dependence is to be placed on emetics for children; and for old people, on warm purgatives, blisters, and stimulating expectorants, especially senega and ammonia. Diuretics and astringents are afterwards of service.

*Opiates* always require caution in bronchitis which is attended with profuse secretion. It is true, they ease the cough; but then it must be recollected that the cough is the only means of getting rid of that superabundant mucus which is choking the patient, and that if the cough stops, the patient will perish; *drowned*, to all intents and purposes. Particular caution must be used if there is any appearance of venous blood circulating—livid lips, or coma. Yet, as it is right to allay inordinate irritation, small doses of paregoric may be combined with the stimulant expectorants, to moderate the violence of the cough; and a larger dose may be given at bed time, if the patient is worn out for want of sleep, and can expectorate freely.

#### PERTUSSIS (*Whooping-Cough*).

This affection is contagious; it seldom occurs twice in the same individual, and particularly attacks children; but adults are liable to it, if they have escaped it in their childhood.

*Symptoms.*—It commences with symptoms of common *cold*, or *catarrh*, which may last for some days; the cough then becomes convulsive, and recurs in fits at various intervals. The fits may last a quarter of an hour or more. Each fit is composed of a quick succession of sonorous coughs, with scarcely any perceptible inspiration between; but at intervals the expirations of coughing are suddenly interrupted by a very deep, sonorous inspiration, or *whoop*, which constitutes the pathognomonic sign of this disease. The peculiar

\* The following is his formula:—*R.* Sp. terebinth. ℥iij.; Acid acet. ℥ss.; Vitell. ovi, j.; Aq. rosar. ℥iiss.; Ol. limon. ℥j. M.

whooping inspiration depends on spasm of the glottis. The face becomes swollen and livid in the paroxysm, and particularly during the whooping. The fit terminates by the expectoration of a colourless and scarcely frothy phlegm, and in many cases by vomiting also. The paroxysms at first recur several times every day, being always more severe towards evening, but less so during the night. After a certain time, they only return in the morning and evening; and towards the end of the disease, in the evening only. The duration of whooping-cough varies from a few weeks to several months. Before it terminates, the paroxysms become shorter, lose their peculiar characters, and are attended by an expectoration more decidedly mucous. This disorder may be complicated with bronchitis, or pneumonia; which are the chief sources of danger:—or it may cause cerebral symptoms, or sometimes a real apoplexy. The younger the child, the greater the danger. In some cases, the disease degenerates into a chronic mucous catarrh, with emaciation, and other symptoms resembling phthisis. In the intervals of the paroxysms, the patient coughs but little, preserves his appetite and strength, and has rarely any fever, except in the case above mentioned, or in the onset of a very severe attack.

*Physical signs.*—In the intervals of cough, the respiratory murmur varies on different points of the chest; at one part it is lost; at another it is slight; at a third it is puerile; there is some degree of *sibilus* and *crepitus*. The sound of the chest, on percussion, is good and unimpaired. The lungs do not become inflated during the strong inspiratory effort producing the whoop; for not only is the rima glottidis spasmodically affected, but in all probability the whole of the ramifications of the respiratory tree participate in this morbid action; for, during that period, if the ear is applied to the chest, no rhonchus or respiratory murmur is heard, except for a moment between each cough. The great tendency of pertussis, in young children, to pass into pneumonia, œdema pulmonum, or intense bronchitis, makes frequent auscultation of the chest very necessary.

At the first invasion, this disease may be mistaken for croup, or suffocative catarrh.

*Morbid appearances.*—The most probable theory of the nature of whooping-cough is, that it is a peculiar irritation of the laryngeal branches of the *par vagum*. When it terminates fatally, it is usually upon the supervention of peripneumonia or œdema pulmonum; in the first case, the lung will be found to contain sanguinolent serum, and here and there a lobule hepatized; in the second, a large quantity of highly spumous and colourless serum follows the scalpel on section of the pulmonary tissue. In some cases, the meninges of the brain are much injected; in rare instances there is also some effusion.

*Treatment.*—In the early stages, the indications are, to avert in-

flammation, to promote expectoration, and to soothe irritation. The child should be confined to the house if the weather is inclement; it should have no meat; the bowels should be kept open; an emetic of vin. ipecac. should be given about every other night, or whenever the chest appears much loaded with phlegm; a grain of calomel and a warm bath at bed time may be given if there is much feverishness: and if any inflammatory symptoms arise they must be combated by leeches.

Frictions to the spine are beneficial throughout; olive oil, and oil of amber; soap liniment and laudanum are useful materials.

When the acuteness of the complaint is over, tonics, especially quinia and sulphate of zinc, and change of air, are the best means of getting rid of the dregs of the disorder. Various other remedies have been recommended in this disease, such as opium, hyoscyamus, belladonna, hydrocyanic acid, acetate of lead, sulphate of zinc, arsenic, nitrate of silver, ammonia, ether, musk, camphor, cantharides, &c. Many of these have enjoyed considerable reputation, but are too dangerous for nursery use. Tartar emetic ointment has been rubbed into the back; but it is too severe for children.

#### CHRONIC BRONCHITIS.

The chief *symptoms* of chronic bronchitis are, cough, shortness of breath, and expectoration of various kinds of mucus.

*Causes.*—This complaint is very common, especially in old people. It may, like other chronic inflammations, be a consequence of one or more acute attacks; or it may, especially in old people, depend on that congestion which is infallibly produced in the lungs by disease of the heart. When habitual, and attended with much expectoration, it is called *humoral asthma*.

The sounds heard by *auscultation* in simple cases, consist of the crepitation and bubbling of mucus in the air-tubes of various sizes.

Sometimes this malady presents all the outward marks of *phthisis*; wearing cough; profuse purulent expectoration; wasting, night sweats, &c. But yet so long as no important organic change has occurred, it is quite curable. The *diagnosis* must be guided by the circumstance, that in chronic bronchitis there is no solidification of the upper lobes of either lung; no pectoriloquy, or signs indicating a cavity or *vomica*.

*Morbid appearances.*—The mucous membrane after death may be of various shades of *redness*; often deep purple; but this is not constant. It may be *ulcerated*; but this is extremely rare. It may also be *thickened*. But the most curious effect of long-continued cough, and difficulty of breathing, is dilatation of the bronchi; which is caused apparently by the accumulation of mucus, impelled by the

efforts of coughing, and unable to escape. These bronchial dilations, it is to be noticed, may present the auscultatory signs of tubercular cavities.

Sometimes the expectoration is excessively profuse, but *clear*; coming up once or twice in the day to the extent of many ounces. Such cases are called *pituitous catarrh* by the French.

*Treatment.*—Occasional leechings or cuppings to obviate congestion: blisters and other counter-irritants; mild, nutritious, unstimulating diet; change of air; tonics, such as sulphate of zinc, with small doses of pill scillæ comp. and opiates, to allay the cough, are amongst the chief remedies for younger patients.

For older habitual cases, and especially if the expectoration is profuse, the stimulating expectorants, especially tinct. benzoës c., bals. copaibæ, senega, &c. are indicated; inhalation of tar vapour also is useful.

#### SPASMODIC ASTHMA.

Asthma is caused by a spasm of the muscular fibres encircling the bronchial tubes, and especially the smaller ones.

The existence of these muscular fibres was proved by Reisseissen, and has been confirmed by Dr. Williams and others, who have produced contraction of them by galvanism.

The *exciting* causes of the purely spasmodic variety of asthma are those which impress the nervous system, as strong or peculiar odours, mental emotions, and particular states of the atmosphere, and especially, irritation of the stomach and bowels.

The *precursory* symptoms of asthma are, languor, sickness, flatulency, and other dyspeptic symptoms; heaviness over the eyes, and headache; uneasiness and anxiety about the præcordia, with a sense of fulness and straitness in this region and in the epigastrium. In some cases, pain is complained of in the neck, with unusual drowsiness and stupor.

*Symptoms.*—The attack of spasmodic asthma takes place generally about one or two in the morning, and during the first sleep. The patient suddenly awakes with a sense of suffocation, great tightness at his chest, difficulty of breathing, and excessive anxiety; he assumes with great eagerness the erect posture, and cannot bear the least incumbrance about the chest. The respiration is wheezing, interrupted, and laborious; the shoulders are raised, the elbows directed backwards, and every effort made to enlarge the thorax. The countenance, which was at first pale and anxious, becomes, especially in plethoric habits, suffused or bloated, and covered with perspiration. A considerable quantity of pale urine is voided at the commencement, or previous to the accession, of the paroxysm; and the lower extremities are usually cold. The pulse is generally

quick, weak, and somewhat irregular. During the fit, the patient has commonly an instinctive desire for cool air. When the fit has continued from half an hour to one, two, three, or even four hours, some degree of cough and expectoration comes on, which relieve the patient; and after a brief period, his respiration, pulse, and feelings assume their natural state.

Such is the common course of a first and moderate attack of this disease. Occasionally the patient has but one such fit, but more generally a slight constriction of the chest is felt through all the succeeding day, and the paroxysms return at the usual period of the night; this may occur for several nights, and at last the patient is altogether released from the attack. The disease may be suspended for several months, but it is liable to recur from changes of air, errors of diet, and the operation of other causes.

*Physical signs.*—In spasmodic asthma, during the fit, the chest does not sound well on percussion, and the respiratory murmur is indistinct, even on the most forcible inspiration. But if the patient, after holding his breath a short time, be desired to breathe again quietly, the spasm will be for a moment overcome, and the entry of air into the cells will be heard in a clear and sometimes puerile sound; after one or two inspirations, the spasm again comes on, and the respiration becomes as dull as before.

In treating of the pathology of this disease, it was stated that the muscular fibres were in a state of spasm during the paroxysm; the obstruction to the entrance of the air into the small bronchi and vesicles thus produced is obviously the cause of the diminution of the respiratory murmur. By this contraction also the lungs are in a manner collapsed within the chest, and the parietes of the thoracic cavity, pressed by the atmospheric weight on them, lose that sonorous elasticity produced by a fulness of their ærial contents.

*Complicated asthma.*—A pure spasmodic asthma, affecting lungs otherwise healthy, is by no means common. In general there is some disease of the heart, or some chronic bronchitis acting as a source of permanent congestion, which both adds to the difficulty of breathing, and predisposes the parts to be more easily affected with fits of spasm.

Sometimes a severe attack of *dry catarrh* is aggravated by spasm. This constitutes the *bronchial asthma* of Andral.

*Morbid appearances.*—The changes which have been noticed in those who have died of asthma are to be regarded chiefly as accidental occurrences, or associated maladies, and, perhaps, more frequently as the remote results of repeated or protracted attacks. No lesions, sufficient to account for the phenomena of *uncomplicated asthma*, could be detected by Laënnec, Andral, Cruveilhier, Bouillaud, and many other investigators. The most common consequences of the disease are, chronic inflammation and dilatation of

the bronchi; the different varieties of emphysema and œdema of the lungs; hæmoptysis; tubercular deposits, with which asthma may be associated from its commencement; hypertrophy and dilatation of the cavities of the heart; atrophy of the heart; effusions into the pericardium; effusions into the pleura; and, in some severe cases, congestions or effusions within the head, giving rise to coma, or apoplexy.

*Treatment.*—The indications during the interval are, to strengthen the general health, and avoid all derangement of the stomach by improper diet, and irritation of the lungs by unwholesome air.

The treatment of the fit consists in administering narcotics and antispasmodics. These should be given, if possible, as soon as the *first sensations* are felt, and then they may avert the attack; and it is noticed, that those do most good which produce expectoration. Strong coffee; laudanum and ether; and stramonium smoked as tobacco, are the most trustworthy. Ipecacuanha first given in an emetic dose, and afterwards in small quantities, so as to keep up a constant nausea, sometimes has a powerful effect on spasmodic asthma. The tincture of *lobelia inflata* (Indian tobacco) is much used in asthmatic cases; it is nearly allied in its operation to stramonium and tobacco, and often succeeds in checking the paroxysm when given shortly before its invasion. Bloodletting is only required if there is inflammatory complication.

## DISEASES AFFECTING THE TISSUE OF THE LUNGS.

### PNEUMONIA.

*Pneumonia* consists in an inflammation of the parenchyma of the lungs, and, according to the changes produced in the tissue, is most commonly divided into three stages.

*Three stages.*—The *first* stage of pneumonia is the stage of engorgement, in which the organ is found intensely loaded with blood; the *second*, is the stage of *hepatization*; in which it is solidified by an effusion of lymph: the *third*, is the stage of *purulent softening*, or suppuration.

Pneumonia may be single or double; in other words, it may attack but one lung or both at the same time. In one and the same lung it may be general or partial, attack the upper or lower lobe, be confined to the base, the root, or the centre (*lobular pneumonia*). It has been said, that all these different seats of pneumonia have been equally frequent. Some numerical results will settle the question. Out of two hundred and ten pneumonias, there were—

On the <i>right</i> side . . . . .	121
“ <i>left</i> side . . . . .	58
Both sides ( <i>double</i> ) . . . . .	25
Cases where the seat could not be detected . . . . .	6



It has been asserted that the upper pulmonary lobes are scarcely ever attacked with inflammation. This statement is not correct; those lobes are often affected, but not so frequently as the lower lobes. Morgagni, Frank, and Broussais, who draw their conclusions from dissections, state that the upper lobes are most frequently the seat of inflammation; Laennec and Andral, on the other hand, who included cases of recovery in their calculation, found the lower lobes to be most commonly inflamed. This discrepancy may be reconciled, as Dr. Williams observes, by assigning as the cause of it the fact, that *inflammation of the upper lobes is the most frequently fatal*.

The disease, as it generally occurs, presents the following characteristic symptoms:—pain, more or less marked, in one of the sides of the chest; dyspnœa, viscid and bloody sputa, dull sound, and modification of the respiratory murmur. The patient lies on the back; the pulse accelerated, but variable in its character; the fever is generally of the inflammatory kind, but is occasionally typhoid.

*Of the pain.*—The pain is generally on the level of, or a little below, either breast; more rarely it is seated either below the clavicles or entirely at the lower part of the ribs, and even in the hypochondria, or, in fine, over all the extent of the thoracic parietes of one side. In some cases it precedes, by several days, the appearance of the other symptoms; being then neither accompanied by fever, cough, nor dyspnœa, it simulates a pleurodynia, or simple rheumatic pain. The pain is increased by coughing, by the movements of inspiration, sudden changes of position, and intercostal pressure and percussion; it is principally exasperated by lying on the side on which it exists. M. Andral says, “In all patients who presented this pain to us, we found the pleura inflamed, and covered with membraniform albuminous exudations.”

*Of the dyspnœa.*—The dyspnœa, in pneumonia, is generally in the direct ratio of the extent of the inflammation, of its seat, and of its intensity in each of the points which it occupies. To this rule, however, many exceptions occur; for, owing to some peculiar idiosyncrasy, there are some individuals a very small portion of whose lung is in the first stage of inflammation, and whose respiration is nevertheless much embarrassed; there are others, on the contrary, in whom a much more extensive inflammation of the lung in the second or third stage exists, and yet the dyspnœa is comparatively slight. It appears, *cæteris paribus*, that inflammation of the upper lobe gives rise to greater dyspnœa than an equally extensive and equally advanced inflammation of the lower lobes.

The dyspnœa in pneumonia presents various grades or degrees. In the mildest form, the patients are not aware of its existence; in a greater degree still, the patient may not feel any oppression, but the inspiratory movements are short and frequent; in a still higher

degree, the patients complain of having on their chest, as it were, a weight which smothers them; when observed, they seem to be abstracted from all that is passing around them, and are entirely occupied with respiring; the face, of a violet red, or livid pale colour, expresses intense anxiety; the nostrils are dilated in a marked degree; the respiratory movements are very frequent and short, as if the air could not penetrate beyond the first divisions of the bronchi. When the difficulty of breathing amounts to this last degree, the termination is seldom favourable. After most of the symptoms of inflammation of the lung have ceased, the breathing still remains embarrassed, and this is particularly observable on the slightest effort. As long as this residue of dyspnœa exists, the resolution of the inflammation is not complete.

*Of the sputum.*—At the commencement of pneumonia there is frequently no expectoration, or it is simply catarrhal, being composed of mucus of moderate tenacity; but as the small crepitation becomes marked, the sputa assume their characteristic form. When the small crepitation becomes evident, which occurs about the second or third day, the sputa become *bloody*, that is, they consist of a tenacious matter intimately united with blood; not merely simple striæ of blood, as in bronchitis; neither is it pure blood, as in hæmoptysis. According to the quantity of blood which they contain, the sputa are either yellow, of an iron-red colour, or of a marked red. They are at the same time tenacious and viscid; they adhere together so as to form a homogeneous whole; at this period of the disease, the sputa adhere firmly to each other, but they are not yet sufficiently viscid to adhere to the sides of the vessel. Frequently the sputa retain the above characters all through the disease; in this case, the inflammation of the lung does not ordinarily pass the first stage, but oftentimes the sputa acquire still greater viscosity, they are no longer detached from the vessel when it is turned upside down.

We should, under these circumstances, have cause to apprehend that the second stage is advancing; in fact, as the viscosity of the sputa increases, the chest, when percussed, yields a duller sound, and the murmur of pulmonary expansion is either gone altogether, or is changed into bronchial respiration. In fine, the degree of viscosity announces with tolerable precision the intensity of the inflammation; and whenever, after having become thinner in the course of cure, the sputa regain their former viscosity, a relapse is indicated.

In the suppurative stage of pneumonia the sputum is generally characteristic. It then occurs under two forms; in the one, we observe a purplish-red muco-puriform fluid; while in the other, the matter expectorated has all the characters of true pus. In some cases, pneumonia runs through its different stages without its exist-

ence being announced in any way by the expectoration, which has been all through either absent or devoid of character.

When pneumonia terminates in gangrene, it is announced by the expectoration of a liquid at first greenish, then of a dirty gray colour, reddish at intervals, and exhaling a fœtid odour, like that of the gangrene of external parts.

At the commencement of this disease, the *face* is usually red; sometimes more so on the affected side than on the other. If the dyspnœa be considerable, the face presents a livid tint; and, when the lung is infiltrated with pus, a characteristic paleness is usually diffused over the entire face.

*Delirium* is frequently present during pneumonia, and generally manifests itself during the night; in most cases where it appears only at intervals, it is an unimportant symptom. But when constant it is serious, as it shows there is a circulation of unoxidized blood.

The character of the *pulse* is very variable in this affection; it is most frequently quick and full; but when the inflammation is very intense, it is sometimes remarkably small, and this smallness disappears after a copious bleeding. In some cases, particularly those occurring in old persons, the pulse retains its hardness and strength; in such cases we may suspect that a hypertrophy of the left ventricle of the heart exists.

M. Andral observes, "Great frequency of the pulse announces danger in this disease. It seldom happens that recovery takes place when the pulse exceeds one hundred and thirty. The frequency of the arterial pulsations is always in the direct ratio with the respiratory movements; however, in the last periods, it is often observed that the pulse loses its frequency, and seems to have returned to its natural state, though the respiration becomes more and more accelerated. This is invariably a fatal sign."

*Physical signs: First stage.*—According to Dr. Stokes, an *intense puerility of respiration in the affected part* will be found to exist for some hours before the characteristic crepitus is heard. But as soon as the first stage is fully developed, we know that where the pain is manifested, the natural respiratory murmur has lost its clearness; it is mixed to a greater or less extent with *the small crepitation*; a sound caused by the breaking of minute bubbles in the air-cells, or by the separation of the adherent walls of the vesicles in inspiration, and resembling that caused by rubbing a lock of hair between the finger and thumb close to the ear. This sound indicates engorgement of the lung; whilst it exists, it is a proof that in several points at least, the inflammation has not passed the first stage. As long as the natural respiratory murmur predominates over the crepitation, we should infer that the inflammation is slight; on the other hand, when the crepitation prevails so as altogether to mask the re-

spiratory murmur, it is a certain indication that the pneumonia has made progress, and that it has a tendency to pass to the second stage. These phenomena soon change, either by the resolution of the disease, or by its making further progress. In the former case, the crepitation diminishes in extent and intensity; the murmur of respiration approaches its natural state; the sound of the chest becomes less dull, and its movements more regular; and, finally, a large crepitation is evident, which indicates an approach to convalescence.

In the first part of this stage the sound on percussion is only slightly impaired; but as the engorgement advances, and the proportion of air in the inflamed spot of lung is diminished, it becomes more dull over the corresponding part of the chest.

*Second stage.*—The second stage of pneumonia is that in which the lung presents that change which is called by Laennec *red hepatisation*. In this condition, the cells being obliterated, while the large tubes remain pervious, dulness on percussion, bronchial respiration, and a loud resonance of the voice (*bronchophony*), are produced; the extension or intensity of these signs furnishes, within certain limits, an accurate measure of the extent or intensity of the disease. The *bronchial respiration* specifically marks the second stage of pneumonic inflammation. It resembles the sound produced by blowing through a crow's quill, and is frequently so loud as to amount to a whistle. If the inflammation is extensive, the respiration is puerile in other parts of the lung. In order that this bronchial respiration should be produced, not only must there be solidity of the lung, but a certain expansion of the side must also take place; for, if the whole lung becomes solidified, the bronchial respiration ceases, and the signs then are, universal dulness, absence of the respiratory murmur, and resonance of the voice. The voice is much modified in its resonance, and this modification is not properly that of *ægophony*, nor *pectoriloquy*; it approaches more to *bronchophony*.

If the patient recovers from the second stage, and the infiltration diminishes, so that the air is again admitted to the minute tubes and vesicles, this is announced by a return of the *small crepitation*, which is of course favourable. (*Crepitus redux*.)

*Third stage.*—In the *third* stage, the diseased lung becomes infiltrated with a purulent matter, which is generally consistent at first, but soon acquires the liquidity of common pus. In this stage, a peculiar muco-crepitating rhonchus is heard, at first in some points, then in the whole of the affected part.

*Of abscess.*—In the infancy of pathological anatomy, the formation of an abscess in the lung, as the result of acute or chronic inflammation, was considered a very common thing. The common

error has been to mistake tubercular vomicæ, or interlobular pleuritic effusions, for abscess of the lung.

When abscess, however, does form in an hepatized lung, the passage of air through the liquid will be indicated by the gurgling or cavernous rhonchus; and when the cavity has been emptied of the pus by expectoration, pectoriloquy and the cavernous respiration will be added to this sign.

Pneumonia may also terminate in *gangrene*; but this is nearly as rare a termination as abscess. The distinctive physical sign of gangrene is the fœtid odour emitted from the diseased part in respiration and cough; and the expectorated matter is also extremely fœtid. This change is usually attended by a collapse of the features, and great prostration of the vital powers.

*Morbid appearances.*—In the *first stage* of pneumonia, the substance of the lung presents an increase of weight and density; it is infiltrated with a frothy, sanguineous serosity, in considerable quantity; it pits on pressure, but yet is still somewhat crepitant; its integral cohesion is diminished, for it can be easily broken down between the fingers; the mucous membrane of the small bronchi is of a deep red colour.

In the *second stage*, or that of hepatization, the lung no longer crepitates; it now sinks in water; and, when cut into, a red liquid, not frothy, nor so abundant as in the preceding stage, flows from it. Externally, the lung is of a deep red colour, and internally it is studded with a number of red granulations, with patches of a white colour, marking the vessels, interlobular septa, &c., less affected with the inflammation. Its friability is very great; in many cases, it is sufficient to press it between the fingers to crumble and reduce it to a reddish pulp. The term “hepatization” is not strictly applicable to this condition of the lung; that of *red softening* gives a much more accurate idea of the real condition of the inflamed organ.

In the *third stage*, the pulmonary tissue, dense, compact, and impervious to the air, as in the preceding stages, presents a characteristic grayish colour. When examined with a lens, it presents granulations of a white or gray colour; these can also be seen by the naked eye in many instances. In a more advanced degree, the colour is of a straw, or sulphur yellow, owing to the greater quantity of liquid pus; the texture is considerably destroyed; and if the lung be cut, and the tissue slightly compressed, without crumbling it, small drops of pus appear on the surface; these seem to issue either from the orifice of the capillary bronchi, or from the granulations themselves. This condition of the lung may be defined as “*gray softening*.”

*Treatment.*—Pneumonia is one of those diseases whose treatment is at once simple and efficacious, provided it be adopted at an early

period; but not if the disease be allowed to run into the second and third stages.

When the practitioner is called in early in this disease, he should have recourse to copious bleedings, holding in mind that they not only act as in all other inflammations, but that they have also the effect of directly diminishing the quantity of blood which, in a given time, must traverse the lung in order to be subjected to the action of the air. But bleeding, although to be performed with determination, must yet not be done indiscriminately, so as to empty the patient's veins, and take away the strength necessary for the laborious work of respiration and expectoration.

"We want some remedy," says Dr. Watson, "to assist the lancet, or to employ alone when the lancet can do no more; and we have two such in *tartarized antimony* and in *mercury*. The tartarized antimony I believe to be best adapted to the first degree of the inflammation, that of *engorgement*; and the mercurial plan to the second—that of *hepatization*."

The tartar emetic may be given in doses of gr.  $\frac{1}{3}$  dissolved in water, with a few drops of syrup of poppies or laudanum, every hour:—after two or three doses the quantity may be doubled;—and after two or three more it may be increased again, to a grain every hour. If the medicine acts favourably, it will relieve the dyspnœa, without causing more than very slight vomiting or purging.

In those cases where tartarized antimony is inadmissible, or inefficient, the *mercurial treatment* must be had recourse to; calomel and opium ought to be given internally, and mercurial inunction be employed.

*Aperients* should be occasionally given in this disease, so as to keep the bowels open; but too much purging is always injurious. When the patient is under the influence of antimony, enemata should be employed.

*Local depletion* is also highly important in this disease. When the *acute stage has passed*, blisters may be applied to the chest.

"After the inflamed lung has become solid and impermeable," says Dr. Watson, "the treatment must be regulated rather by the state of the system at large, than by the actual or present condition of the lung: we must look more for guidance to the general symptoms than to the physical signs. If the pulse continues firm and steady, wait patiently the effect of the mercury. But when sunken features, a pallid face, coldness of the surface or extremities, a tendency to delirium, and above all, a feeble and irregular pulse, proclaim that the vital powers are giving way, it will be requisite, as in other cases where death is threatened by *asthenia*, to administer cordial and stimulant medicines; the carbonate of ammonia in a de-

coction of senega ; wine ; and to feed the patient well on milk or beef tea.”\*

The regimen should be strictly antiphlogistic ; and with a view to prevent vomiting, very little liquid should be allowed during the antimonial treatment. During convalescence from this and all other acute diseases of the chest, visitors should be excluded, as talking, even in an under tone, is injurious to the patient.

#### EMPHYSEMA OF THE LUNGS.

The term *emphysema of the lung*, given to this disease by Laennec, is not strictly applicable, inasmuch as that term signifies an escape of air into the cellular tissue. This disease, more correctly speaking, consists in a *dilatation of the air cells* ; the parieties of which may also be ruptured, in which case several may coalesce, and form a cavity of some extent.

*Causes.*—It has been stated that long-continued and violent coughing acts in distending the air-cells beyond their ordinary dimensions, and from this repeated dilatation they finally become permanently enlarged. Again, in cases of chronic catarrh, particularly of the *dry* kind, the small bronchial ramifications become so obstructed by the swelling of their membrane, or by the secretion of a viscid mucus, that the air can only be forced through them into the vesicles by a considerable effort. Now, an inspiration is more forcible than expiration ; the former may be sufficient to overcome the obstacle to the admission of air into the vesicles, while the latter is not adequate to its expulsion : thus the vesicles would be kept in a permanently distended state. Further, an additional cause has been suggested by Laennec, namely, the expansion of the air in consequence of the temperature of the body. Successive portions of air expanding by the increased temperature, are thus introduced and incarcerated in the cells, which are thereby kept in a continual state of dilatation. Dr. Williams observes—“ In dry chronic catarrh, the general starting point of emphysema, small particles of viscid mucus form a kind of movable obstruction, which, falling into a bronchial ramification, instantaneously and effectually plug up the tube. Now, suppose this to happen in a tube at the termination of an expiration ; inspiration takes place, but this pellet of mucus acts as a valve, preventing the entry of air into the cells, supplied by this tube ; the consequence is, that the air in the surrounding cells presses in to fill the vacuum, by dilating or rupturing their membranous tunics.” Miliary tubercles, and other causes, producing partial pressure and obstruction among the air-cells, may lead to the development of this disease. To the practical physician, however, the great point of consideration is, that this affection is the result of

\* Dr. Watson's Lectures, vol. ii., p. 93.

bronchitis; and that, for its prevention and alleviation, the treatment must be conducted on this principle.

*Symptoms.*—Habitual dyspnœa, which, during the earlier periods of the disease, is mitigated in summer, but returns in the winter with increased violence: the complexion is of a dusky hue; the countenance has an anxious and melancholy expression; the nostrils are dilated and thickened; the lower lip is enlarged, and its mucous membrane everted and livid. The movements of the thorax are irregular and habitually unequal; inspiration is short, high, and rapid; but expiration is slow, incomplete, and, as it were, graduated; there is thus a manifest difference in the duration of the two movements. The shoulders are elevated and brought forward, and the patient stoops habitually, a habit contracted in his various fits of orthopnœa and cough; thus, even in bed, we find these patients sitting up, with their arms folded and resting on their knees, and the head bent forwards, the object of which seems to be to relax the abdominal muscles, and to substitute the mechanical support of the arms for that of muscles which would interfere with inspiration. During the fits, the respiration becomes convulsive. There is a constant cough, returning in fits, usually dry, but often attended with the expectoration of a viscid liquid, of a dirty gray colour. This is one of the diseases long confounded under the name of “*asthma*.”

*Physical signs.*—The chest yields a morbidly clear sound on percussion; it is not, however, tympanitic, as in pneumo-thorax, but may be described as the maximum of true pulmonary sound. This excessive resonance is not given equally at all points, as the disease seldom extends to the whole lung. But although percussion indicates the presence of *air*, the ear applied to the chest detects that the *air is not in motion*, for there is very little or no vesicular breathing. There is heard occasionally some *large crepitation*; this was called by Laennec *dry crepitation*, and he supposed it to be produced, like the crackling of a dry bladder, from the entrance of air into the dilated vesicles. Dr. Watson, however, believes it to be nothing more than the crepitation of large bubbles of mucus, arising from the catarrh, which is almost always present. Where this disease is extensive, we generally find, owing to long-continued pulmonary obstruction, that the right cavities of the heart are hypertrophied; this latter fact will obviously account for the congested and enlarged state of the liver which also occurs.

*Morbid appearances.*—The ordinary appearance of an emphysematous lung is a remarkable coarseness of the vesicular texture, as seen through the pleura; it is also elastic, lighter, and less crepitant than usual, and does not collapse. In a greater degree, the enlarged cells look like the vesicular lungs of cold-blooded animals, and occasionally raise the surface of the lung into rounded inequali-



ties. Single vesicles, like fish bladders, of various sizes, sometimes project from the surface or margins of the lung, in some instances attaining an extraordinary bulk.\*

*Treatment.*—This disease may exhibit itself under two circumstances: first, it may have existed from infancy, or the causes which produce it may have been present from the earliest period of life; second, it may result, as before stated, from obstructions dependent on bronchitis and the other causes enumerated. Now, in the first case, our treatment avails but little; all we can do is to palliate the symptoms: the mode of treatment in the second case is evident enough. In this disease we must, as in all others, direct our attention to the cause; in fact, we should as soon as possible remove the obstruction of the tubes, and then endeavour to restore the lung to its original condition.

The patient should clothe warmly, particularly about the feet, and should live in a sheltered genial situation. He should also take care to avoid all causes of indigestion and flatulency, because, if the action of the diaphragm is impeded, an attack of dyspnœa may be brought on directly.

The fits of dyspnœa may often be relieved by opium and ether.

#### PHTHISIS PULMONALIS.

Phthisis pulmonalis is owing to the development in the lungs of a peculiar substance, called *tubercle*.

*Of tubercle.*—Andral describes tubercle, at its origin, as a pale yellow, opaque, round body, of various degrees of consistence, in which no trace of organization or texture can be detected by the naked eye, although the microscope shows various forms of cells, imperfectly developed; so that tubercle evidently consists of unhealthy lymph, whose powers of organization are imperfect.

*Seat of tuberculous matter.*—The prevailing opinion among pathologists is, that the seat of tuberculous matter is the cellular tissue of organs. It may, however, be formed on secreting surfaces; as, in the mucous follicles of the intestines, on the surface of the pleura and peritoneum, and likewise in false membranes, or other morbid products, and in the blood itself.

Dr. Carswell regards the mucous surfaces as the principal seat of tuberculous matter; and asserts, “that, in whatever organ the formation of tuberculous matter takes place, the mucous system, if constituting a part of that organ, is in general either the exclusive seat of this morbid product, or is far more extensively affected with it than any of the other systems or tissues of the same organ.” Andral considers the cellular tissue its chief seat, but that it may occasion-

\* Dr. Hope's Morbid Anatomy, Part 2.

ally occur on mucous and serous surfaces. Lombard supposes it to be restricted to the cellular tissue.

In confirmation of Dr. Carswell's statement, he has shown it in the lungs formed on the secreting surface, and collected within the air-cells and bronchi; in the intestines, in the isolated and aggregated follicles; in the liver, in the biliary ducts and their extremities; in the kidneys, in the infundibula, pelvis, and ureters; in the uterus, in the cavity of that organ and Fallopian tubes; and in the testicle, in the tubuli seminiferi, epididymis, and vas deferens. The formation and subsequent diffusion of tuberculous matter is also observed on the secreting surface of serous membranes, particularly the pleura and peritoneum; and in the numerous minute cavities of the cellular tissue. The accumulation in the lacteals and lymphatics, both before and after they unite to form their respective glands, is frequently very considerable.

*Morbid appearances and Pathology.*—Tubercles in the lungs, in their earliest stage, may present themselves in three forms: 1st. The *common cheesy tubercle*, in yellowish friable masses, in more or less rounded masses, or sometimes filling one or more of the bronchial tubes. 2d. *Miliary tubercles*; small granules, like millet seed, bluish white and semi-transparent, often found in great quantities. Some pathologists consider these as the earliest stage of the yellow cheesy tubercle; others, on the contrary, believe them to be merely some of the air-vesicles solidified by chronic inflammation. But certain it is that they have some relation to the regular tubercle, as they are found in the same person and in the same parts of the lung. 3d. *Tubercular infiltration*; the morbid matter being diffused uniformly through a tissue, and not agglomerated in masses.

Tubercle when deposited may lie dormant for a long time, without exciting any particular symptoms. In very rare and favourable cases, their softer particles may be absorbed; and nothing be left but the phosphate and carbonate of lime they contained, which may lie quietly in the lung for a whole life.

But, in general, tubercle, after a time, acts as a foreign body, excites inflammation and suppuration in the neighbouring sound parts, and is expelled.

The first visible step is a *softening*, which depends most likely on the exudation of serum or pus by the surrounding lung, or by the cellular tissue, that may be entangled in the tubercle. This increases, till an abscess forms, called a *vomica*.

The vomica enlarges till it bursts into a neighbouring bronchial tube; and then, in *favourable cases*, after the expulsion of the tubercular matter and pus by expectoration, the cavity may contract, become smooth and cartilaginous on its inner surface, and at last be obliterated, and the phthisis be cured.

More generally, however, fresh tubercle is deposited, fresh vomicae

form, and unite, till the patient's lung is riddled with cavities, and he dies exhausted. One or more bronchial tubes are found opening into each vomica.

Tubercle generally occasions some degree of pleurisy and consequent adhesion; this diminishes the frequency of what, nevertheless, happens sometimes, viz., ulceration of the pleura, and escape of the matter from a vomica, and, of course, of air into the pleural cavity; constituting a kind of *pneumo-thorax*, sometimes met with in the last stages of phthisis.

Ulceration of the larynx, tubercular deposits in, and ulceration of the intestinal glands, and a peculiar fatty condition of the liver, are morbid appearances often met with in the phthisical.

Tubercles most frequently are found in the *upper lobes*, and generally at first in the *left lung*; *pneumonia* in the *lower lobes* of the *right lung*.

*Symptoms which mark the onset of pulmonary phthisis.*—Before the signs of pulmonary tubercles are observed, we may often remark first, a tendency to simple inflammation of the mucous membrane of the air-passages; secondly, one or more attacks of hæmoptysis; thirdly, an inflammation of the pulmonary parenchyma, or of the pleura.

Among the acute exanthemata, there is one in particular after which we frequently see pulmonary phthisis makes its appearance—that is, *measles*. The reason of this will be readily understood if we reflect that in measles, much more than in small pox or scarlatina, the bronchi are the seat of either an active congestion or an acute inflammation.

*Symptoms which appear during the progress of pulmonary phthisis.*—Three stages of the affection are described by Dr. Stokes.

In the first stage, the tubercle is developed, but not yet suppurated; in the second, small ulcerations are formed; and in the third, we have vast caverns excavating great portions of the lung.

“*First stage.*—The more prominent symptoms are those of irritation, cough, pain, and quickness of pulse, which in certain cases are preceded, but in the greater majority followed, by an unaccountable emaciation; the cough is almost always dry during the first few weeks, unless where the tubercle has succeeded to catarrh; it may occur in every variety, but it is most commonly a slight, frequent, and irritating cough, referred by the patient to a tickling sensation in the trachea. The expectoration, when occurring, is scanty, and consisting of a thready, grayish, and nearly transparent mucus, occasionally dotted with blood; a slight wheezing sometimes accompanies the cough.

“With these symptoms the patient frequently complains of pain, which may be situated in any part of the side. In some instances, it is only felt in the lower, while in others it occupies the upper part

of the chest, shooting from the clavicle to the subscapular regions, and often occupying the articulations of the shoulder, when it is often mistaken for rheumatism, or pain of hepatic disease; it occurs with various intensities, is generally remittent, and often relieved by anodyne, or slightly stimulating applications. This pain is commonly accompanied by tenderness of the subclavicular region, and often with that irritation of the muscular fibres which causes their contraction on percussion; the respiration is slightly hurried, and the first approaches of hectic can be perceived.

“*Second stage.*—This is characterized by the establishment of decided symptoms; the emaciation increases; the pulse continues quick; the countenance becomes characteristic; the sweatings are more profuse; the cough looser, the expectoration becoming puriform, tubercular, and often bloody. The digestive system now begins to suffer; thirst, loss of appetite, and abdominal pains, torment the patient, and the first indications of the wasting and persistent diarrhœa appear; the patient feels he can lie better on one side than the other, and begins to feel pain in the opposite side of the chest,—a sure sign that his terrible disease has invaded the remaining lung.

“*Third stage.*—In this condition, the patient is often apyrexial, and the perspirations cease, particularly if the digestive system remains healthy; the pulse may be slow, though generally becoming accelerated before death; emaciation proceeds to the last extremity. The voice is sometimes lost, at others hollow and melancholy; the cough is loose, the respiration tranquil, and expectoration easy; aphthæ appear on the tongue, and spread over the cavity of the mouth; the limbs become cold; the breath gets a heavy odour, and the appetite in general fails.” Life may, however, even under these circumstances, be protracted for a considerable time.

*Physical signs.*—These may be divided into two classes; first, those of the earlier stages, which betoken the presence of *tubercles*; secondly, those of the later stages which show the existence of *vomicæ*, besides which, there are in the last stage of certain cases the signs of *pneumo-thorax*.

*Of tubercle.*—When a portion of lung is solidified by the deposit of tubercle; the corresponding part of the chest will be dull on *percussion*.

*Vesicular breathing* will be inaudible; and instead of it the *whistling* sound (called bronchial respiration, and arising from the passage of air through the bronchial tubes), will be heard if any such tube is enclosed in the solidified portion of the lung. Before the portion of lung is so filled with tubercle as to render its vesicles *quite* impervious, there are heard a feebleness and roughness in the respiratory murmur; and the sound of *expiration* is prolonged.

The *voice* will be conveyed with unusual loudness through the solidified lung, so as to give the sensation called *bronchophony*.

But yet auscultation is far from an infallible means of judging of the existence of tubercles in their earliest stage, and moreover, numerous tubercles, either still in a state of crudity, or already softened, may exist in the lungs; these tubercles may give rise to all the symptoms of phthisis in the second and even in the third stage, and yet the sound yielded on percussing the parietes of the thorax may not have undergone any alteration. This perfect sonorousness of the chest in phthisical patients is always observed, when the pulmonary parenchyma has retained its healthy state around the tubercles. *Increased sonorousness* may exist under three circumstances—1st. When there exists a large tuberculous cavity, into which the air enters by one or two bronchi which open into it, and the parietes of which secrete but a little liquid, so that the cavity contains more air than pus. 2dly. Where a partial emphysema has been produced. 3dly. When a pneumo-thorax occurs as the result of the opening of a tubercular cavity into the pleura; this occurrence is generally manifested by the sudden accession of an acute pleurisy.

When tubercular induration in the upper parts of the lung is considerable, it has the effect of conducting the sounds of the heart with great distinctness to the upper regions of the chest. This fact was first noticed by Dr. Townsend.

*Indications of vomicae*.—First, supposing the vomica to be half filled with liquid, and to communicate freely with the air-tubes, there will naturally be heard on every entrance and exit of air, a *gurgling* sound like the bursting of very large bubbles. The same may also arise from dilatation of the bronchi, or from abscess of the lung; but these conditions, and especially the last, are rare.

If the vomica is empty of liquid, there will be heard a class of sounds called *cavernous respirations*; consisting of certain variable sounds indicating the passing of air into and out of a cavity.

If the vomica be partially full of liquid, the latter may perhaps be heard to splash, when the patient *coughs*.

The *particular resonance of the voice* which constitutes *pectoriloquy*, is another sign of a vomica. When a cavity of moderate size and regular form, empty, or nearly so, is in free communication with a large bronchial tube, and is very near the surface of the lung in contact with the thoracic parietes, or when the intervening structure is rendered a good conductor by condensation, the voice is transmitted in the most perfect and unmodified manner, and seems to be produced in that spot of the chest, seemingly distinct from the oral voice. This is *perfect pectoriloquy*. If heard with the stethoscope, the sound of the voice seems to come through the tube, and enters the observer's ear louder than that which, coming from the

patient's mouth, strikes the other ear ; but the utterance is never so distinct. When heard to this degree in parts where there is naturally little or no resonance of the voice, it proves beyond doubt the existence of a cavity communicating with the bronchi.

By *imperfect pectoriloquy* is meant that form in which the voice does not seem to enter the stethoscope, but only to resound at the end. This sign cannot be relied upon when heard in the sternal half of the infraclavian and mammary regions, the axillæ, and interscapular spaces.

There is yet another class of sounds to be spoken of. It was said before, that the pleura sometimes ulcerates, so that a communication is formed between a vomica and the pleural cavity. In consequence of this aperture, air passes at each inspiration into the pleural cavity, whilst the lung collapses ; and more or less liquid will also escape from the vomicæ. The spot where this perforation occurs, is generally, says Dr. Watson, opposite to the angle of the third or fourth rib. The indications of this state of things will be, 1st, great clearness on percussion ; 2d, complete absence of respiratory murmur ; 3d, a peculiar resonance of the voice, breathing, and cough, called by the French *amphoric resonance*. This is a sound of metallic character, and greatly resembles that produced by speaking or coughing over an empty barrel or copper boiler, or by blowing into an empty bottle ; 4thly, there is occasionally a tinkling sound of a metallic character, produced by the fall of a drop of liquid from the upper to the lower part of the cavity.

Now, these four sounds, all indicating, as they do, the existence of a large cavity containing air and liquid, and communicating with the trachea, are generally caused by pneumo-thorax, as before said. But they may also, though very rarely, be caused by the presence of a very large vomica. In this case they will only be heard in the upper part of the chest, and instead of great clearness, there will be extreme dulness on percussion.

*Of the sputum.*—In pulmonary consumption, there is no constant relation between the appearances of the expectorated matter and the state of the lung. In many cases, it is not at all characteristic ; indeed, it may be mucous while large cavities exist in the lung, or purulent from bronchial irritation. Dr. Forbes observes—"In the earliest stage of the disease, the cough is either quite dry, or attended by a mere watery or slightly viscid, frothy, and colourless fluid : this, on the approach of the second stage, gradually changes into an opaque, greenish, thicker fluid, intermixed with small lines or fine streaks, of a yellow colour. At this period, also, the sputa are intermixed with small specks of a dead white or slightly yellow colour, varying from the size of a pin's head to that of a grain of rice, and which have been compared by Bayle to this grain when boiled. These have been noticed by many writers, from Hippocrates down-

wards. After the complete evacuation of the tubercles, the expectoration puts on various forms of purulency, but frequently assumes one particular character, which has always appeared pathognomonic of phthisis, although the more accurate and extensive observation of modern pathologists has proved the same to exist occasionally in simple catarrh. The expectoration alluded to, consists of a series of globular masses, of a whitish-yellow colour, with a rugged woolly surface, and somewhat like little rolled balls of cotton or wool. These commonly, but not always, sink in water. This kind of expectoration has appeared most common in young subjects, of a strongly-marked strumous habit, and in whom the disease was hereditary. At other times, in the cases in which these globular masses are observed, and also in those in which they have not appeared, the expectoration puts on the common characters of the pus of an abscess, constituting an uniform, smooth, coherent, or diffluent mass, of a greenish, or rather grayish hue, with an occasional tinge of red, (from intermixed blood,) and sometimes more or less fœtid." Dr. Stokes considers the expectoration, in which the globular ragged masses here described are expelled, more peculiarly allied to phthisis than any other. He also adds, "I do not recollect a single case in which I observed this character, that did not turn out to be phthisis."

*Treatment.*—In the treatment of consumption there are two grand rules—to diminish irritation or inflammation in the chest; and to support the general health and strength.

*Preventive treatment.*—When persons are known to be disposed to phthisis, they should most carefully avoid every imaginable source of irritation in the chest; for a bad catarrh or pleurisy is exceedingly apt to bring consumption after it. A warm sheltered residence; exercise in the open air, especially on horseback; and a diet calculated to keep up the strength without producing feverishness, are very important. A prolonged course of iron is often of service.

If the complaint has actually appeared, and is complicated with bronchitis, the patient must be confined to his room, and all exertion of the lung be prohibited. If he be of a robust habit, and has a full pulse, a single abstraction of blood from the arm is indicated; the bowels must be kept gently open, and the diet consist of milk, farinaceous substances, and light vegetables. But it is on local depletion and counter-irritation we must chiefly rely. Leeches should be frequently applied to the sub-clavicular and axillary regions of the affected side; the number used on each occasion should be small, and they ought to be applied alternately in each region. After this treatment has been persisted in for a short time, blisters and other derivatives are to be frequently applied under the clavicles and over the scapular ridge. Issues may also be established. During this treatment the cough is to be allayed by mild sedatives. In fine

weather, horse exercise should be taken, and the invalid, to promote his recovery, should remove to a milder climate.

In cases where there is *laryngeal* or *tracheal irritation*, leeches should be applied over the part most affected, and a mild mercurial treatment had recourse to. Calomel and opium, or blue pill with opium, should be given so as to slightly affect the mouth. Blisters may be then applied to the nape of the neck and to the sternum.

An individual in perfect health, or labouring perhaps under a slight cold, is attacked with copious hæmoptysis, accompanied with considerable excitement of the heart. The hemorrhage having subsided, we find the respiration hurried and the pulse quick; the cough continues, and there may be local pain. The upper portion of one side sounds dull, and here the respiration is decidedly feeble, although generally with little crepitus. In these cases, the tubercular development is very rapid, no interval occurring from the first invasion. In a considerable number of patients, it is in this way phthisis makes its outbreak. It is not uncommon, however, to see persons whose health is perfectly re-established after a first hæmoptysis, so that it does not appear to be connected with anything serious. At the end of a longer or shorter time, a second hæmoptysis supervenes, then a third, and again they are restored to health; finally, they have a new attack of spitting of blood, and this time their health does not return; they cough, and have oppressed breathing; and all the symptoms of pulmonary consumption develop themselves.

The treatment of this form consists in subduing the hæmoptysis by proper means, and then paying assiduous attention to the condition of the respiratory apparatus, especially the upper lobes of the lungs.

Dr. Cheyne strongly recommends bleeding in the hæmoptysical variety of consumption; and in bronchial hemorrhage, threatening consumption, he advises small bleedings at intervals of a week. He considers bleeding to be justified during hæmoptysis, or any symptom or sign of inflammation. Laennec observes,—“I shall content myself with asserting briefly, in this place, that bleeding can neither prevent the formation of tubercles nor cure them when formed. It ought never to be employed in the treatment of consumption, except to remove inflammation or active determination of blood, with which the disease may be complicated; beyond this, its operation can only tend to an useless loss of strength.” Tartarized antimony, in nauseating doses, is a useful remedy. Dr. Cheyne combines a quarter of a grain of the antimony with fifteen grains of nitre, and places much confidence in the combination.

When phthisis is complicated with *pneumonia*, we must have recourse to frequent local depletions by leeches, continued counter-irritation, the use of setons, and a mild course of mercury. The idea of arresting the progress of scrofulous ulceration of the lung by



mercury occurred about the same time, and without any mutual communication, to Drs. Stokes, Graves, and Marsh. Dr. Stokes observes—"For the last few years, these gentlemen and I have treated with mercury several cases of incipient pulmonary disease, which in all probability would have ended in phthisis. But a great number of observations must still be made in order to establish the actual value of this practice, and it must be recollected that, in the cases thus treated, other and active means were employed to remove the local disease."

When a *tubercular excavation* is formed, our art avails us but little indeed; in fact, all we can do is to palliate the concomitant symptoms. True it is, that in many cases of this kind, judicious treatment may prolong life for many years; in the great majority of cases, however, after a large cavity is formed, a fatal issue soon succeeds. In some cases, a healthy action is set up in the cavern, and the patient is saved, but, unfortunately, such an occurrence is exceedingly rare. The patient's best chance, under such circumstances, is afforded by the use of setons, and travelling.

The *palliative treatment* must be directed to the more distressing symptoms, such as the hectic fever, cough, pain, diarrhœa, &c.

Hectic fever in this disease must be regarded more as a measure of the irritation than of the suppuration of the lung; it is often alleviated by local depletions, by the occurrence of an hæmoptysis, or by regulating the diet. The patient should stay as little as possible in bed, and should sit during the day in a large airy apartment; his chest should be sponged with tepid vinegar and water; frequent changes of linen are to be provided; and the state of the digestive system should demand our attention. Sulphate of quinine has been recommended, especially when the fever assumes an intermittent character.

The pains are best relieved by leeches, blisters, and anodyne liniments. For quieting the cough, all the different forms of demulcents and narcotics have been employed; of the latter, the best are, the different preparations of opium, henbane, conium, and belladonna, and especially the old *paregoric*. When the cough resists these means, a few leeches may be applied to the trachea; in some chronic cases, where even these means fail, inhalations of the vapour of water, containing a narcotic extract, are frequently useful."

The diarrhœa must be looked upon as proceeding from an enteritis, and it is best treated by attending carefully to the regimen; in the early stages, it can generally be controlled by the ordinary cretaceous and opiate medicines, but these soon lose their effect. In the more advanced stages, the metallic astringents, with opium, and anodyne enemata, are employed; in cases where even these fail, decided benefit is produced by the application of a blister to the abdomen.

## DISEASES OF THE PLEURA.

PLEURITIS (*Inflammation of the Pleura*).

It is more usual to meet pleuritis alone, without being complicated with pneumonia, than to meet pneumonia without pleuritis. The most striking difference existing between cases of pleuritis consists in the presence or absence of effusion. The form occurring without liquid effusion is rarely severe, unless it is very extensive; it is the *dry* pleuritis of authors.

*Symptoms.*—Fever, acute pain in the side, hurried and interrupted respiration, *dry* cough, and a hard resisting pulse, are the marked symptoms of this disease in its early stages. The pain is often intense, all motions of the thorax increase it, and the affected side is fixed and motionless. The patient complains of intense heat within the chest, and there is occasionally an extreme tenderness of the integuments. The pain is usually felt below the breast; but it may be felt in the shoulder, the axilla, the lumbar region, or lower portion of the right hypochondrium. Sometimes the pain is wandering and fugitive, and it is not till the lapse of some days that it becomes fixed and continued. In this case it is often taken for a mere rheumatic pain. The pain, after continuing for forty-eight or sixty hours, in general diminishes or ceases altogether; and this coincides with an effusion. But in some severe cases the pain continues, with slight remissions, long after copious effusion has occurred, or even remains unabated up to the period of death. Sometimes, after having disappeared, it shows itself anew with great violence; this is a sure sign of the return of the inflammation. During the first stage, the patient seldom lies on the affected side, in consequence of the position causing increase of pain. The rule generally is, that in the first stage he lies on the healthy, in the second, on the diseased side. When the diaphragmatic pleura is affected, there is generally orthopnoea; as might be expected, the respiration is more hurried and difficult during the persistence of the pain.

This disease, when established, runs one of two courses. The effusion may increase rapidly, and between the first attack and fatal termination no interval of ease is afforded the patient; or more frequently, as in other visceral irritations, a change of symptoms occurs, characterized by diminished suffering, and a transition from the inflammatory to a hectic, or nearly apyrexial, condition. The symptoms vary, according as the effusion is on the increase or stationary. In the first case, we observe the cough continuing, with increase of dyspnoea on motion; the patient emaciates; the countenance becomes pale, or sallow, and contracted; palpitations are often complained of; and the feet or ankles become slightly swollen. In this condition, the side will be found extensively dull; the mediastinum displaced;

and in all probability, protrusion of the intercostal spaces will be found to exist. But when the effusion is not very extensive, nor on the increase, it may coincide with a constitutional state but little removed from health.

The cough never occurs in fits; it is small, as if cut short, and frequent. It may be even entirely wanting, though the inflammation is intense and a considerable effusion exists in the pleura. In pure pleurisy there is little or no expectoration; but if it be complicated with pneumonia, there will be the characteristic sputa of that affection.

When the pleura covering the diaphragm is inflamed, the distinctive symptoms are said to be,—1st, a more or less acute pain along the cartilaginous edge of the false ribs, generally extending into the hypochondria, and sometimes even to the flank; 2dly, complete immobility of the diaphragm in inspiration; 3dly, a very remarkable anxiety, expressed particularly by the sudden alteration of the features; 4thly, an almost constant orthopnœa, with inclination of the trunk forwards. Patients in this situation dread the slightest motion, as being calculated to awaken the most violent pain; this symptom, which is sometimes absent, is considered by M. Andral to be one of the most characteristic. The less constant symptoms are,—hiccup, nausea, and vomiting; convulsive movements of the muscles of the face, and particularly of those of the lips; delirium, which supervenes either in a continued or intermittent form. Finally, when the diaphragmatic pleura of the right side is the seat of inflammation, the liver may be sympathetically irritated, and jaundice develop itself. The coexistence of this jaundice with a more or less acute pain in the right hypochondrium may induce one to believe in the presence of hepatitis.

*Physical signs.*—The earliest sign of pleurisy, occurring during the first stage, when the membrane is slightly roughened by lymph, is a *rubbing sound* heard during the movements of inspiration, and arising naturally from the friction of the roughened surfaces against each other. This sound is often perceptible to the patient himself. But it ceases as soon as the opposing costal and pulmonary membranes are separated by liquid effusion.

When effusion has occurred, it is denoted by dulness on percussion of the portion of the chest corresponding to the effusion. This dulness, supervening much more rapidly than in ordinary pneumonia, and unaccompanied or preceded by crepitation, generally points out pleuritic effusion. The resonance of the chest is commonly diminished first in the inferior dorsal and lateral regions, corresponding to the base of the lung. As the effusion increases, the dulness of sound gradually extends upwards, and becomes more pronounced. Sometimes the transition from the dull to the healthy sounding parts is so abrupt that a horizontal line will exactly divide them, and this,

when well marked, is a very characteristic sign. A change of position will also alter this line in a manner quite distinctive, and, what can happen only in liquid effusion,—the dull sound always accompanies the liquid as it gravitates to the lowest parts. When the effusion is copious, the entire side, from the clavicle down, may be dull. M. Reynaud has pointed out another effect of effusion, which may furnish a diagnostic sign, in its intercepting the slight fremitus or vibration which accompanies the voice in all parts of the chest. The hand applied to a healthy chest readily feels this general vibration; but a layer of liquid, interposed between the lung and the chest, acts as a damper, and prevents the transmission of the vibration.

The respiration is usually heard becoming *bronchial*, as the effusion increases up to a certain point; but then, as the bronchi themselves become pressed by further increase, it becomes faint, and at last ceases.

The *voice* furnishes a valuable sign. If it traverses a thin layer of liquid interposed between the lung and the ribs, it throws it into vibrations, and is itself modified, and rendered sharp and tremulous, resembling the bleating of a goat or lamb. This modification of the voice M. Laennec therefore called *ægophony*. Its most distinctive mark is its tremulous or subsultory character. This is regarded as a pathognomonic sign of effusion into the pleura, as it can only be produced by this cause.

When the effusion is very considerable from the commencement, or becomes so during the progress of the disease, the *ægophony* disappears, and the respiration is no longer heard, unless where old adhesions retain some part of the lung near the ribs, and prevent it from being forced back by the effusion. The intercostal spaces become enlarged and elevated; the affected side is more expanded than the sound one, but is no longer influenced by respiration, its immobility forming a striking contrast with the great mobility of the other, in which the respiratory murmur is increased in intensity, so much so as to assume the "puerile" character. Now, as the sound of this respiration is sometimes heard on the diseased side, through the liquid, it will be necessary to guard against the error of mistaking it for a faint respiration on that side.

Another effect of a large collection of liquid in the chest is to displace the viscera in a remarkable manner. Thus an effusion on the left side will often displace the heart, and make it pulsate under, or even on the right of, the sternum. The liver will be pushed downwards by a large collection of fluid on the right side. These signs are important, because they distinguish this disease from hepatization of the lung, which is liable to be mistaken for pleuritic effusion, but which produces no such displacements. A useful criterion of this kind, drawn from percussion on the sternum, has been pointed

out by Dr. Stokes; a copious effusion on one side will displace the sternal mediastinum, and render the whole sternum dull on percussion. A hepatized lung, on the other hand, will not encroach on the mediastinum, but, lying under one half of the sternum, will render that half dull, whilst the other half will remain resonant as usual.

The absorption of the fluid is indicated by the gradual return of the respiratory murmur: first, in those points where it had persisted latest; afterwards in others; and last of all in the parts where the accumulation had begun. It is very faint at first, and becomes stronger in time; but, generally, a very long period is required to bring it on a par with that of the healthy side. In other instances, however, the absorption is nearly as rapid as the effusion, and in these cases a returning ægophony (*ægophonia redux*) also announces the diminution. As the absorption proceeds, there is sometimes heard a sound of friction, like that which accompanies the dry stage of pleurisy. This is produced by the approximation and habitual friction of the pleuræ, the surfaces of which are covered with false membranes.

In double pleuritis, where both sides are simultaneously affected, the indications given by percussion are less certain; for both sides sounding equally bad, the standard of comparison is lost. The upper parts of the chest, however, remaining sonorous, with the exact demarcation between these and the line of effusion, will still characterize the disease.

*Complications.*—Acute pleurisy may be complicated with pneumonia, bronchitis, pericarditis, pneumo-thorax, or peritonitis.

When pleuritis is not very acute, and the effusion is not extensive, it may be mistaken for phthisis, debility, remittent fever, liver disease, &c.

*Morbid appearances.*—The pleura, when attacked, presents—1st, alterations of tissue; 2d, alterations of secretion.

1st. *Alterations of tissue.*—When a person labouring under a slight pleuritis, dies of another disease, the pleura will be found to be red to a greater or less extent; but a careful examination soon shows that this redness is solely owing to the greater or less injection of the vessels which pass through the sub-serous cellular tissue; the membrane itself has retained its transparency, and no red vessel ramifies through it. Should the inflammation be more intense, the serous membrane itself then presents vessels, in greater or less number, filled with blood; sometimes these vessels, not being very numerous, leave large intervals between them, and they scarcely disturb the transparency of the membrane; sometimes their number is greater, they become agglomerated, and anastomose in various ways, so as to produce mere points, long streaks, large patches, and finally, a uniform red tint, to a greater or lesser extent; this last

case is very rare. These different shades of inflammatory redness must not be confounded with the product of simple ecchymosis; sometimes after chronic diseases, or certain severe fevers, effusions of blood, merely passive, take place on the external surface of the pleura and peritoneum, in the same manner as they are formed under the mucous membranes and under the skin. In the majority of cases, the pleura, red or white, opaque or transparent, is not increased in thickness; we very rarely find it really thickened.

2d. *Alterations of secretion.*—The alterations of secretion presented by the inflamed pleura are more numerous and more varied than its alterations of tissue. The liquid exhaled by the inflamed pleura presents a multitude of varieties; in some cases, it consists of colourless or lemon-coloured serum, perfectly limpid and transparent; in more common instances, however, albuminous flocculi are observed to float in the limpid fluid. In other persons, there is found a liquid decidedly turbid, of a yellow, green, brown, or grayish colour, which is sometimes very thick, and as it were muddy. Finally, after several immediate states, this liquid presents itself under the form of real pus, such as it exists in an abscess. In some rare cases, the pleura is filled with a peculiar liquid, which is neither serum nor pus; this liquid, usually deposited in compartments formed by false membranes, resembles either animal jelly half liquefied, or honey. Blood may also be effused into the inflamed pleura; but sometimes the red tinge is so slight that it is evidently merely serum, mixed with colouring matter, which constitutes the effusion. In other cases, on the contrary, the pleura is found filled with a liquid altogether resembling the blood which comes from a vein. It cannot be doubted in this case but that natural blood was really exhaled by this membrane.\* The different liquids effused into the pleura are always inodorous, unless a solution of continuity of the thoracic parietes, or a pulmonary fistula, establishes a communication between the cavity of the pleura and the exterior.

*Aeriform fluids* sometimes exist in the pleural cavity, either alone, or, more frequently, mixed with a liquid. Their presence is principally ascertained—1st, by the hissing noise produced at the moment an incision is made into the chest; 2dly, by the frothy state of the liquid; 3dly, by opening the thorax in water. In some circumstances, these gases are evidently the product of an exhalation from the membrane; but most usually they are found in the pleura only when the latter communicates more or less immediately with the bronchi.

A portion of the liquid exhaled by the pleura naturally tends to concrete and pass into a solid state. Hence the false membranes,

\* Besides, in the case of hemorrhagic pleurisy (*hæmothorax*), blood may be effused into the sac of the pleura from a wound, by the rupture of an aneurism, by pulmonary apoplexy, or by a passive transudation.

which present so many varieties with respect to their organization, form, colour, extent, consistence, and thickness.

Gangrene sometimes takes place in the pleura, presenting itself in the form of circumscribed spots of a dark-brown or greenish colour, penetrating the substance of the membrane, and extending in some cases to the sub-pleural cellular tissue, or to the surface of the adjacent parts, which become infiltrated with a serous fluid.

*Treatment.*—The treatment of pleuritis rests on the same basis as that of peripneumonia. When the patient is of a robust habit, and the inflammation runs high, free *bloodletting* must be employed. As soon as the pain appears, and there is as yet no effusion, *leeches* or *cups* applied over the painful side often remove the disease. This effect is obtained with more certainty if general bloodletting be premised. The combination of both is extremely useful. Large emollient cataplasms should be applied to the affected side. After a full bloodletting, a brisk *cathartic* may be given, so as to act freely on the bowels, and also produce derivative effects. In most cases, it will now be advisable to bring the system under the influence of *mercury*; and this may be effected in various ways. Some practitioners give blue pill and opium, others prefer calomel and opium: and again, some rely on mercurial inunction. Three grains of calomel, half a grain of opium, and a quarter of a grain of tartar emetic, made into a pill, to be taken every third or fourth hour; or the same proportions of calomel and opium, and one grain of digitalis, instead of the tartar emetic; the pill to be taken in the same way. As long as the fever is high, we should not have recourse to revulsives; but when it is lowered, and no signs of violent reaction are observed, a large blister should be applied to the affected side. The violent symptoms having been subdued, the effusion may be rapidly absorbed, and the sonority of the chest be restored. But in most cases the constitutional symptoms and local sufferings only are removed, while the effusion continues stationary, or perhaps even on the increase. It is at this period that, by small local bleedings, repeated counter-irritation, diuretics, and diaphoretics, we can generally succeed in effecting a cure.

In *chronic pleurisy* there is but little constitutional distress: yet the patient emaciates rapidly, the pulse is quick, and the breathing hurried. On examining the chest, one side is found dull and enlarged, the heart is displaced, and the respiration is puerile in the opposite lung.

In such cases, the patient must be confined to bed, his bowels be freely acted upon, and his diet consist of farinaceous substances. A few leeches are to be occasionally applied to the affected side, and mild mercurials are to be exhibited, so as to induce slight ptyalism. Counter-irritants are now to be employed. M. Andral recommends, "that the blister to the chest should be replaced either by a seton,

the suppuration of which should be kept up for a long time, or by a moxa. As all febrile symptoms subside, we may improve the patient's diet by allowing light broths, fresh eggs, &c.; diuretics should also be now had recourse to. In this stage, Dr. Stokes places great reliance on the internal and external use of iodine. When the absorption of the effused fluid has been effected, change of air should be recommended.

*Paracentesis.*—If effusion into the pleura is so extensive as to endanger the patient's life from the difficulty of breathing it occasions; or if his health and strength are giving way, it will be proper to make an aperture for the escape of the liquid by *paracentesis*.

#### DISEASES OF THE HEART AND ITS MEMBRANES.

*Auscultation of the heart in health.*—On applying the ear to the region of the heart in a healthy person, a sound is heard at each pulsation, followed by an interval of silence. This sound is double, consisting of a dull slow sound, immediately followed by a short quick one. The first sound is produced by the contraction (systole) of the ventricles, and is synchronous with the pulse of arteries near the heart. The second, or short one, accompanies the dilatation (diastole) of the ventricles. This second sound is said to be produced by the shock caused by the tightening of the semilunar valves at the ventricular diastole. Laennec rates the relative duration of these sounds to be as follows—The first sound, two-fourths; the second sound, one-fourth, or a little more; the interval of silence, one-fourth, or a little less. These sounds are naturally most distinct in the space between the cartilages of the fourth and seventh ribs of the left side, and on the lower part of the sternum; the former part corresponding with the left, and the latter with the right side of the heart. Simultaneously with the first, or systolic sound, an impulse or shock is communicated to the stethoscope. It is most perceptible at and between the cartilages of the fifth and sixth ribs, where it may be felt by the hand; but the stethoscope commonly renders it sensible in lean persons over the whole præcordia. Considerable variety in the force of the impulse may occur from various extraneous causes acting on a healthy heart. Thus, the pressure of tumours behind it, flatulent distension of the stomach, great enlargement of the liver and spleen, contraction of the chest from pleurisy, deformity of the spine, and similar causes, which have the effect of pushing the heart into closer contact with the anterior walls of the chest, will make its impulse against them stronger. Again, extensive effusions of air or liquid in the left pleura may displace the heart, so that its impulse can only be felt under or even to the right of the sternum. The action of the heart is naturally accelerated by exercise, stimulating drinks, heat, &c.; and this excited action is attended with an increased impulse and with louder sounds.



*Exact position of the heart.*—"A line," says Dr. Hope, "drawn from the inferior margins of the third ribs, across the sternum, passes over the pulmonic valves a little to the left of the mesial line, and those of the aorta are behind them, but almost half an inch lower down. A vertical line coinciding with the left margin of the sternum has about one-third of the heart, consisting of the upper portion of the right ventricle on the right, and two-thirds, composed of the lower portion of the right ventricle, and the whole of the left, on the left. The apex beats between the cartilages of the fifth and sixth left ribs, at a point about two inches below the nipple, and an inch on its sternal side."

"Take the fifth costal cartilage on the left side," says Dr. Latham, "and let a point midway between its junction with the sternum and its junction with the rib be the centre of a circle, two inches in diameter. This circle will, as nearly as possible, define the space of the præcordial region, which is naturally less resonant than the rest."

*Relation of the sounds to the state of the heart.*—"A clearer sound," says Dr. Latham, "proceeds from a thin heart; and a duller sound from a thick heart; a sound of greater extent from a large heart, and a sound of less extent from a small heart. A more forcible impulse is given by a thick heart, and a feeble impulse by a thin one; the impulse is conveyed to a longer distance from a large heart, and to a shorter distance from a small heart."\*

"Sounds and impulses," continues Dr. Latham, "are the interpreters of each other. The true meaning of the sound is tested by the impulse, and the true meaning of the impulse is tested by the sound. Thus, from a clearer sound, we argue only the probability of an attenuated heart, but we argue its certainty from a clearer sound, joined with a weaker impulse. From a stronger impulse we argue only the probability of an hypertrophied heart; but we argue its certainty from a stronger impulse joined with a diminished sound. When impulse and sound increase together, there is probably no hypertrophy, but the heart is only acting more forcibly from pure excess of nervous energy. When impulse and sound decrease together, there is probably no atrophy, but the heart is only acting more feebly from pure defect of nervous energy. When the sounds and impulse of the heart are both perceived beyond the præcordial region, they give notice (generally speaking) of dilatation of one or other of the ventricles. If, under these circumstances, sound predominates over impulse, then with dilatation there is either attenuation, or somewhat less than a proportionate increase of its muscular substance. If impulse predominate over sound, with dilatation, there is either hypertrophy, or somewhat more than a proportionate increase of its muscular substance."

\* Lectures on Diseases of the Heart, vol. i. p. 18.

*Morbid sounds of the heart.*—Unnatural sounds may be called *murmurs*; and they are of two kinds; the *exocardial*, produced *external* to the heart, that is to say, *in the pericardium*; and the *endocardial*, produced in the heart itself.

The *endocardial* murmurs have a *blowing* character, the *exocardial* give the idea of friction.

“The endocardial murmur,” says Dr. Latham, “is not only different in kind from the natural sounds of the heart, but it takes their place, and is heard in their stead. It comes exactly where the first sound, or where the second, or where both sounds should be. It keeps strict time with the systole or with the diastole of the heart, or with both.

“The exocardial murmur, too, is different in kind from the natural sounds of the heart. But it does not take the place of them; it is not heard in their stead. In proportion as it is louder, it obscures or overpowers the natural sounds. But the natural sounds are still apt to reach the ear through the exocardial murmur; and when they do not reach the ear, it is because they are imperceptible under the circumstances, not because they cease to exist.”

Endocardial murmurs (i. e., murmurs *within* the heart) are caused by peculiar *vibrations of the columns of blood* which pass through the heart; and these vibrations may depend,—1st, upon an unnaturally thin *quality*, and deficient quantity *of the blood*, as in the murmurs heard after hemorrhage; 2ndly, *on disease of the valvular orifices* of the heart, offering obstacles to the passage of the blood.

A murmur caused by the passage of the blood through a diseased valvular orifice may be *direct* or *regurgitant*; that is, may be produced during the flow of the blood along its natural channel, if contracted; or during its regurgitation, which will happen if the diseased valve is unable to shut properly.

In order to ascertain which valve is diseased, notice must be taken of the *time* at which the murmur is heard;—of the *part* of the præcordial space *where it is heard most loudly*; and of the *direction in which it is conveyed the farthest*.

Valvular disease of the right side of the heart is very rare indeed; and the diagnosis of it from disease on the left side is a matter of some uncertainty. The following observations, therefore, chiefly apply to the aortic and mitral valves.

When a single endocardial murmur is heard during the *systole* of the heart, its seat is most probably the aortic valve, which is thickened, so as to impede the blood in its exit from the heart and to throw it into vibration.

When a single murmur is heard, coincident with the heart's *diastole*, this also may be produced by a diseased aortic valve, if so diseased as to be incapable of closing, and permit the blood to *regurgitate* into the ventricle.

When there is a double murmur, both *systolic* and *diastolic*; these also may arise from disease of the aortic orifice alone; the former being a murmur caused by the flow of blood from the heart; the latter by its regurgitation.

Again, when there is a *single systolic murmur*, it may be caused by disease of the *mitral valve*, permitting the blood to regurgitate into the left auricle from the ventricle, when the latter contracts.

The spot where all endocardial murmurs are heard most distinctly, is immediately over the valve which originates them. And the space under which the cardiac valves lie, may be said to be comprised *between the lower margin of the 3rd left costal cartilage, and the lower margin of the 4th*; extending inwards to the middle of the sternum. Here it is that almost all murmurs are heard most clearly.

The method of distinguishing them from each other is based on the fact that the murmur will be conveyed along the direction of the column of fluid whose vibration causes it.

Thus if a murmur be seated at the aortic valve, it will be heard most clearly *over the left half of the sternum, between the 3rd and 4th costal cartilages*. But the sound will also be conveyed with tolerable clearness *in the course of the aorta and its branches*; that is to say, upwards and between the second and third ribs of the *right side*—perhaps it will also be heard in the carotids.

If the disease (which is very rare) were seated in the *pulmonic valves*, the murmur would follow the course of the *pulmonary artery*, upwards between the 2nd and 3rd ribs of the left side.

If it were seated in the *mitral valve*, the murmur would be lost if the stethoscope were moved upwards; but would still be heard distinctly if it were moved *downwards towards the apex of the heart*.

If the murmur is heard plainly in *both directions*, then *both aortic and mitral valves* are probably diseased.

There are some few circumstances which must be taken into account in estimating the value of endocardial murmurs as signs of valvular disease.

For first, they are sometimes absent altogether when the patient is in repose; although they may be excited by causing the patient to move about, so that the heart may beat more forcibly.

Secondly, the loudness of the sound is by no means a measure of the extent of the disease; for in long standing cases, where a diseased orifice has become very contracted, the sound often becomes very feeble indeed.

Thirdly, very violent action of the heart alone, without valvular disease, may occasion a murmur; this often happens to children; seldom to adults.

Fourthly, if the heart is embarrassed by deformity of the chest, or if it is too much pressed upon by the stethoscope, murmurs may be created.

Fifthly, in cases of anæmia, after hemorrhages, or when the blood has become pale and watery through ill health, there will be a loud systolic murmur, conveyed along all the arteries; and also often accompanied by a continuous humming noise heard in the veins, especially the internal jugular. This state is to be remedied by nourishing food and tonics.

Lastly, the sounds of respiration may imitate cardiac murmurs so closely, that it may be necessary to make the patient hold his breath, to distinguish their real source.

#### INFLAMMATION OF THE HEART; ENDOCARDITIS, AND PERICARDITIS.

These maladies are generally found to be concomitants of *rheumatism*. No doubt they do often occur from other causes; and they often occur, too in slight degrees without being complained of or suspected.

*Symptoms.*—The symptoms of endocarditis are, 1st, *pain* in the heart; 2nd, *disordered action* of the heart which may be violent, or else feeble, irregular, and intermitting; 3rdly, some dyspnœa; and, lastly, *abnormal sounds*; beginning with a *roughness* and afterwards, a murmur, arising from thickening of, or deposit on some of the valves. One or more of these symptoms, occurring in the course of acute rheumatism, may be considered a sign of endocarditis.

The pain is sometimes so slight that the patient scarcely notices it, if at all; but in dangerous cases is an extreme anguish, liable to be followed by orthopnœa, restlessness, delirium and death. The murmur sometimes is heard at the very beginning, whilst there is no other symptom or complaint about the heart; sometimes it does not come on till the middle or end of the disease.

The symptoms of *pericarditis* are, 1st, pain in the region of the heart, augmented by pressure and by a deep inspiration; 2ndly, irregular or violent action of the heart; 3rdly, difficulty of breathing; and, lastly, the *physical signs*—an *exocardial murmur*, caused by the rubbing of the roughened and inflamed serous surfaces of the heart and pericardium against each other; dulness of percussion over an unusually large space of the præcordial region; and sometimes a distinct undulation visible between the cartilages of the 2nd, 3rd, and 4th left ribs. The exocardial murmur resembles the rubbing of two rough surfaces against each other—it is called by Dr. Watson the *to and fro sound*; which name well expresses its character. The dulness on percussion, and the undulation, arise from the presence of fluid effusion in the pericardium.

The friction sound ceases of course if the heart and pericardium become adherent together.

Inflammation of the heart is sometimes attended with so much nervous and cerebral irritation, as to mislead the practitioner, unless

very cautious, and induce him to look to the head instead of the præcordia.

Pericarditis, like endocarditis, may come on in the course of acute rheumatism, without being denoted by pain, or any symptom sensible to the patient. The region of the heart should therefore be frequently scrutinized by the stethoscope in rheumatism, and proper measures be adopted as soon as there is the first indication of murmur.

*Frequency of the disease.*—Dr. Latham shows that the heart is much more frequently inflamed in acute rheumatism than is often imagined. Out of 136 cases of that disease, the heart was inflamed in 90, about two-thirds; of these 90 cases there were 63 of endocarditis; 7 of pericarditis; 11 of endocarditis and pericarditis combined, and 9 in which the seat was doubtful.

Out of this number there were but three deaths; but yet in the great majority of those who recovered, there was some deviation from the healthy state remaining, which, no doubt, laid the foundation of subsequent chronic disease of the valves.

*Morbid appearances in acute pericarditis.*—The membrane intensely red; perhaps ecchymosed, its cavity containing serum with flakes of lymph; and both the inside of the pericardium and the outside of the heart covered with a layer of lymph of variable thickness; sometimes the opposing surfaces adhere; sometimes they are free, and the lymph is flocculent, or corrugated, making the heart's surface look like tripe.

*Of endocarditis.*—The affected portion of the valves is generally found thickened, pink, and fringed with deposits of lymph.

*Treatment.*—The treatment of inflammation of the heart is the same as that of acute rheumatism, only modified to meet the emergency. *Bleeding* must be employed, if the general state of strength and excitement show it to be demanded, and that it can be borne; *cupping between the shoulders*, or *leeches to the præcordia*, are indispensable. Full doses of *opium*, at bedtime, to ensure sleep; and *calomel*, with smaller doses of opium, in such quantities as the severity of the disease may demand during the day; *purgatives*, so as to clear out the abdominal viscera, and *colchicum* are the main remedies. And it should be observed that it will be right to leech or cup the instant any abnormal sound is heard in the region of the heart, although no symptom of uneasiness there may be complained of by the patient. When the acute state has subsided, *blisters* will hasten the absorption of effusion or deposit of lymph.

#### HYPERTROPHY, DILATATION, AND ATROPHY OF THE HEART, AND ANGINA PECTORIS.

*Hypertrophy* signifies a preternatural increase of the muscular substance of the heart; and there are generally said to be three

varieties of it, viz.,—*Simple hypertrophy*, in which the muscular parietes are thickened, but the cavities unaltered in size; *hypertrophy, with dilatation*, or *eccentric hypertrophy*, in which there is also an increase of the capacity of the cavities; and *concentric hypertrophy*, in which the substance of the heart is thickened, and its cavities diminished.

Modern pathologists have decided that the *concentric hypertrophy* is a pathological mistake; that, in fact, it depends on the state of contraction in which the heart happens to be left at the moment of death; and that the so-called concentric hypertrophy often vanishes as the *rigor mortis* goes off, and the heart dilates and becomes flabby.

*Hypertrophy of the left ventricle* may be caused *first*, by circumstances that excite the action of the organ to a great degree; such as high living, violent exercise, and mental excitement; and, *secondly*, by obstructions of the mouth of the aorta. These, of course, require greater muscular force to be exerted in order that the blood may be propelled in the same time through a small aperture as through one of the natural size.

*Hypertrophy with dilatation* is much more common under the last mentioned circumstances, than simple hypertrophy; for the same cause that obstructs the current of blood, will also give the cavity a tendency to dilate, especially if the patient has but little tone and vigour in the muscular system.

*Dilatation without hypertrophy*.—This is a kind of muscular atrophy, and happens to flabby cachectic patients, in whom the heart gives way and stretches in its efforts to carry on the circulation.

*Hypertrophy of the left ventricle, without valvular disease*, causes the patient to feel an unnatural beating; the pulse is full and strong, the face florid, and there is a disposition to hemorrhage and inflammation. On auscultation, the *impulse* is felt to be strong and widely diffused; the *systolic sound* less loud and clear than natural.

*Treatment*.—Spare, unstimulating diet, repose of body and mind, small bleedings and purgatives.

*Hypertrophy of the left ventricle, with valvular disease*.—This is much more common than the last variety; its symptoms are much the same, except that if there is much obstruction of the aortic valves, the pulse cannot be strong or full: if the obstruction is very great, the pulse will be feeble or intermitting. The valvular obstruction will cause a blowing murmur.

*Hypertrophy with dilatation of the left ventricle from valvular disease*, is, as was before said, much more common than simple hypertrophy; and the *greater the dilatation, the feebler will be the impulse and clearer the sound*. A great amount of dilatation, like great obstruction of the aortic valves, causes the pulse to be feeble and intermittent; the extremities cold, and a tendency to faintness.

*Hypertrophy of the right ventricle with dilatation* is often a con-

sequence of the obstruction the blood meets with from pulmonary disease.

*Consequences of diseased heart.*—From the obstruction the circulation meets with, various organs become congested, and ultimately diseased, whilst the serum is apt to be effused, constituting various forms of dropsy. Great dyspnœa, with more or less bronchitis, and finally hydrothorax; congestion of the liver, and abdominal viscera, or of the kidneys; blueness of the lips, and ascites and anasarca are the general precursors of death. Sometimes the heart becomes so thin and soft that it bursts or ulcerates at one point, causing sudden death from hemorrhage into the pericardium.

*Treatment.*—The treatment of permanently diseased heart, must be *palliative*; whatever symptoms happen to be urgent must be relieved. The general rule is, that all violent exertion and mental anxiety, especially running up stairs, and fits of anger; all intemperance and unwholesome food must be shunned. Unwholesome food is very liable to cause distress, by distending the greater end of the stomach, and pressing it up against the heart.

If there is much palpitation, pain, and dyspnœa, with *blood to spare*, leeches or a small cupping will relieve; a belladonna or opiate plaster over the heart, and small doses of *hydrocyanic acid*, if the stomach is irritable, are the remedies. But it must be borne in mind, that if the aortic orifice is contracted, increased action of the ventricle is beneficial, and must only be kept within reasonable limits.

If the patient's condition is feeble and bloodless, and there seems evidence of dilatation, tonics, especially iron, given in very small doses for a long time, and a nutritious diet, are of service. The *ferrum tartarizatum* is a good form from its diuretic qualities.

*Diuretics* are always of immense service in heart disease, by relieving vessels loaded with the blood which cannot pass rapidly enough through the heart. Digitalis in small doses, with squill and mercury, may be tried, especially if there is any dropsical tendency.

*Purgatives* and *mercurials* for relieving abdominal and hepatic congestion are often also necessary.

*Blisters* and setons to the chest may be used if there is a suspicion of any inflammatory process about the heart, or pericardium.

*Stimulants* and *antispasmodics*, such as ammonia, æther, henbane, &c., in small doses, often give great relief where there is palpitation, combined with nervous debility and a languid circulation.

#### ANGINA PECTORIS.

This dreadful complaint attacks persons who have some organic alteration of the heart, and generally of an atrophic character. In some cases the heart has been found excessively loaded with fat; in

others there has been a softness of the heart; in others disease of the valves or of the aorta; and in several *ossification of the coronary artery*, a change which would, of course, greatly interfere with the proper nourishment of the heart.

*Symptoms.*—These seem to be of the nature of a *cramp*, or *spasm of the heart*, combined with inability to propel its contents properly. The patient, in walking briskly, especially if he does so after a meal, is seized with a peculiar pain in the region of the heart. It is a pain of an alarming nature to the patient, who often feels that he must stop and support himself, and as if another step would be fatal. The pain goes through to the back, and often shoots down to the elbow of the left arm. The pulse sometimes stops during the paroxysm. When it has lasted some seconds, it goes off.

The attacks, generally, as the disease advances, become more and more frequent and violent, and more easily induced.

*Treatment.*—This may be comprised in the word *quiet*. The patient should be warned of his danger; and the means which have been before spoken of should be employed to allay irritation of the diseased organ, taking care neither to weaken the patient too much on the one hand, nor on the other to let his veins become too full, or the liver and kidneys inactive.

## OF PARTICULAR HEMORRHAGES.

### EPISTAXIS (*Bleeding from the Nose*).

There is no part of the body more disposed to hemorrhage than the pituitary membrane, and none in which the recurrence of the discharge is productive of so little injury, as respects either the structure or the constitution. The blood effused from this membrane may be discharged either by the nostrils or by the mouth, after having passed into the posterior fauces.

*Causes.*—In its idiopathic states, epistaxis occurs most frequently in children and young persons. In the more mature periods of life, it is most frequently *symptomatic*, or dependent upon disease of the heart, of the liver, spleen, or of some other viscus, or consequent upon the disappearance of some sanguineous or other evacuation. The *external* causes are, injuries, irritants, exposure of the face to fires or to the sun's rays. The *internal* causes are, whatever increases the flow of blood to the head, as mental excitement; sneezing; catarrh, &c., &c.

*Symptoms.*—The *sthenic* form is ushered in by pain of the head, vertigo, or somnolency; with increased pulsation in the temporal arteries. The *sthenic* epistaxis is often *symptomatic* or *critical* of several acute diseases; especially the more inflammatory kinds of fever, and inflammations of the brain, or of the lungs, &c. The *passive* forms are frequently *symptomatic* of several cachectic



maladies, and of the last stages of malignant or low fevers. The quantity of blood discharged may vary from a few drops to many pounds; and in the more obstinate passive states the patient may be reduced to the utmost danger, or may be carried off in a few hours or days, according to the continuance or violence of the discharge.

*Treatment.*—If the patient be robust or plethoric; if he have experienced attacks of determination of blood to the head; the discharge should not be arrested until the vascular system is relieved, and when this is accomplished the epistaxis will cease of itself. If it should seem to cease prematurely, and particularly if the above symptoms still continue, depletions, purgatives, and an antiphlogistic regimen ought to be prescribed.

When it is requisite to check the hemorrhage, the patient ought to be placed in a cool, airy apartment, with the head elevated, or held upright, and the feet plunged in warm water containing mustard. The neck should be bared, and cold fluids aspersed over it and the face, or ice applied upon the nape of the neck or upon the forehead; and an active cathartic exhibited; the sulphate of magnesia with sulphuric acid is the best. Lemonade and cooling drinks may also be given. When the epistaxis has become habitual, or periodic, and especially if it be vicarious of menstruation, it may be anticipated by cupping on the nape of the neck.

In the *passive* or *atonic* states of the disease, astringents should be injected into the nostrils, and astringents and tonics given internally. A solution of acetate of lead, or of sulphate of zinc, or of sulphate of iron or copper, or of the sulphate of alumina, may be injected into the nostrils; or lint, moist with either of these solutions, introduced. The superacetate of lead, with acetic acid, and small doses of opium, may be exhibited with advantage. If the bleeding will not stop, the anterior and posterior apertures of the nostrils should be plugged.

#### HÆMOPTYSIS AND PULMONARY APOPLEXY.

##### (*Hemorrhage from the Respiratory Organs.*)

Hæmoptysis is one of the most frequent varieties of hemorrhage, owing to—1st, the very extensive bronchial and vesicular surface to which the blood is circulated for the purpose of undergoing the requisite changes during respiration; 2d, to the delicate conformation of the capillaries of the mucous membrane of this part; 3d, to the liability of the lungs to congestions, from impaired nervous power, from obstructions of the pulmonary veins and of the circulation through the left side of the heart, and from tubercular or other lesions of the substance of the lungs.

We may admit three principal sources for the blood which is ex-

pectorated in hæmoptysis. It may come, *first*, from the mucous membrane of the bronchi; *secondly*, from a vessel ulcerated in a tuberculous excavation; *thirdly*, from an aneurism of the aorta, or of the large trunks arising from its transverse arch, in which case it will be soon fatal.

*Pathology.*—Some few cases of hæmoptysis depend on suppression of the menses, and are habitual and not dangerous; but in by far the majority of cases it depends on disease of the heart, or on the irritation of tubercle. Hypertrophy of the right ventricle is generally supposed to be a frequent cause of pulmonary hemorrhage; but the momentum caused by hypertrophy of the right ventricle is rarely sufficient to rupture any branch of the pulmonary artery. Dr. Watson states, “that every instance of pulmonary hemorrhage dependent upon organic disease of the heart, which he had observed, coincided with disease on the left side of that organ, mechanically obstructing the return of blood from the lungs. The obstacle has sometimes been placed at the entrance of the aorta; but it has most commonly consisted of narrowing of the left auriculo-ventricular orifice, and a rigid condition of the mitral valve.”

When these morbid states exist, it is easily brought on by violent exercise, or anything that irritates the lungs.

Pulmonary hemorrhage may be *simple*, the blood being all spit up; or it may be attended with what is most improperly called *pulmonary apoplexy*; that is to say an infiltration of blood into the minute tubes and air cells, rendering a portion of lung solid. This, as Dr. Watson has shown, is an accident of pulmonary hemorrhage, and occurs in this way. A portion of the blood instead of being coughed out is drawn back by the patient's inspiratory efforts into one or more small tubes, and fills and blocks up one or more lobules; giving rise to one or more knobs or masses, composed of blood that has coagulated in the air vesicles. Sometimes, though not often, the latter are broken down and ruptured by it. In other cases, hemorrhage occurs in the minuter tubes and vesicles, and goes on clogging up a large portion of lung progressively; there being not the circumscribed lumps just described, but a large irregular diffused solidification.

*Symptoms.*—Some degree of pain or oppression at the chest, with cough, which brings up mouthfuls of blood, fluid or clotted. The quantity may vary from a teaspoonful to several pints; so that the patient may be suffocated by the abundance of the hemorrhage.

The stethoscope is useful as indicating the extent and place of the hemorrhage, for wherever there is blood in the air-tubes or vesicles there will be a corresponding crepitation, or if the lung is solidified there will be absence of respiration.

After pulmonary apoplexy, the blood is expectorated in dark red sputa, mixed with mucus.

*Treatment.*—When the pulse is full, strong, and vibratory, bleeding is required, and the quantity of blood abstracted will necessarily depend on the strength of the patient. One bloodletting of twenty or twenty-four ounces on the first or second day, will have more effect in checking the hemorrhage than several pounds taken away in the course of a fortnight. When the patient's powers will not admit of general depletion, cupping or leeches should be resorted to. A free current of cold air should be allowed to pass over the patient, who should be lightly covered; the bowels should be opened with Epsom salts and sulphuric acid; and the best remedy is the acetate of lead with opium. Perfect silence should be enjoined; the diet be very meagre, and comprise lemonade or other acid drinks. If the hemorrhage assumes a passive character, alum, with dilute sulphuric acid may be administered. In slighter cases, saline draughts, with small doses of digitalis, may suffice. Any inflammatory or irritative symptoms must be treated by blisters and other remedies that have been adverted to when speaking of phthisis.

#### HÆMATEMESIS (*Hemorrhage from the Stomach*).

*Causes.*—Whatever irritates the mucous surface of the stomach, or interrupts the return of blood from that organ, will occasionally produce this disease. Blows and injuries on the abdomen, particularly on the hypochondria and epigastrium; violent concussions of the trunk; external or internal pressure on the stomach; the ingestion of irritating or hurtful matters into this viscus; intemperate indulgence in food or stimulating liquors; the presence of worms in the stomach or upper part of the small intestines; powerful or irritating emetics, especially when given in the advanced stages of fevers, or in cachectic or visceral diseases; the suppression of accustomed discharges, particularly the menstrual or hæmorrhoidal; the application of cold, or of cold and moisture, to the lower extremities or surface of the body during perspiration or the catamenial period; neglect of the bowels, and consequent accumulation of fæcal matters; diseases of the vessels of the stomach and neighbouring viscera; the gravid uterus, and large tumours developed in any part of the abdomen.

*Symptoms.*—In most cases, there are *premonitory* symptoms, such as tension or pain about the epigastrium, with faintness, or a sense of sinking, or of anxiety, at this region; flatulent or acrid eructations; lassitude with irregular chills and flushes of heat. The *pathognomonic* phenomena of the disease are, nausea, followed by vomiting of blood, either fluid or coagulated, pure, or mixed with the contents of the stomach. The blood and other matters thrown up come away with more or less effort, frequently with comparative ease, even when the hemorrhage is greatest, and seldom with much previous retching; it is sometimes gulped or eructated upwards.

When the quantity of blood thrown up is great, the effort at ejecting it may sometimes occasion irritation in the pharynx, and excite coughing, and, from this circumstance, cause some doubt as to the seat of the effusion; but the history of the case will easily show the nature of the disease. After an attack of hæmatemesis, the bowels are generally relaxed, and the dejections dark coloured, from the presence of blood in them, and extremely fœtid. Sometimes the evacuations are quite black, and of the consistence and appearance of tar. This state of the evacuations (the *melæna* of old authors) often continues for some time after the vomiting has ceased; and they are often preceded by colicky pains through the abdomen, distention, flatulence, tormina, and even slight meteorismus.

The *physical characters* of this hemorrhage which require notice are merely those which are referable to the colour, consistence, and quantity of the effused blood. The blood effused into the stomach and intestines is seldom found to present its *natural red colour*, either when thrown out from these organs or when contained in them after death. It has often acquired a dark purple, and still more frequently a deep brown tint, or even the blackness of soot. The dark brown and sooty discolorations of the blood may always be regarded as the result of the action of an acid chemical agent, formed in the digestive organs, on the effused blood, except in those cases in which they are produced by the action of an acid poison. Hence we may conclude, that the diseases called *black vomit* and *melæna* are mere modifications of gastric and intestinal hemorrhage, the black colour being an accidental circumstance of no importance, and derived from the chemical action of the acid product on the blood, previous to its evacuation. The *consistence* of the effused blood is very generally increased with the darkness of colour which it has acquired. It is sometimes coagulated into large masses, or into a multitude of smaller portions, resembling a mixture of water, blood, and soot. This appearance is peculiarly characteristic of the action of an acid on the blood. The *quantity* of blood effused may vary from a few ounces to several pints; and although it is generally greatest in cases of perforation of an artery of the stomach, it is sometimes no less abundant when it has its source in exhalation from the mucous membrane.

Of the different *local lesions* which are found to accompany gastric and intestinal hemorrhage, follicular ulceration is, perhaps, the most common. The mucous membrane may be perfectly pale when the hemorrhage has proceeded from perforation of an artery; red and vascular when preceded by congestion; or it may be of a deep red colour throughout a great extent, whatever be the source of the effusion, from imbibition alone. It almost always presents this deep red colour when the hæmorrhage arises from a mechanical obstacle to the return of the venous blood, the submucous tissue

being at the same time in a state of great congestion, and infiltrated with blood.

*Treatment.*—In plethoric and robust persons, in cases depending on congestion of the liver or spleen, or upon suppressed discharges, and where there are indications of increased or sthenic action, we should have recourse to copious or repeated *bloodlettings*, according to circumstances. *Cupping* over the hypochondria, purgatives, cathartic enemata, and external *derivatives*, should be resorted to. In the more active forms, a full dose of *calomel*, followed in a few hours by a purgative draught, and this by a cathartic enema, so as to procure copious alvine evacuations, should precede the use of astringents. When the hemorrhagic discharge is so copious as to forbid the delay which this practice would occasion, the calomel should be followed in a short time by a full dose of oil of *turpentine*, given on the surface of milk or of some aromatic water, or of this medicine conjoined with castor oil. If this draught be thrown off the stomach, it should be repeated; and it may be even again preceded by the calomel. Notwithstanding its usual nauseating effect, turpentine is generally retained in hæmatemesis, and it allays the vomiting by arresting the hemorrhage.

Of the *astringents*, the acetate of lead, in large doses, with opium, or with pyroligneous acid, acetate of morphia, and creasote, is the most efficacious. In the more *passive* states of the disease, the tonic astringents, as the tincture of the sesquichloride of iron, the oil of turpentine with aromatics, the sulphates and sulphuric acid with opium and infusion of roses, alum in milk-whey, are generally useful.

During the continuance of the discharge, total abstinence should be enjoined; but afterwards, mild mucilaginous drinks, and farinaceous food in small quantity, may be allowed, and the transition to solid and more nutritious diet carefully and gradually conducted. The drink should be cooling and astringent, and appropriate to the state of the digestive organs, especially the liver and spleen. Subsequently, change of air, regular exercise on horseback, and the use of deobstruent mineral waters, ought to be recommended.

#### HÆMATURIA (*Hemorrhage from the Urinary Organs*).

*Symptoms.*—The source of blood voided through the urethra may be either the kidney, ureters, bladder, or urethra. When it proceeds from an affection of the kidneys, it is attended with a sense of heat and pain in the loins, and sometimes with coldness of the extremities, *and the blood is intimately mixed with the urine*. When the disease is in the ureters, there is a sense of pain and tension in their course; *and coagulated shreds of fibrine, having the shape of the ureters are frequently voided*. When the hemorrhage is from the bladder, it is usually preceded by heaviness and tension above the

pubes, extending to the perinæum, groins, and lumbar regions; the passing of the urine is attended with pain and difficulty; the blood is little, if at all, combined with the urine. When the hemorrhage is from the urethra, pain is felt in a particular part of the canal, and the blood is red, liquid, and pure, and generally is voided *guttatim*. When the blood, however, flows back into the bladder, some uncertainty as to its origin is produced.

Hemorrhage of the urinary organs presents little worthy of notice, as regards its *physical characters*, except when it occurs in the bladder. In this organ, it takes place from isolated points of the mucous membrane, which, as well as its sub-cellular tissue, presents a number of deep red patches, varying from a line to half an inch in diameter, the larger ones having often a small ash-coloured slough in their centre. These patches consist of blood effused into the mucous and sub-mucous tissues, and are accompanied by venous congestion of those tissues where the effusion has not taken place. This form of hemorrhage is chiefly observed in injuries of the spine; and appearances perfectly similar sometimes follow the application of blisters to the chest, abdomen, and other parts of the body. The most frequent cause of hemorrhage from the urinary organs is the presence of the fungoid disease in the prostate, and hence its much greater frequency in the male than in the female.

*Treatment.*—The treatment of this affection will, of course, depend on its seat and cause. When the hemorrhage is from the kidney, if the patient be strong, and the pulse full, either general or local depletion, with the usual antiphlogistic treatment, is requisite. On the contrary, when the patient is debilitated, as in typhus or scurvy, the urine being generally alkaline, the mineral acids should be given. In ordinary cases, when neither excitement nor depression is present in a marked degree, small doses of copaiba, turpentine, or of the *inct. ferri sesquichlorid.*, the latter of which is the best, are to be administered. The avoiding of all stimulants, and absolute rest, should be insisted on.

## OF DROPSIES.

If, in man, a large venous trunk be compressed or obliterated, so that the blood no longer circulates through it, whilst at the same time the collateral vessels can relieve but imperfectly the principal vein thus obstructed, an effusion of serum is sure to take place. But if the obstruction exists not merely in the veins of a limb, if it occur in a vessel into which the blood of a much greater number of parts empties itself, then the dropsy will necessarily become more considerable. If, for instance, the obstacle to the return of the blood should exist in the abdominal vena cava, the two lower extremities, as also the scrotum, will become filled with serum. If it be the trunk of the vena portæ, which is more or less completely oblite-

rated, it is in the peritonæum that the serous collection will first take place; it is in this way we may suppose that certain diseases of the liver become causes of ascites. If, in fine, the obstacle to the free return of venous blood exists at the very centre of the circulation, namely, at the heart, we must then draw the theoretical conclusion, that in this case, the circulation of the venous blood being everywhere embarrassed, serous collections must form in all directions, and the dropsy become general. This case, anticipated by theory, is actually established by experience; all practitioners know *that dropsy is one of the most common symptoms of the different organic affections of the heart.*

The next cause of dropsy is *cold*, applied in such a manner as to check the secretion of the skin. From this cause we have frequently general anasarca, and effusions into the pleuræ, the pericardium, the peritonæum, &c. These cases are, from the attendant constitutional symptoms, called *inflammatory dropsy.*

A *third* cause of dropsy is some exanthematous disease, and especially scarlatina.

A *fourth* cause of dropsy is the granular degeneration of the kidney, first pointed out by Dr. Bright, and lately elucidated by the admirable researches of Dr. G. Johnson, of King's College.\*

A *fifth* source of dropsy is debility, exhaustion from loss of blood, &c.

A *sixth* and frequent cause of dropsy is obstruction to the flow of the venous blood, owing to tumours pressing on the large venous trunks, and glandular enlargements, as hypertrophy of the liver, &c.

The presence of *albumen in the urine* depends on the presence of *blood*, or else of the *serum of blood*. If serum only be present, the albumen may be detected by boiling a portion of urine, and adding nitric acid; if the entire blood be present, the red particles may be detected by the microscope, and will render the urine *smoky* or dusky in colour.

These conditions of the urine in dropsy depend on a congested, or irritated, or diseased state of the kidney, so that the capillaries of the Malpighian bodies either exude serum, or else are ruptured and pour out blood.

#### NEPHRITIC DROPSY (*Dropsy from Bright's kidney*).

Dr. Bright first pointed out, in 1827, the frequent connexion which exists between dropsy and what has since been called granular degeneration of the kidney, and the presence of albumen in the urine, as an indication of the latter lesion; but it has been reserved for Dr. G. Johnson, of King's College, to detect the real nature of this most prevalent and fatal disease.

\* See two excellent lectures, by Dr. Todd, of King's College, in the *London Med. Gaz.* Dec. 19th and 26th, 1845.

*Pathology.*—This state of the kidney is not an inflammation, but a slow *degeneration of structure*, commencing by an abnormal deposit of fat in the epithelium cells lining the uriniferous tubes. It is a degeneration, therefore, much allied to the tubercular deposit, or to the *fatty liver*, common in phthisis, and may properly receive the name of the *fatty kidney*. It is a slow insidious disease, beginning generally much further back than the patient is aware of.

The uriniferous tubes become by degrees blocked up with an excessive accumulation of fatty epithelium; the result of this is, that the tubes become dilated, so as to press on the portal plexus of veins which surround them. The veins being thus compressed, the Malpighian capillaries, which open into them, are unable to discharge their contents, and so become distended with blood; and either allow serum to exude from their walls, or else burst and admit the escape of red particles and fibrine. As the accumulation goes on, portal plexuses and uriniferous tubes become atrophied, and hence, shrinking of the kidney and deficiency of secretion ensue. As, however, some Malpighian tufts remain healthy, the secretion from these is sometimes abundant, or even excessive.

The *morbid anatomy* is thus described and explained by Dr. Todd:—

1. “Both kidneys are found in a diseased state. It seldom or never happens that the disease is limited to one kidney.

2. “We meet with irregular vascular congestion, the vessels are full at some parts of the organ, and empty at others, and this gives rise to a mottled appearance on the surface of the kidney.

3. “A deposit of a new matter is found either in or between the tubes of the kidney; this deposit has hitherto been called *granular*.

4. “As the disease advances, the kidneys, which at first were enlarged, shrink, their cortical or external portion becoming wasted, here and there leaving depressions on the surface of the organ, corresponding to the wasted portions; and thus a tuberculated aspect is given to the kidney. The blood-vessels are obliterated in many situations, and it is impossible to inject such kidneys.”

*Constitutional Symptoms.*—These may be divided into three stages.

In the first, the patient is weak and dyspeptic; and his *blood loses its red particles* in an extraordinary degree; but there is very little to call attention to the kidney.

In the second stage, the symptoms are, a pallid pasty complexion; dry hard skin; drowsiness; weakness; indigestion; and frequent nausea; often retching the first thing in the morning; and palpitation of the heart. A most characteristic symptom is, that the patient is awakened once or twice in the night, with desire to make water.

In the third stage, if the patient is exposed to cold, the kidney becomes congested; anasarca, with, perhaps, ascites, makes its ap-



pearance; debility increases; the secretion of urine becomes more inefficient, urea, and other excrementitious matters accumulate in the blood; and drowsiness and coma, signs of effusion into the head, are sure precursors of death.

*Of the state of the urine.*—In the first stage, if examined, it will often be found to contain particles of epithelium, loaded with fat.

In the second stage, the urine is *albuminous*, and not only so, but contains sometimes red particles of blood, and little *fibrinous shreds*, moulds of the tubuli uriniferi, in which they have coagulated. Its *specific gravity is generally very low*; instead of 1025, the healthy average, it sinks to 1016, and gradually gets lower; down, perhaps, to 1004. It will often be found under the microscope to contain a large amount of fatty epithelium scales.

In the last stage, the quantity of urine is very variable; sometimes very scanty, or even suppressed, so that the patient dies comatose, from the urine retained in the blood; sometimes extremely abundant; and sometimes before death the albumen entirely vanishes.

*Consequences.*—This fatty disease of the kidney, besides dropsy, and fatal coma, is apt to induce acute inflammation of the serous membranes, disease of the heart, and obstinate indigestion.

*Causes.*—It may be caused by intemperance, privation of air and light, and neglect of proper exercise; frequent exposure to cold, and the other causes of scrofula and phthisis.

*Treatment.*—If the disease assumes an *acute* character, with pain in the loins, fever, and evidence of renal congestion, cupping should be performed on the loins. But in most cases the treatment should be so conducted as to keep the emunctories open, and reduce the strength as little as possible. The skin should be kept open by baths; the bowels by saline purgatives; and in the intervals of purgation, the kidneys should be solicited by the milder kinds of saline diuretics, such as tartarized soda. When there is an absence of fever the tartarized iron can sometimes be borne. Lastly, the diet should be plain and as nourishing as the stomach will digest, and fatty matters should be excluded from it as much as possible.

#### HYDROTHORAX (*Dropsy of the Pleural Cavities*).

It was formerly the common opinion, and is even now believed by many, that *idiopathic* hydrothorax is a very common disease, producing a formidable array of symptoms, and often causing death by suffocation. In these late years, the erroneousness of this opinion has been shown, on the one hand, by the study of pathological anatomy, which has discovered, in the supposed cases of simple hydrothorax, extensive organic disease, without any effusion; and, on the other hand, by auscultation and percussion, which have not only proved the same during life, but have likewise taught us that

hydrothorax, when it does exist, can have but a very small share in producing the symptoms that have hitherto been ascribed to it.

*Symptoms.*—The patient feels an oppression and difficulty of breathing, and generally lies on the affected side, leaving the healthy one unencumbered in its functions. When the fluid is in both cavities, the respiration is still more difficult and short; the patient sits up in bed, and calls in the aid of all the muscles of inspiration; and his countenance assumes a cast of anxiety. Corvisart describes the chest as being more distended and rounded on the side which contains the fluid; and as the collection increases, the intercostal spaces are widened, the integuments of this side becoming œdematous, and, in a few instances, the arm on the same side. In the acute states of this disease, a feeling of soreness, tenderness, or pain, is often complained of in or over the seat of effusion. *Symptomatic* hydrothorax will combine with the common signs of pleuritic effusion those of whatever organic disease it is the consequence; and this will generally be found to be some lesion of the circulatory apparatus, by which its function is extensively impeded. Laennec states that it scarcely ever supervenes earlier than a few days before the fatal termination of such diseases, and may therefore be considered the immediate harbinger of death, the agony of which it increases by dyspnœa.

*Physical signs.*—On *percussion*, a dull sound is emitted, resembling that produced by striking the thigh, on the side containing the fluid, or on both sides when the effusion has taken place into both. When the patient sits, or stands up, and the fluid only partially fills the cavities, the lower part of the thorax only will give out a dead sound. This sound generally changes its place with the change of position, owing to the gravitation of the fluid to the depending part. This, as M. Piorry contends, is an important diagnostic between the dead sound of effusion and that produced by hepatization of the substance of the lung, which always retains the same situation. Upon *auscultation*, the respiratory murmur is found to have ceased in the region corresponding to the fluid collection; and in its place is heard the *bronchial* respiration. When the effusion is not very great, *ægophony* is occasionally heard.\* If the fluid be accumulated only in one cavity, *mensuration* of the thorax then becomes a useful mode of diagnosis; but the increased fulness of one side, and widening of the intercostal spaces, may be recognised at sight.

*Treatment.*—The plan of treatment must depend upon the cause of the effusion, which may be, an organic lesion of the heart or lungs, or inflammation of the pleura; and these are to be managed on the general principles laid down when treating of those affections. *Cathartics* and *purgatives*, especially the hydragogues, often afford speedy relief; but they are admissible only when the powers of life are not greatly reduced, and in the more acute cases, not caused by

inflammation of the pleura. *Diuretics* are more certainly beneficial in this dropsy than in any other; and of this class *digitalis* is the most efficacious, particularly in the form of infusion. All authors agree in admitting the power of *digitalis* in this affection. Where there is much prostration of vital energy, we should combine *tonics*, and *antispasmodics*, with the diuretic medicines. *Paracentesis thoracis*, once so strenuously advised, is seldom or never resorted to, excepting in empyema. The chief danger in this operation proceeds from the introduction and action of the air; but not so much from its preventing dilatation of the lungs as from its action on the diseased pleura and the fluid effused from it, which becomes putrid and poisonous.

#### ASCITES (*Dropsy of the Abdomen*).

Ascites, or dropsical effusion within the abdomen, may exist either alone or complicated with hydrothorax and general anasarca.

*Causes.*—The great extent of the peritoneum, the number and importance of the viscera with which it is connected, and of the absorbent glands it encloses, the numerous sources of disorder to which these organs are exposed, the great number and weakness of the veins which transmit their blood to the portal vessels, and the absence of valves from them, in some measure account for the frequent accumulation of fluid in this cavity. Ascites may arise at any age. Camper, Lee, and others, have observed it in new-born infants; but it is most common in women and aged persons. It occurs more frequently in married than in unmarried females; and is often the consequence of the distention and pressure attending pregnancy, of difficult or instrumental labours, and of suppression of the puerperal secretions, or of the perspiration, of catamenia, or of the disappearance of this last evacuation.

*Pre-existent disease*, particularly diarrhœa or dysentery, and sudden interruptions of these discharges; intestinal worms; organic lesions of the liver and spleen, especially obstructions of their venous circulation; inflammation of the vena portæ, and obliteration of one or more of its principal branches; the suppression of chronic eruptions, or of the exanthemata,—as scarlet fever, erysipelas, &c.; acute or sub-acute peritonitis; organic change of the structure of the kidneys; the rupture of cysts into the abdomen; uterine or ovarian disease; intermittent or remittent fevers; excessive evacuations and hemorrhages; are all occasionally productive of ascites.

*Symptoms.*—Idiopathic ascites generally assumes an *acute*, or even *inflammatory* form. It usually occurs either in the young, the robust, or well fed, and presents all the symptoms of the phlogistic diathesis; the pulse is hard, thirst increased, the urine scanty; the skin is warm, hot, or coloured, and resists more or less the pressure of the finger. There are evidences of inflammatory or excited action

of the peritoneum, with pain, tenderness, and sometimes tension of the abdomen; a quick, small, hard or wiry pulse, and suppression or diminution of all the secretions or excretions. Either consecutively on, or concomitantly with, these symptoms, fulness of the abdomen is observed, which usually augments rapidly. At first, the increase is most remarkable in the lower part of the abdomen and iliac regions when the patient is sitting up, and the liver is not enlarged; but it is always diffused when the patient is in the supine posture, and without any limitation or tumour. Upon examining the abdomen, a dull sound is emitted by percussion, and fluctuation is easily perceived. As the effusion augments, all the abdominal functions are more and more disturbed, and at last respiration becomes difficult from the pressure of the fluid impeding the descent of the diaphragm, and the patient is unable to lie down. The abdomen is now large and prominent in its upper regions, and pushes, particularly in young subjects, the ribs and cartilages upwards. Irritability of the stomach, anxiety, restlessness, want of sleep, great quickness of pulse, sometimes delirium, and ultimately coma and death, supervene, if temporary or more prolonged relief be not obtained from treatment.

Ascites may be mistaken for tympanitis, ovarian dropsy, and for pregnancy. *Tympanitis* is readily recognised by the clear resonance furnished on percussion, by the absence of fluctuation, and of the œdema of the lower extremities, and by the history of the case. *Ovarian dropsy* is never general or uniform in its earlier stages, like ascites; and fluctuation is usually very obscure, and to be detected only in the situation of the tumours, the circumscribed form of which may be determined until a very advanced period of the disease. *Pregnancy* is distinguished from ascites by the state of the *os uteri* upon examination, by the progress of the enlargement, and the defined form of the uterus when the patient is supine, and the abdominal muscles relaxed; by her unbroken health and clear complexion,—the countenance of dropsical persons being pale, sickly, and cachectic; by the enlargement and firmness of the breasts, and the deep colour of the areolæ,—these organs being soft and flabby in ascites.

Let the patient lie on his or her back, and percuss the abdominal parietes. In ascites, they generally yield a dull sound towards the back, where the fluid settles, and clear in front, because the bowels float upwards through the serum. It is the reverse in pregnancy and ovarian dropsy.

*Treatment.*—This must depend, as in other dropsies, upon the organ affected, and upon the extent and nature of the disease. The *acute* forms require vascular depletions, general or local, or both, to an extent which the pulse and symptoms indicate. Mercurials and antimonials, at first so as to act on the bowels, and subsequently as

alteratives, or with opium, and pushed so far as to affect the mouth; external irritants and derivatives; deobstruent diuretics; diaphoretics, and warm or vapour baths, followed by oleaginous frictions of the skin, in order to restore its perspiratory functions; and lastly, gentle tonics conjoined with purgatives, or with diuretics, and assisted by warm iodine or medicated baths, will frequently succeed in removing disorder, if early employed, and if a vital organ have not experienced serious structural change. The *symptomatic* forms of ascites must be treated with strict reference to the original lesion or malady, as far as that can be ascertained. *Graduated compression* of the abdomen, by means of the belt recommended for ascites by the first Munro, has been employed successfully by Professor Speranza and M. Godelle, and, when it can be borne, may prove serviceable in some asthenic and chronic states of the disease. With respect to *paracentesis abdominis*, it should be avoided as long as possible, and, although it should not be proscribed from practice, the cases are few that will be benefited, and still fewer that will be cured by it.

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## DISEASES OF THE DIGESTIVE ORGANS AND THEIR APPENDAGES.

### CYNANCHE TONSILLARIS.

*Causes.*—The most frequent cause of common inflammation of the tonsils is, exposure to cold damp air,—hence it prevails with inflammation of the pharynx, at certain seasons of the year.

*Symptoms.*—This disease is easily detected by the tumefaction, pain, and redness of one or both tonsils, which are covered with white spots, or an inflammatory crust. There are, moreover, pain on deglutition, dryness and heat in the fauces, frequent desire to swallow the saliva, and, when the inflammation is general and severe, the respiration becomes extremely impeded by the mechanical obstacle, and the symptomatic fever runs high.

*Treatment.*—This is simple, but should be actively employed in severe cases. Bleeding or leeches, purgatives, calomel, cooling gargles of nitre, muriatic acid, &c., poultices to the throat, followed by stimulating liniments or blisters, and the inhalation of steam, will soon reduce the inflammatory tumefaction and give relief. The nitrate of silver, or sulphate of copper, is also often of great use. If, however, symptoms of suffocation be imminent, from considerable swelling of both tonsils, the surgeon must immediately scarify the glands.

After the disease has been subdued, it sometimes happens that the

tonsil remains indurated, and very susceptible of becoming inflamed on exposure to cold, &c. In such cases, extirpation of the gland may become necessary, and has been practised with success.

#### INFLAMMATION OF THE PHARYNX.

This affection, which constitutes what is commonly called sore throat, may be easily detected by an inspection of the pharynx, which presents an uniform dark red colour, and is frequently spotted with whitish patches. The general symptoms resemble much those of tonsilitis, but there is seldom any marked degree of fever, and no difficulty of respiration. The leading signs are, redness at the back of the fauces, pain, and difficult deglutition, and a copious secretion of mucus from the part.

*Treatment.*—General bloodletting will seldom be required. If the pain be very severe, leeches may be applied externally to the neck, and the bowels should be freely opened by active purgatives. At the commencement, the inhalation of steam affords most relief; and as the inflammation subsides, recourse may be had to astringent or stimulating gargles, nitrate of silver, and the internal use of ice.

#### GASTRITIS (*Inflammation of the Stomach*).

Inflammation of the mucous membrane of the stomach may be either chronic or acute. The latter, however, is very rare.

*Causes.*—The chief causes of acute gastritis are, external violence; acrid poisons; (the most frequent cause;) and cold drinks taken whilst the body is heated.

*Symptoms.*—Heat, and acute pain, increased on pressure over the stomach, or by coughing, or deep inspiration; instant vomiting of the matters ingested; constipation and prostration of strength. The pulse is usually quick, small, and irregular; the tongue clean, and red at the point or edges. The skin is hot and dry; there is thirst, and a desire for cold drinks. This disease is attended with great depression of the heart's action through the influence of the *solar plexus* of the great sympathetic. As it advances, the face becomes collapsed, the extremities cold, and the patient lies in a state of complete prostration; cerebral symptoms now supervene, the abdomen becomes tympanitic, and death soon closes the scene.

The anatomical characters of acute gastritis are those of inflammation in general, but they may vary according to the exciting cause. Thus certain mineral poisons may give rise to peculiar states of the mucous membrane. In some cases, the inflammatory injection and thickening are confined to particular spots; sometimes they follow the course of the principal blood-vessels, and on other occasions the whole mucous membrane presents a uniform vivid or dark red colour.

*Treatment.*—The first indication of treatment in this, as in all other affections, is the removal of the exciting cause. Should the presence of any poison be suspected, the proper antidotes are to be

at once administered, or vomiting excited; circumstances alone can determine an election. Blood must be freely drawn from the arm in severe cases, and the venesection repeated according to circumstances; leeches, also, may be applied over the epigastric region. The pulse will often be found to rise in force and fulness after bleeding. Warm fomentations, containing an anodyne, will be found useful in allaying the pain, but some prefer the immediate application of a large blister over the region of the stomach, and of sinapisms to the feet. The thirst may be allayed by the frequent administration of cold water in small quantities, but it will be advisable to abstain from giving medicines by the mouth as long as acute inflammation exists. If any be given they should be of the least irritating nature. It is more prudent to administer laxatives by the rectum, to trust to general bleeding and strict regimen, with revulsives or counter-irritants; small doses of calomel and opium might in some instances be advisable.

#### CHRONIC GASTRITIS.

This is an occasional cause of the severer forms of dyspepsia, and is often attended with one or more *ulcers* in the stomach.

The *symptoms* of chronic gastritis are extremely various, both in number and intensity. The following, however, are usually present in well-marked cases:—Pain and uneasiness about the region of the stomach, particularly increased after meals; sense of constriction in the œsophagus, near the lower part of the neck; imperfect digestion, accompanied by eructation, nausea, and occasional vomiting of food, or of mucus streaked with blood; skin dry, but not warm; pulse nearly natural, but sometimes accelerated; tongue covered with a whitish fur, or red at the tip and edges, or dotted with red spots from development and injection of the papillæ. The patient often exhibits symptoms of hypochondriasis, and the spirits become low as the disease advances.

*Treatment.*—The principal indications are fulfilled by the application of leeches to the region of the stomach, followed up by external irritation and a careful regulation of the bowels. Strict attention should also be paid to the diet. The patient should eat nothing but very light food, at regular intervals, and the general health should be improved by gentle exercise in the open air. In some cases, the stomach is so irritable that no food of any kind can be borne. Asses' milk, given by spoonfuls at a time, may be tried, and very small doses of prussic acid; but if all these measures fail, it will be advisable to abstain from administering food by the mouth, and to support the patient by nutritious enemata. After the subsidence of all symptoms, the tone of the digestive organs may be improved by mild tonics, but the best strengtheners will be found to consist in moderate exercise and a strict attention to diet.

## DYSPEPSIA.

Dyspepsia signifies any derangement of the functions of the stomach. It may be temporary and depend on mere functional derangement, or may be a consequence of the most serious organic disease.

*Causes.*—The causes of dyspepsia are extremely various, as the function of digestion may be disturbed under a great number of different circumstances; those which are now enumerated chiefly refer to simple indigestion. They are, irregularities of diet, the use of debilitating substances, indulgence in spirituous liquors, mental emotions, suppression of accustomed discharges, &c.

The *symptoms* of dyspepsia are also extremely various, for the process of digestion is a complicated one, and its derangement acts differently on different individuals. The following are the most prominent characteristics of the disease, which differ according as the attack is acute or chronic.

Acute dyspepsia generally arises from the ingestion of irritating food, or indeed of any alimentary substances in too great quantity. Errors of diet thus committed are sometimes followed by a sense of distention and uneasiness at the pit of the stomach, which is very sensitive to pressure; fœtid eructations, nausea, and occasional vomiting; colicky pain of the abdomen; diarrhœa. The tongue is foul and loaded, the patient suffers from a "sick headache," and a variety of secondary symptoms present themselves. The *treatment* of this form, which often occurs in healthy individuals, is extremely simple. If we have reason to believe that the offending matters have passed into the intestinal canal, the administration of one or two drops of croton oil will effect their ejection in the most speedy and efficacious manner. Any other brisk purgative, will, however, act equally well, though more slowly. A purgative enema may also be given with good effects. Where the stomach is evidently the seat of disorder, an emetic should precede the use of purgatives.

The following are the more common symptoms of chronic dyspepsia and the most appropriate remedies for them:—

*Simple want of appetite;* often relieved by acids and bitters.

*Voracious or unnatural appetite.*—Rhubarb and magnesia, bismuth, and chalk mixture.

*Acidity,* and eructations of acrid matter, causing *heartburn.*—Small doses of soda and ammonia, after meals, in aromatic water.

*Flatulence* before meals, with loss of appetite.—Small doses of ferri sulph., with pil. rhei c., before meals.

*Flatulence* after eating.—Sal volatile.

*Pain when stomach is empty.*—Magnesia and bismuth, with a biscuit or crust of bread.

*Pain after eating.*—Soda and ammonia; or bismuth and opium taken a little before eating.



*Vomiting*—vide *chronic gastritis*.

*Waterbrash*, or *pyrosis*; eructation of clear liquid.—Good plain meat diet, bismuth, kino, oil of amber, and tonics.

*Gastrodynia*, severe spasmodic pain.—Bismuth, and magnesia, or nitrate of silver, or hydrocyanic acid.

*Constipation*.—A compound rhubarb pill before dinner, or dec. al. c. in the morning, or any other mild aperient taken habitually.

The greatest attention should be paid to the diet and regimen; the patient should take gentle exercise, and the mind should be diverted by such occupations as combine amusement with moderate muscular exertion. Palpitation of the heart in dyspeptic patients is often a troublesome symptom. It may be palliated by the combination of sedatives with tonics, as the sulphate of iron with extract of hop, the nitrate of silver with henbane, or prussic acid. Dr. Johnson speaks highly of the nitrate of silver in cases of dyspeptic palpitation. A disordered state of the *liver* also frequently accompanies dyspepsia. Should this organ appear to be congested, some blood may be drawn by cupping glasses over the right hypochondrium, and small doses of blue pill, with saline aperients, administered three times a week. Finally, as auxiliaries, the change of air and scene, and the use of mineral waters, should not be neglected in protracted cases of dyspepsia.

#### DYSENTERY.

Dysentery is an inflammation of the colon, with much pain and spasm. It most commonly prevails in warm climates, when men are collected together in large numbers. It may, however, occur sporadically in the acute or chronic form.

*Causes*.—The chief causes of acute dysentery are, exposure to cold damp air, acrid indigestible food, spirituous liquors, and exposure to unwholesome exhalations. It prevails most in autumn, and is held by some writers to be contagious.

*Symptoms*.—General febrile excitement, nausea, vomiting, griping pains about the umbilical region, frequent, painful, straining, ineffectual efforts to pass stools; heat of skin, frequent pulse, thirst, heat and pain about the anus, anxiety, and prostration of strength. The dejected matters are various: in the commencement the stools are often bilious; but the evacuation of fæces soon ceases, and nothing is passed but small quantities of bloody mucus, intermingled with pus or shreds of albuminous matter.

If the disease be not checked, the abdominal pain becomes more fixed, the pulse is feeble and extremely quick, the strength fails, the dejections assume a very fœtid character, delirium supervenes; and the patient sinks at a period varying from fifteen to thirty days. The disease may terminate unfavourably by ulceration, gangrene, or the extension of the inflammatory action to the peritoneum.

*Morbid appearances*.—Dysentery consists essentially in an in-

flammation of the mucous and sub-mucous coats of the large intestine. Hence traces and effects of inflammatory action in various degrees are found in the rectum and colon. The mucous coat is more or less injected in several points, and certain portions of the cæcum and colon are either ulcerated or entirely disorganized, the membranes hanging by shreds into the interior of the bowel. The ulcers are sometimes small and numerous; at other times they are elevated, hardened, and covered with sloughy or fungous granulations. Some parts of the great intestine may be in a state of sphacelus; and more or less coagulable lymph, mixed with shreds of disorganized cellular tissue, adheres to different points of its surface.

*Treatment.*—The treatment of acute dysentery must be regulated by the form in which the disease presents itself; but as in this country the sthenic form usually prevails, the following remarks are applicable to it only. The chief remedial means then, in the beginning of the disease, are, local or general bleeding, with fomentations to the hypogastrium;—calomel and Dover's powder at night, and castor oil with laudanum in the morning; and starch enemata, so as to clear out all irritating fæcal matters, and soothe the bowels. Some physicians, however, place more reliance on calomel and opium, and very extraordinary doses of the former medicine have been administered with the best effects, especially in warm climates. When the inflammatory symptoms have been completely subdued, and there are no longer any tenesmus and tormina, if the patient remain feeble, gentle tonics, such as infusions of cinchona or columba, with rhubarb, may be administered. The state of the bowels should be carefully regulated during convalescence.

#### CHRONIC DYSENTERY.

Chronic dysentery may either succeed the acute form or it may commence with diarrhœa, and gradually assume the character of dysentery. The symptoms are the same as those of the acute form, merely differing in intensity. The alvine discharges are more copious, but less frequent; they contain less blood, and less fibrinous matter. There is not much abdominal pain; the pulse is commonly natural during the day, and symptoms of general excitement only occur on aggravation of the local disease.

*Treatment.*—As long as there is any reason to believe that sub-acute inflammation exists in the intestinal canal, local depletion, aided by counter-irritants and diaphoretics, must be cautiously employed; but the disease often persists after the subsidence of all inflammatory symptoms. In such cases, a great variety of remedies has been recommended. Some place their chief reliance on small and frequently repeated doses of ipecacuanha; others advise the administration of astringents, such as the infusion of catechu, the sulphates of zinc or copper, and the superacetate of lead. The last is frequently employed in combination with opium and ipecacuanha.

Tonics may also be given with advantage in the chronic stage, particularly when the disease assumes an asthenic form. Those generally administered are, cinchona and the infusion of serpentaria, colomba, or simaruba barks. Great attention should at the same time be paid to the condition of the liver; the bowels must be kept regular, and all errors of diet or exposure to damp, cold, &c., carefully avoided.

## DIARRHŒA.

Diarrhœa consists in the copious and frequent discharge of alvine evacuations, which are generally fluid, without tenesmus or fever.

The *symptoms* are, frequent discharge of mucus or slimy stools, containing feculent or ill-digested matters, with griping pains, nausea, and foul tongue. The state of the skin is generally natural.

*Causes and Treatment.*—The causes of diarrhœa are very various, and so must be the treatment adapted for various cases.

1st. *Inflammatory diarrhœa.* This arises from irritation, inflammation, or ulceration of the intestines, and is a frequent attendant of fever, phthisis, &c. It is characterized by pain, tenderness, thirst, and slimy evacuations; and is to be relieved by small doses of hyd. c. creta, and pulv. ipec. c.; injections of starch and laudanum; rubefacients or fomentations to the abdomen; chalk mixture, &c.

2d. Diarrhœa from *unwholesome food*, or *irritating substances*, or foul accumulations in the intestines. This is a very common form, being often produced by unripe fruit, and it is in fact what is caused by a common dose of physic. This form of diarrhœa tends to work its own cure, which is best accelerated by a dose of rhubarb and magnesia or castor oil, followed by chalk mixture.

3d. *Diarrhœa from debility and relaxation.*—This form is apt to follow any of the others, and is to be recognised by the kind of constitution to which it happens, and by the freedom from active symptoms. The various vegetable and mineral astringents with opium are the remedies.

4th. Diarrhœa in *young children* often arises from the irritation of weaning, or from an unnatural quality of the milk, or from attempts to bring up children by hand. A very small dose of hydr. c. creta with rhubarb, followed by chalk mixture with five or ten minims of paregoric, are the remedies. Baked flour or biscuit powder may be tried as food.

In all cases of diarrhœa it is important to attend to the skin, and to keep it warm.

## CHOLERA MORBUS.

*Causes.*—Costiveness; exposure to change of temperature; indigestible food; putrid miasmata; certain seasons.

*Symptoms.*—Violent griping pain, followed by frequent vomiting, and purging of greenish bilious matter; spasms of the abdominal

muscles, sometimes extending to the legs and arms; tongue dry; urine high coloured, scanty, or suppressed; thirst urgent; pulse frequent, but soon becomes small and weak. As the disease continues, the spasms become more severe, the countenance anxious and collapsed; the strength is much reduced, and fainting occurs.

As cholera morbus depends on simple irritation of the mucous lining of the alimentary canal, the morbid appearances after death are not very remarkable, consisting in some injection or congestion of the vessels.

*Treatment.*—To allay the spasm and irritable state of the digestive canal, calomel and opium should be administered in a full dose, and then repeated injections of gruel or starch in large quantities, to bring away the irritating matters;—and opiates. Warm fomentations may be applied over the abdomen, or the turpentine or ammoniated liniments. When the surface of the body becomes extensively cold, and symptoms of exhaustion appear, it will be necessary to administer stimulants, as camphor, ammonia, small quantities of brandy, &c., combined with aromatics. When the more urgent symptoms have been relieved, the discharge of the different abdominal secretions should be promoted by gentle laxatives, by enemata, &c.; and light nourishment may be permitted during the convalescence.

#### CHOLERA INFANTUM.

(*Summer Complaint of Infants.*)

This disease seems to be peculiar to the United States. It prevails most extensively in large cities, during the hot months; and is one of the most fatal affections to which childhood is subject.

It *occurs* in children from four to twenty months of age, or during the period of dentition; the *second summer* of children is considered the period at which they are most liable to the disease.

It *commences* with a profuse diarrhœa, the stools being light-coloured and thin; this is succeeded by great irritability of the stomach, so that by constant vomiting and purging the child becomes languid and prostrate, often in a few hours.

The pulse is quick, small, and often tense; the tongue is white and slimy; the skin is dry and harsh; the head and abdomen are hot, whilst the extremities are natural in temperature, or even cold. Towards evening there is fever, restlessness, and pain. Occasionally delirium occurs, manifested by violent tossing of the head, attempts to bite, the eyes becoming wild and injected. Death may result in six hours; but generally the case is more protracted. The emaciation becomes extreme, the eyes languid and hollow, the countenance pale and shrunken, the nose sharp and pointed, the lips thin, dry, and shrivelled; the skin upon the forehead tight and

shining. The child lies in an imperfect doze, with half closed eyelids, insensible to external impressions.

The surface of the body is now cool and clammy, of a dingy hue, and often covered with petechiæ; the tongue is dark, and the fauces dry. The abdomen becomes tympanitic; the discharges from the bowels are dark coloured, profuse, and offensive, resembling the washings of stale meat; in other instances they may be small, and consist of mucus, and undigested food.

According to Dr. Condie, "the disease is evidently dependent for its production upon the action of a heated, confined, and impure atmosphere, directly upon the skin, and indirectly upon the digestive mucous surface, at an age, when the latter is already strongly predisposed to disease, from the effects of dentition, and from the increased development and activity of the muciparous follicles, which takes place at that period.

*Treatment.*—The most important point in the treatment is to remove the child from a heated and impure atmosphere. A nursing child should be confined exclusively to the breast; if weaned, to tapioca, arrow-root, or ground rice, and cool mucilaginous drinks. A tepid bath should be employed night and morning; the clothing should be light and dry, and the chamber well ventilated.

The gums should be examined, and if swollen and hot, they should be freely lanced.

Small doses of calomel, acetate of lead, and prepared chalk, will be found most serviceable in arresting the diarrhœa. The irritability of the stomach may be overcome by small doses of calomel, or a few drops of spirits of turpentine; a blister applied over the stomach will also be decidedly advantageous.

When there is much heat about the head, with injected conjunctiva and delirium, leeches should be applied to the temples, and cold lotions to the scalp. Stimulating pediluvia, and blisters placed behind the ears, will also be found extremely beneficial.

After the irritability of the stomach is sufficiently quieted, the addition of a small quantity of ipecacuanha to the calomel, chalk, and acetate of lead, will most certainly, according to Dr. Condie, promptly restrain the disordered action of the bowels, and complete the cure.

#### ASIATIC CHOLERA.

This disease is endemic in India, but sometimes extends to other parts of the globe. It is, no doubt, propagated by atmospheric influence.

*Symptoms.*—There is generally a *premonitory diarrhœa*, with occasional nausea, slight cramps, and heaviness about the head. In other cases, it commences suddenly with violent vomiting and purging (not of bile as in common cholera) but of a rice-coloured

fluid, with excessive and painful spasms of the abdominal and other muscles; the pulse is quick, small, and soon disappears altogether; the skin is cold; the features collapsed; the urine altogether suppressed. As the vomiting and purging continue, the powers of life quickly fail; the extremities become deadly cold, and of a bluish colour; the pulse ceases to be felt at the wrist; the breathing is laborious; and the patient, who gets very restless, is generally carried off within ten or twelve hours.

*Morbid appearances.*—The blue colour of the extremities, which are rigid, remains after death. The fingers are flexed and shrunk, and the nails blue. The arterial system is empty; the venous, and particularly the right side of the heart, contains a quantity of dark, grumous, and uncoagulable blood; the latter fluid is deficient in salts and serum. When death has taken place rapidly, the intestinal canal is often pale throughout; most frequently it presents an injected appearance, either in spots or along continuous surfaces, from congestion of the veins, or effusion of bloody serum underneath the mucous coat; there are no ulcerations or other signs of inflammation. The abdominal viscera are gorged with dark venous blood, and the urinary bladder is empty, and contracted into a hard ball.

*Treatment.*—A successful mode of treating Asiatic cholera still remains to be discovered. Many of the Eastern physicians strongly recommend bloodletting in the commencement of the disease, to be followed up by calomel and opium. Others reject venesection, and endeavour to allay the the most prominent symptoms—viz., the irritability of the alimentary canal and the spasms, at the same time such means as are best calculated to restore the circulation to the surfaces of the body. This, perhaps, is the most rational mode of treatment that can be adopted; but, unfortunately, medical men are not agreed upon the means. Some prescribe nothing but ice-cold water, as long as the vomiting continues; others vaunt small and frequent doses of calomel, or calomel and opium; others advise the administration of emetics; and others again prefer stimulants, as cajeput oil, brandy, &c. In order to determine the blood to the surface, and allay spasm, the extremities should be assiduously rubbed with warm anodyne embrocations; or when the vapour or hot air bath can be obtained, these may be employed with advantage. Dr. Stevens speaks highly of the saline treatment, which consists in the administration of the salts of soda and potash in any appropriate vehicle. In extreme cases, these salts have been injected into the veins with apparent advantage in a few instances. When the symptoms have subsided, and the patient survives, a stage of reaction often succeeds, and is attended with symptoms of a typhoid character. The treatment should then be directed by the principles which have been laid down under the head of typhus fever.

## COLIC.

This disease is characterized by severe griping pains in the bowels, with costiveness, (sometimes with diarrhœa,) and frequently with vomiting. Colic may be produced by a variety of causes, the most common amongst which are, irritating ingesta, flatulency, or a morbid sensibility of the mucous membrane.

*Symptoms.*—Severe twisting or griping pain in the abdomen, particularly in the umbilical region or along the course of the colon; the pain is not increased by pressure, nor is there any fever,—circumstances which distinguish the disease from peritonitis and enteritis; it comes on in fits, and in the intervals there is perfect ease; it usually comes on quite suddenly; the muscles of the abdomen are often retracted; the patient also complains of borborygmi, or rumbling noises from flatus in the canal.

*Treatment.*—The first care of the practitioner should be to determine, if possible, the exciting cause of the colic, and whether it be occasioned by an organic disease, such as hernia, intus-susceptio, tumours, &c. This done, and the complaint having been ascertained to be simple colic, he may at once administer anodynes combined with cordials, and proceed to evacuate the intestinal secretions by the use of enemata and mild purgatives. For this latter purpose, the blue-pill will be sufficient, or castor oil with laudanum, or the tincture of hyoscyamus may be given, either by the mouth or in enema. The abdomen should also be fomented with the decoction of poppy-heads.

## COLICA PICTONUM.

*(Painter's Colic.)*

*Cause.*—Exposure to the poison of lead. M. Andral considers lead colic as a neurosis, in which the spinal marrow and abdominal plexuses of the great sympathetic appear to be the peculiar seat of lesion. The constipation seems to depend either on the abolition of the contractile motion of the intestines, or on the suspension of the secretion of the intestinal mucus.

*Symptoms.*—Violent pain at the umbilical region; sickness and obstinate constipation; pains in the wrists, ancles, and neck; headache; bitter eructations; and occasionally paralysis of some of the voluntary muscles.

*Treatment.*—The best mode of treatment consists in the free administration of purgatives with opiates, such as calomel and opium, followed by castor oil and laudanum; croton oil will sometimes be required to overcome the constipation. A warm bath should be given, with injections of a large quantity of warm water into the bowels while the patient is in the bath.

Dilute sulphuric acid, which may be mixed with beer or made into a kind of lemonade, and extreme cleanliness, are the best preservatives from the poison of lead.

Paralysis of the limbs sometimes accompanies lead colic, and remains after the removal of that disease. Here great attention must be paid to the bowels, and on the least indication of costiveness the purgative salts should be administered. The diet should be generous; friction along the limbs with stimulating liniments should be practised, and the extract of nux vomica or strychnine administered internally. Great good is produced by supporting the paralytic limb in splints.

#### ILEUS.

This complaint consists of very severe colic with obstruction of the bowels, and generally ends in inflammation.

*Symptoms.*—Violent griping and twisting pains about the umbilicus, which is retracted; obstinate constipation; nausea, and vomiting of stercoraceous matter; tension and tenderness of the abdomen. The pulse is at first natural and the skin cool, but febrile symptoms soon set in, and are followed by hiccup, prostration, cold sweats, sinking, and death.

*Morbid appearances.*—Mechanical obstruction in some part of the intestinal canal produced by knots of the bowels; intussusception; adhesions; bonds of false membrane; strangulation of the gut; organic constriction of its calibre; foreign bodies, such as fruit stones, &c. The parts of the intestine above the obstructed point are generally dilated and inflamed, and in many cases the inflammation has extended to the peritoneum, producing its usual results.

Invagination of the intestine most frequently occurs in children, and, in addition to the symptoms already enumerated, may sometimes be recognised by the presence of a painful tumour over the invaginated portion of gut.

*Treatment.*—The medical treatment of ileus will seldom be of any avail, as may be readily inferred from a consideration of the pathological conditions with which it is connected. The forcible inflation of air per anum has been recommended. Copious enemata frequently repeated, and mild purgatives given in moderate doses, regularly repeated, may be tried first. If they do not succeed, stronger purgatives may be tried, such as croton oil, or a combination of aloes with sulphuric acid. But if the purgatives add to the sickness and pain, they should be suspended. Crude mercury in large quantities has been given by the mouth, and in some instances with relief. If inflammatory symptoms arise, they should be combated by bleeding or leeches, and the warm bath. The operation of gastrotomy has been frequently performed for the cure of ileus, and there are two or three cases of success on record. The great



objection, however, to its performance is, the obscurity and uncertainty of the symptoms. When the case seems hopeless, the patient's sufferings should be soothed with opiates, and his strength kept up by nourishing enemata.

#### PERITONITIS.

*Causes.*—Inflammation may exist at any point of the peritoneal sac, but the term peritonitis more properly belongs to inflammation of that portion which does not invest any of the viscera. The *causes* of peritonitis are the same as those of inflammation in general; besides which are, external violence, metastasis, disease of the mesenteric glands, obstruction of the bowels, the irritation produced by disease of neighbouring viscera, and the effusion either of the contents of the alimentary canal or of the urinary bladder, &c.

*Symptoms.*—Acute pain, commencing at a particular part of the abdomen, and gradually extending over the rest of the surface; heat of skin; frequency and smallness of the pulse; in many cases, nausea and vomiting; constipation; anxious countenance; tongue dry, but not foul; respiration accelerated and costal; urine scanty. The patient lies on his back, with the thighs flexed, and cannot bear the slightest pressure on the abdomen, which becomes tumid or tympanitic. In addition to these general symptoms, others will present themselves, according to the vicinity of the part inflamed to any of the principal abdominal viscera. Peritonitis from intestinal perforation is characterized by the suddenness and the rapid progress of the symptoms, and the great accompanying prostration.

*Morbid appearances.*—Injection, by patches, of the sub-serous tunic; effusion of lymph, or a sero-purulent fluid, into the cavity of the abdomen; adhesions, by means of soft, whitish false membranes, between the folds of the intestines.

*Treatment.*—Bloodletting, to be repeated according to the patient's strength, &c.; leeches over the painful parts, and warm fomentations, are the chief means on which reliance is to be placed at the onset of the disease; small doses of calomel may also be given, until the mouth becomes sore; and the bowels must be kept open with gentle laxatives or enemata. If the tympanitis be troublesome, enemata containing turpentine or assafœtida may be administered for the sake of obtaining temporary relief. In peritonitis from perforation of the intestinal canal, the only hope of saving the patient lies in the instant administration of opium in doses sufficient to arrest the peristaltic motion of the bowels. This gives us some time for the employment of other means, with a faint chance of success.

#### ENTERITIS.

This term signifies inflammation of the serous and muscular tunics of some portion of the intestines; the point most frequently attacked being the termination of the ileum.

*Symptoms.*—*Pain* in the abdomen, generally worst at some particular spot, whence it radiates. It is of a severe burning character, unlike colic. It is aggravated by pressure. The patient lies on his back, with the knees drawn up, so as to relax the abdominal parietes, and breathes with the thorax. Coughing and deep breathing are painful. The pulse is small and wiry, there is often vomiting, obstinate constipation, and much distress of countenance.

If the case assumes an unfavourable character, death ensues from failure of the heart's action. The pulse becomes very rapid and feeble; the features sunk; and there is great restlessness or hiccup. But perhaps the patient loses all pain, so that he and his friends flatter themselves with hopes of amendment, when death is at the very threshold.

*Causes.*—Wounds or other injuries; hernia and ileus; or cold and wet, when the bowels are loaded or in an otherwise unhealthy state.

*Treatment* nearly the same as of peritonitis. Bleeding according to the state of strength (and the pulse often rises under it); leeches to the abdomen; opium after bleeding; and regular doses of calomel and opium to affect the mouth; warm fomentations and poultices to the abdomen, are the chief measures.

But the bowels are obstinately costive, and what is to be done for that? Why, "the costiveness arises from their being inflamed and unable to propel their contents; and the proper remedies for it are such as will relieve the inflammation."—(Druitt's Surgery, p. 417.) Purgatives given during the acute stage only add to the sickness. But when the pain and tenderness are relieved, castor oil, or small doses of colocynth and henbane may be tried; and throughout the disease, the bowels may be solicited by enemata. Blisters will be of service in the later stages.

If there is any great tendency to faintness or collapse after bleeding, wine must be administered.

#### CHRONIC PERITONITIS, AND TABES MESENTERICA.

Chronic peritonitis is sometimes a sequel of the acute disease, sometimes, on the contrary, it begins in a very obscure and insidious manner, and is attended in scrofulous subjects by a deposit of granules or tubercles external to the membrane.

*Symptoms.*—Slight occasional abdominal pains, often scarcely noticeable, increased by pressure; fulness and tension of the belly, particularly a deep-seated tightness, as if the integument and muscles glided over the tight and thickened peritoneum; feverishness and emaciation.

This disease is often attended by enlargement of the mesenteric glands, with which it is usually identical in symptoms.

*Morbid appearances.*—The peritoncum thickened; the bowels

glued together; the abdomen containing more or less turbid serum; perhaps ulceration of some part of the bowels; the omentum thick, red, and fleshy.

*Treatment.*—Occasional leechings, blisterings, frictions, and flannel bandages to the abdomen; or warm fomentations and poultices, if the pain is very severe; nourishing diet; small doses of mercurials, and mild laxatives and antacids.

## WORMS.

There are three species of worms which most commonly inhabit the intestinal canal—viz., the *ascaris lumbricoides*, *ascaris vermicularis*, and *tænia*.

The *lumbricus* is a round worm, varying in length from four to ten inches; the tail ends in a blunt point; the head is sharp, and set between three oblong tubercles.

The *ascaris vermicularis* is very thin, and does not exceed an inch in length, but it is usually shorter; the tail terminates in a fine point. It inhabits the rectum.

The *tænia* is a very long, flat worm, articulated, and furnished with four suckers at the head. Two species of *tænia* are met with in man.

Worms very frequently exist in the intestinal canal without producing any irritation or inconvenience whatever; on other occasions, however, they are attended with the following symptoms:—disgust of food, or irregular appetite; nausea, vomiting, griping pains in the abdomen; tenesmus; disturbed sleep, irregular accessions of fever; diarrhœa, with slimy stools; foul breath; headache; dilatation of the pupils; strabismus; and, in young children, cerebral disturbance, or convulsions. Ascarides often produce a sensation of itching about the anus, while the lumbricus occasions pain of a gnawing character in the umbilical regions. The stools should be constantly inspected, for the presence of the worm in them alone can render us certain of the correctness of the diagnosis.

*Treatment.*—The objects of treatment are, to destroy and expel the parasitical animal. For this purpose various remedies, called anthelmintics, are administered. Common purgatives will sometimes suffice to expel the worms. Should these fail, we may employ the dolichos pruriens, or turpentine. M. Raspail regards camphor as a specific against ascarides; and in France and Italy the root of the pomegranate is employed with success in cases of *tænia*. The condition of the bowels should be carefully regulated, and all errors of diet avoided, for worms are most frequently found in children who are ill fed upon unwholesome and indigestible vegetable food. After the complete evacuation of the parasitical animals, a course of vegetable or mineral tonics has been recommended; but wholesome food, exercise, and a proper regimen, will be found the best means

of preventing their recurrence. Small doses of ferri sulph. with pil. rhei. c., may be useful, if taken regularly.

#### ACUTE HEPATITIS.

*Causes.*—External violence; hepatic calculi; suppressed secretions; influences of climate; duodenitis, &c.

*Symptoms.*—General febrile excitement; lancinating or dull pain of the right side, increased on full inspiration; a sympathetic pain is also sometimes felt in the right (very rarely in the left) shoulder, and along the neck. Sense of uneasiness at the stomach, and nausea or vomiting; short, dry cough; hiccup; bowels constipated; pulse frequent and hard; and the urine high coloured. The patient commonly lies on the right side, and the skin is often tinged with the yellow colour of jaundice. Rigors indicate suppuration.

*Morbid appearances.*—In this climate, it is rather the peritoneal covering than the liver itself which is the seat of the disease. When the substance of the liver is inflamed, it becomes brittle and friable; the granulations are larger and more red than natural, and the lining membrane of the biliary ducts is injected and of a reddish brown colour. In most cases, abscesses are found in different parts of the liver, or the greater part of the organ may be converted into one large cyst containing pus. In other cases, the purulent matter is infiltrated into the substance of the gland. Dr. Budd has called attention to the fact, that the abscesses in the liver, following dysentery, are often owing to an inflammation of the hepatic veins.

*Treatment.*—General bloodletting; leeches, or cupping over the region of the liver, followed by a large blister. The bowels must be kept constantly free by saline cathartics. The Indian practitioners are very partial to mercury, which they administer in large doses to produce salivation as quickly as possible; but in this country, when mercury is given, it should be exhibited more with a view of restoring the biliary secretion than of exciting salivation.

#### CHRONIC DISEASE OF THE LIVER.

This is denoted by more or less pain and tenderness, or weight and fullness in the right hypochondrium, with sallowness of the skin, emaciation, and depression of the spirits.

It may be a consequence of acute inflammation, or of long residence in unhealthy climates, or of diseases of the heart; one very frequent cause is *intemperance*.

Sometimes the liver increases greatly in bulk, and may be felt low in the abdomen, or its limits be ascertained by percussion. Sometimes, on the contrary, it is shrunken and atrophied.

One common form of disease, which is often a precursor of ascites, is what is called the *hob-nailed liver*. This disease originally consists in an inflammatory thickening of Glisson's capsule, which

forms a sheath for the portal vessels, the hepatic artery, and biliary ducts. The thickening of this cellular sheath may compress the biliary ducts, and so cause jaundice, or the portal veins, and so cause ascites. Finally, the thickened cellular sheath shrinks and becomes atrophied, and by its shrinking compresses the hepatic artery, and so causes general atrophy of the organ; whilst by its shrinking it leaves the lobules projecting as little rounded eminences like the heads of nails.

The appearance called *nutmeg liver*, is a mere consequence of congestion. If after death the hepatic vessels, which run in the centre of each lobule, are injected, the liver presents on its surface numerous red spots, with pale interstices. If, on the contrary, the portal system only is injected, it will display pale spots corresponding to the lobules, with red interstices.

*Abscess in the liver* may burst either externally, in which case the liver first adheres to the parietes of the abdomen, so as to prevent the escape of the pus into the peritoneal cavity; or in less fortunate cases, it may burst into the pleura, or peritoneum, or lung, or intestines, generally with a fatal result.

*Treatment.*—The general rules in treating chronic hepatic disease are, to diminish congestion of the portal vessels; to keep up the secretion of the urine, to allay irritation, and support the strength. Small doses of mercury with squill; saline aperients, and diuretics; taraxacum; sulphate of manganese; muriate of ammonia; iodine; colomba, and other light tonics; nitro-muriatic acid, given internally, and used as a bath for the legs; occasional leeching, blistering, or frictions with mercurial ointment, or with iodine; Cheltenham waters; and a light nourishing diet, are the main remedies.

#### JAUNDICE.

The term jaundice is applied to a yellowish tinge of the skin and eyes, depending on the presence of bile in the circulating fluids.

*Causes.*—These are, diseases of the liver; obstruction to the free passage of bile into the duodenum; congestion of the portal system, or excessive secretion of bile; gastro-duodenitis, &c.

*Symptoms.*—The symptoms of jaundice will evidently depend on the nature of the cause which has given rise to the unnatural colour of the skin. The yellow tinge is the most prominent sign; it usually commences in the face, and thence may extend over the whole body, being most clearly distinguished underneath the conjunctivæ. The digestive functions are deranged; the bowels usually costive, and the fæces untinged by bile; the urine is high coloured, and more or less of a saffron tint; the tongue is foul and covered with a yellow fur; the patient complains of headache, and very often of pain in the region of the liver. The

condition of the pulse is extremely variable, and the skin is usually dry, with a sense of itching or stinging.

The morbid appearances found in persons who have died with jaundice depend on the causes which have produced the disease; and they may be deduced from the enumeration of those already given.

*Treatment.*—The treatment of jaundice requires much discrimination on the part of the medical attendant. As it almost always depends on some affection of the liver or neighbouring organs, the chief attention should be directed to the cause of the malady.

When the jaundice depends on excessive secretion of bile, local depletion over the region of the liver, with diaphoretic medicines, and demulcents, will be found useful. If the liver itself be inflamed, the treatment must be the same as that indicated under the head of "HEPATITIS."

Jaundice from congestion of the vena portæ should also be combated on the same principles. Finally, when the disease depends on some chronic affection of the liver, it is a symptom of comparatively little importance, as our whole care should be directed towards the organic lesion whence it originates. For jaundice depending on spasm of the biliary ducts, full doses of opium, aided by warm bath, and hot fomentations to the abdomen, will be found advantageous.

#### GALL-STONES.

Gall-stones may exist in any part of the biliary passages; they are also extremely various both in size, number, and shape. The *causes* of gall-stones are obscure, but their formation is frequently connected with imperfect assimilation of the nutriment. They are composed of the colouring matter of the bile, and of cholesterine.

*Symptoms.*—Biliary concretions often pass into the duodenum without causing any disturbance; on other occasions, the patient is suddenly seized with acute pain in the right hypochondrium, increased on the slightest motion, and shooting backwards under the scapula; the pain is increased after meals. There are also nausea, vomiting, distention of the abdomen, and alternations of diarrhœa and constipation. The paroxysms occur at irregular intervals; the pulse is commonly natural, and the skin cool.

*Treatment.*—The treatment of biliary calculi, or rather of the irritation produced by their passage into the duodenum, is merely palliative. Opium, or its salts, should be freely administered, to relieve the agonizing pain which is frequently the most prominent symptom, and warm anodyne fomentations should be applied to the abdomen. Dr. Prout recommends large draughts of warm water containing carbonate of soda in solution. The

warm bath will also be useful in allaying spasm. When we have reason to think that the gall-stones have been evacuated, the patient should be ordered to take a course of vegetable bitters, and occasionally alkalies; the diet should be light, and a sojourn at some of the watering places should be recommended, when circumstances will permit.

## DISEASES OF THE NERVOUS SYSTEM AND ITS APPENDAGES.

### HYDROCEPHALUS (*acute*).

*Hydrocephalus* is a name likely to mislead the student, as it signifies merely *dropsy of the brain*; whereas, the disease which it is used to designate, is an acute inflammation of the brain and its membranes, often, but not invariably, ending in serous effusion.

*Predisposing causes*.—The *epochs of infancy and childhood* may be called predisposing causes, because, at these periods, the great irritability of the nervous system disposes the cerebral circulation to frequent excitement. A *scrofulous diathesis* is also a powerful predisposing cause; and Dr. Cheyne attributes the hereditary disposition to this cause; it, however, occurs as a hereditary disease without a scrofulous taint existing. Fright and anxiety in the mother, during the last months of utero-gestation, predispose to it, the disease often appearing soon after birth. Amongst the other causes enumerated are, premature application to study; remittent and exanthematous fevers; syphilitic taint of the parents; application of cold to the head; torpor of the secretory system, &c.

The *exciting causes* are, external injuries from blows, falls, &c., concussions of the brain, from whirling or tossing the child; the suppression of eruptions on the scalp, and behind the ears; the extension of inflammation from the ear; the retrocession of acute eruptions, and suppression of chronic discharges; the extension of irritation to the membranes of the brain, from inflammation of the pharynx, scalp, face, &c.; too copious depletion in exanthematous or other diseases; metastasis of various affections; the too free use of narcotics in young children, &c.

This disease has usually been divided into *periods*, or *stages*;

and the division employed by Dr. Cheyne, is, 1st, the stage of increased sensibility; 2d, that of diminished sensibility; and, 3d, that with palsy or convulsions.

*Symptoms: First stage.*—After the existence of precursory signs, for a variable period, the child is attacked with head-ache, confined to the forehead or temples; the pulse becomes quick and hard; the skin hot and dry; and the bowels obstinately constipated. The tongue is loaded or furred; the stomach is exceedingly irritable, vomiting being frequently produced on the child changing its position; and the urine is scanty and thick. The temperature of the head is much increased; the pupils are contracted; the brows are knit; there is an inability to sit up, and a whining or moaning noise when the child is lying down. The sleep is short and disturbed; the patient rolls its head on the pillow, or often awakens with a scream, or crying, and raises its hands to its head. Sometimes the attack begins by convulsions.

*Second stage.*—The sensibility is now remarkably impaired; the drowsiness increases in degree; the pupils are dilated, and there is strabismus, and imperfect or double vision; the eyes are dull, heavy, vacant, or staring; the eyelids drooping or half closed. The pulse, from being frequent, now becomes slow, and sometimes even more so than natural, when the patient is in the horizontal position; but if he attempts to sit up, it immediately acquires its former rapidity. Slight convulsions show themselves in momentary attacks in the eyes, mouth, or upper extremities, which are tremulous. The hands either are raised to the head, or the child picks its nose or mouth. The stupor is occasionally interrupted by loud and shrill screams from the child; and partial contractions of some of the limbs begin to manifest themselves.

*Third stage.*—The last stage now comes on; the pulse is quick, thready, and weak; there are partial or general convulsions; and paralysis of one side or limb occurs. The pupils become more and more dilated, the eyes suffused, and the cornea dull and filmy. The patient is either comatose or delirious, rolls its head about on the pillow, grinds his teeth, and moans or breathes heavily and quickly. The skin becomes cold and covered with perspiration, or the sweating may be partial; the respiration is irregular, or stertorous. The excretions are passed involuntarily, and the patient generally dies in a brief convulsive fit.

*Morbid appearances.*—Inflammation of the pia matter, most commonly observable at the base of the brain, around and in the fissures of Sylvius. The cerebral substance is generally engorged, and the central white parts of the brain are more or less softened. The lateral ventricles frequently contain from four to six ounces of fluid. The most common complication of hydrocephalus is, tubercle of the nervous substance, which, amongst the poorer classes, occurs



in nearly one-third of the cases. Tubercular deposits are also found in various other parts of the body, in a vast majority of cases.

*Treatment.*—This should be strictly antiphlogistic, and should be resolutely employed at once. The patient should be placed in the erect posture, and blood should be drawn from the arm till the approach of syncope; below the age of five, it will be more prudent to apply leeches to the temples or behind the ears; but some physicians deem it right to abstract blood from the arm, even in children of three or four years of age. The abstraction of blood must be followed up by free purging; and as the bowels are always constipated, recourse must be had to the most active purgatives, especially calomel and scammony; in many cases, the administration of croton oil will be found necessary to obtain evacuation of the bowels. During the employment of these means, the head should be shaved, and kept cool by the constant application of cold lotions. Calomel may be administered in small regular doses, till it causes green stools like chopped spinach. Great excitement or delirium may be mitigated by giving very small doses of tartar emetic in solution. When the force of the circulation and the acuteness of the disease have diminished, blisters may be applied to the nape of the neck. In the latter stages, digitalis, colchicum, and a variety of remedies have been recommended, but the case is almost beyond relief. There is, however, a combination of equal parts of crude mercury and fresh squills, rolled into a mass, which may be given in doses of five grains *ter die*, and it causes a great secretion of urine.

Whatever mode of treatment be adopted, it should be had recourse to at the very onset of the disease, for experience unfortunately shows that little hope of recovery remains when the affection has arrived even at the second stage.

*Cerebral exhaustion* in children produces many symptoms like hydrocephalus, for which it would be most dangerous to mistake it, as the causes, nature, and treatment are quite opposite. It occurs to children ill fed, or exhausted by depletion: the face is cool; the child very drowsy, and unable to hold its head up; the breathing irregular and sighing. One grand distinctive mark is, that the *fontanelle is sunken*, showing that there is no vascular turgescence in the brain. Beef-tea, small doses of ammonia, good nursing, and warmth, are the remedies.

*Chronic Hydrocephalus.*—This disease seems to depend, not on inflammation of the cerebral membranes, but on increased secretion of the cerebro-spinal fluid, which is commonly connected with some congenital lesion of the brain. Chronic hydrocephalus generally exists at the period of the infant's birth, but it sometimes appears during the first few years of infantile existence. It manifests itself by a gradual enlargement of the cranium, which occasionally attains

an enormous size. The accumulation of fluid within the skull not only distends the bony cavity and impedes its ossification, but separates the bones from each other, leaving spaces at the fontanelles, and in divers other places, which are now merely protected by membranous expansions. The cerebral substance is also more or less injured. In some cases, a great portion of the nervous matter seems to have disappeared; while in others it is spread out in thin layers, which embrace the fluid, as it were, in a sac. The gradual augmentation of the head is the chief sign of chronic hydrocephalus; in addition to this symptom, we find that the infant gradually loses flesh, and becomes dull; manifests signs of suffering in the head; sympathetic vomiting is also frequently observed; and the intellectual faculties and senses gradually become more obtuse. The child is unable to carry the head erect, and the muscles of the face become the seat of convulsive movements. As the disease progresses, the well-known symptoms of compression manifest themselves more and more, and the patient dies either in a state of idiotcy or in convulsions.

*Treatment.*—There are only two modes of treatment worth mentioning, viz., gradual compression of the head, and puncture. The former method, which was well known to the physicians of the seventeenth and eighteenth centuries, has been recently revived by Sir Gilbert Blane; while the happy results of puncture, through the anterior fontanelle, in the hands of Dr. Conquest, sufficiently justify us in having recourse to this operation as a probable means of cure. Compression should be well kept up after the operations.

#### ENCEPHALITIS.

##### *(Inflammation of the Brain.)*

*Causes.*—Long exposure to a vertical sun, anxiety of mind, the inordinate use of ardent spirits, cold, fright, external injury, the sudden disappearance of an old discharge, &c., may produce this disease; it sometimes occurs as consequent on small-pox, or erysipelas of the face and scalp, and fevers, especially those of typhoid character, &c.

*Symptoms.*—Violent inflammatory fever, hot and dry skin, flushed countenance, suffused eyes, quick and hard pulse, throbbing of the carotids, and delirium. The senses are morbidly acute, there being intolerance of light and sound. The person is extremely restless; there is jactitation of the limbs, and rigidity of the muscles; the head is remarkably hot, the pupils contracted, and the excretions and secretions are suppressed. Occasionally, the muscles of the face are spasmodically affected, the upper eyelid hangs down, and the commissures of the lips seem to be drawn to one side. The tongue is white, loaded, red at its edges, and the papillæ elevated;

there is nausea and vomiting, and obstinate constipation of the bowels. This last symptom is common in congestion, or inflammatory affections of the brain.

As the disease advances, all these symptoms are reversed; the morbid acuteness of the sensations changes into blindness and deafness; the delirium passes into stupor, and gradually into coma. Convulsions and different forms of paralysis ensue; the countenance is vacant or idiotic; the eye loses its lustre; the pupils become dilated; and occasionally there is strabismus. The respiration is now irregular, occasionally stertorous, the articulation imperfect, the pulse frequent and small, the limbs spasmodically convulsed or paralytic; there is retention of urine, and involuntary discharge of the fæces. In the still more advanced stage the countenance becomes pale and sunken, the pulse weak and irregular, the urine passes off involuntarily, the skin becomes cold and clammy, the coma more profound, and death soon closes the scene.

*Morbid appearances.*—The inflamed part of the brain presents different appearances, according to the time the disease has lasted. When it is only of some days' duration, the white substance, and still more perceptibly, the gray, exhibits a rosy, or slight red colour; and in it we perceive several vascular filaments. The firmness of the affected part is considerably diminished, and when cut into, the surface of the incision presents a number of small red points, which cannot be removed by ablution.\* In a more advanced stage of encephalitis, the brain is red, the vascular injection more strongly marked, and the softening very considerable. Finally, in some cases, the blood becomes so intimately mixed with the cerebral substance, that its colour approaches that of the lees of wine, being of a deep dusky red; there is no actual effusion of blood, except we consider as such some small dots, about the size of a pin's head, which we occasionally find in some particular points; in such cases, the brain is in a state of extreme *ramollissement*.

Should it happen that the inflammation passes into these stages without causing death, then the part affected begins gradually to lose its softness, and ultimately becomes more dense than in the natural state; it retains for some time its red colour, but finally changes to a dusky yellow.

The third stage of encephalitis is that of suppuration; the red colour gradually disappears, and the blood is replaced by a seropurulent fluid, which is infiltrated into the substance of the brain, combines with it, and gives to it, according to the extent of the admixture, a grayish, dull white, or yellowish-green colour. Sometimes the pus is found in small isolated spots; at other times small

\* These small red spots differ from those of congestion, in which small drops of blood reappear, as soon as the first are wiped away.

distinct cavities form, and occasionally we find several small cavities uniting to form a large one. In some instances, the pus is found enclosed in cysts, in which case the purulent matter assumes the same characters as that found in the cellular membrane of the body. The gray substance is the most usual seat of encephalitis; and the parts most commonly affected are, the corpora striata, optic thalami, the convolutions, pons Varolii, and cerebellum.

*Treatment.*—In this case, the most active treatment must be had recourse to. The patient should be bled to the approach of syncope; the head should be shaved, and leeches applied to the scalp, or cupping to the nape of the neck. There is great tolerance of the loss of blood in this case, and it is extremely difficult to produce syncope, owing to the excited condition of the brain producing a continued determination of blood to that organ. Cold should be applied to the head, and this treatment is indicated in all cases of meningitis, and meningo-encephalitis, except in the rheumatic or erysipelatous forms. The bowels should be well emptied in the first instance by a large dose of calomel, and compound extract of colocynth, followed in about two hours by a brisk cathartic draught, aided in some instances by a purgative enema. Having procured a proper action on the bowels, repeated doses of calomel should be exhibited, either in combination with digitalis, colchicum, or James' powder; and its action should be established in the system as quickly as possible. During the progress of the disease, enemata and brisk cathartics should occasionally be administered. In the advanced form, should there be deep coma, blisters to the scalp have been recommended.

Blisters, however, should never be applied in this situation, unless there is profound sopor, weak action of the carotids, and no remarkable increase of temperature of the head. If applied in the earlier stages they seem to add to the excitement. Sinapisms may be applied to the feet, or inner sides of the legs or thighs; blisters are generally applied to the nape of the neck, or between the scapulæ.

#### DELIRIUM TREMENS.

(*Delirium c. tremore.*)

The *brain fever of drunkards* (Armstrong) is variously modified, according to the causes in which it originates, and the habits and constitution of the patient. It may, however, be divided into two species—the one being evidently connected with inflammatory irritation, or with excited vascular action in the meninges of the brain, and associated with great irritability; the other consisting chiefly of this last state, attended by exhausted nervous energy.

*Symptoms.*—The phenomena of this disease vary remarkably, from the slightest forms of nervous tremor, with spectral illusions

and accelerated pulse, to the most alarming state of vital depression, muscular agitation, and mental alienation. In ordinary cases, it is characterized by constant watchfulness, and tremulous quivering motion in the lips, hands, and muscles, generally, on making any effort. The pulse, which is at first slow, becomes quick; there is a constant disposition to talk, now on one subject, and now on another. In the first variety mentioned, the pulse is full and hard, the skin dry, the delirium furious, the eyes injected, the temperature of the head increased, and the tongue is often dry, and red at its edges. In the second form, which is the most common, the pulse is small, or soft, and ranges between 100 and 120; the face is not flushed, nor the skin hot, but is covered with a clammy perspiration. As the disease advances, the mental delusion becomes constant, and is generally of a low or melancholic kind, with continued reference to the patient's ruling passions and occupations, and anxiety respecting them. He is perpetually haunted by frightful creatures, or occupied with the most extravagant ideas, and is continually endeavouring to avoid them. If a favourable change do not now take place, the skin becomes more cold and clammy, and exhales a peculiar smell, which is, as Dr. Hodgkin has remarked, between a vinous and alliaceous odour; the pulse becomes still more frequent, small, weak, and thready, so that it cannot, in some cases, be counted; the general tremor increases; the patient talks incessantly, and with great rapidity; the delirium increases, and the patient either sinks into the calm which sometimes precedes death, or is carried off in a convulsive effort.

*Morbid appearances.*—The appearances on dissection give no direct information on the nature of this disease. In the true delirium tremens, the *membranes of the brain* evince but little change, the chief lesion consisting of slight opacity of the arachnoid, especially at the base of the brain. The pia mater is more or less injected, and an effusion of serum is occasionally observed in the ventricles. In those cases which have accompanied or directly followed intoxication, the vessels are often much congested, particularly those of the velum interpositum; the arachnoid is thickened, and the serum is more abundant, and occasionally is even sanguineous. The appearances of the *stomach* and *liver* are not necessarily connected with the pathology of this disease.

*Treatment.*—In the form of this disease which is attended with increased vascular action, cupping below the occiput, or leeches behind the ears, will be required; cold lotions, or cold affusion to the head, when its temperature is increased; sponging the body with tepid water; purgatives, judiciously combined with stimulants; and aperient and antispasmodic enemata. When the affection has been caused by spirituous liquors, we should assiduously watch the subsidence of the inflammatory symptoms, and anticipate the depression

which ensues; with this intention, liquor ammoniæ acetatis, with excess of ammonia, and camphor mixture, may be given. Moderate doses of *opium*, or of laudanum, with the view of lessening nervous irritability and inducing sleep, should also be exhibited. Or tartar emetic may be given in combination with opium, with the view of quieting both nervous and vascular action.

In the treatment of the second variety, or the *true delirium tremens*, we should endeavour to cut short the disease by giving *opium*, with full doses of *camphor* and *ammonia*, and administering enemata, containing laudanum and assafœtida. Dr. Blake recommends the accustomed stimulus in moderate quantity and at short intervals; it may, however, cause too violent reaction, unless the head be guarded by having frequent recourse to cold affusion. In some cases, warm spiced negus, or punch, may be allowed. Stimulating liniments applied over the epigastrium are occasionally very efficacious. When the symptoms of nervous irritation have been allayed, we should direct our attention to the condition of the gastro-hepatic system; in which, frequently, there is derangement of function. By the judicious combination of stimulants and medicines which will act on the liver, such as calomel or camphor, and stimulating purgative draughts, we again restore the proper secreting action of this gland, and dissipate any sanguineous injection or infarction of its structure. Having produced a proper action on the alimentary canal, we may again have recourse to opium if any signs of irritation remain. The use of opium is much abused in this disease, and in many cases it is pushed to a most unjustifiable extent. *It is an important question, In how many cases of delirium tremens does the patient die in a state of narcotism?* It is certain that the use of large and repeated doses of opium promotes the supervention of coma, effusion, and paralysis; and that its effects nearly resemble the phenomena of the last stage of delirium tremens. During the convalescence, mild tonics should be given, the diet should be light and nutritious, and a suitable beverage, in moderate quantities, allowed.

#### APOPLEXY.

This affection is characterized by loss of consciousness, feeling, and voluntary motion; or, in other words, by a suspension of the functions of the brain, respiration and circulation being also more or less disturbed.\*

The suspension of the cerebral functions may be connected with any of the following pathological conditions:—1. Great congestion of the brain, in which the vessels of that organ are gorged, but without extravasation of blood or serum; this is termed, "*congestive apoplexy.*" 2. Congestion of the vessels of the brain, with extra-

\* Dr. Copland's Dictionary.

vasation on its surface, forming the "*meningeal apoplexy*" of Serres. 3. Hemorrhage into the substance of the brain, with lesion of its structure. 4. A serous effusion on the external surface, and into the ventricles of the brain, constituting what is defined, "*serous apoplexy*;" but this is more frequently the termination of an inflammatory or congestive disorder of the brain, than of that deranged state which constitutes the apoplectic attack. 5. Apoplexy may occasion death without leaving any sign at all in the dead body. To this variety, to which the older writers gave the names *nervous*, *convulsive*, and *hysterical*, Dr. Abercrombie has applied the term *simple apoplexy*.

*Causes.*—Apoplexy is said to be hereditary. It may occur at an early period of life, but in the majority of cases the age is above fifty. Among the causes of apoplexy are—ossification, or aneurism of the arteries of the brain; obstruction, thickening, induration, or obliteration of the canals of the sinuses; diseases of the heart, especially hypertrophy of its left ventricle; diseases of the kidney, particularly the granular degeneration described by Dr. Bright; torpor of the liver, or other excreting glands; diseases of the air-tubes and lungs, especially those attended with violent fits of coughing; the *coup de soleil*; suppressed hemorrhages, particularly epistaxis and hæmorrhoids; suppression of the menstrual discharge; metastatic gout and rheumatism; suppression of any vicarious discharge; depressed and anxious states of the mind; excessive use of wine or malt liquors; too great sexual indulgence; frequent indulgence in sleep after a full meal; the use of neckcloths worn too tightly round the neck, &c., are among the predisposing causes to apoplexy. Gastric disease, narcotics, and mephitic gases may also be enumerated. Overloading the stomach and neglecting the bowels are often enough to cause an attack in the predisposed.

Apoplexy is said to occur chiefly in persons of a full habit of body. Upon this point, M. Rochoux's cases afford important data. Of his sixty-three patients, thirty were of an ordinary habit of body, twenty-three were of a thin, meagre habit, and ten only were large plethoric, and fat.\*

*Symptoms, (premonitory.)*—Apoplexy is sometimes preceded at considerable intervals by precursory or warning symptoms, such as vertigo, headache, ringing in the ears, loss of memory, a feeling of drowsiness and lethargy, depraved vision, or partial palsy. In some cases, there is a sense of great fulness in the head, the veins of the head and forehead become turgid, the countenance is suffused and occasionally livid, and there are slight attacks of epistaxis. If any individual were to complain of several of these symptoms at any period of life, he might be regarded as on the very brink of some

\* *Recherches sur l'Apoplexie*, p. 214.

serious affection of the brain; and if the person be in the decline of life, it may safely be said he is in immediate danger of an attack of apoplexy. But it is a serious error to suppose that premonitory symptoms always occur; indeed, if we may trust the experience of M. Rochoux, one of the best authorities on apoplexy, they are by no means common. Of *sixty-three cases* which came under his notice, *nine only* had distinct precursory symptoms.\*

*Symptoms of the attack.*—In the *mild* form of apoplexy (the *atonic* apoplexy of Dr. Good), the patient, after experiencing some of the premonitory symptoms, is seized with alarming vertigo, leipthymia, or feeling of faintness; nausea and vomiting; disturbance of the senses, particularly of the sense of sight; loss of memory; partial loss of sense, consciousness, speech, and voluntary motion; weak, irregular, and sometimes quick pulse, and more or less of sopor.

In the *more active form* (the *entonic* apoplexy of Dr. Good), the patient is more or less suddenly seized with profound sopor, the eyes being either open or closed; the breathing deep, slow, sonorous, or stertorous; and the pulse slow, full, hard, or strong, sometimes irregular. In this form of the disease, the above are often the chief symptoms, there being no paralysis; but frequently the mouth is drawn to one side, the eyes are distorted, and one eyelid immovable, with relaxation, loss of sensation and of motion of a limb, or of one side of the body; the arm of the non-paralysed side being often closely applied to the chest or to the genital organs. The patient generally lies on the paralysed side, which is relaxed, incapable of motion, and insensible to the application of irritants.

In the *most severe and sudden* forms of attack, the patient is struck down instantly, sometimes froths at the mouth, has a livid countenance, dilated pupil, complete relaxation and immobility of the voluntary muscles and limbs, and unconscious evacuation of the urine and fæces, and dies very shortly afterwards either with or without stertor, with cold, livid extremities, cold perspiration, and sometimes a cadaverous cast of countenance. This form constitutes the *apoplexie foudroyante* of the French, in which there is generally an immense extravasation of blood.

*Duration of the symptoms in fatal cases of apoplexy.*—According to the common opinion, apoplexy may prove fatal instantly or in a few minutes. The best modern pathologists deny this, and assert that when death is so sudden the cause is commonly disease of the heart, and never apoplexy. Although, however, it seldom proves instantaneously fatal, it may undoubtedly cause death in much less than an hour. In some cases, on the other hand, patients remain even for months in a comatose, paralytic state.

\* *Loco citato*, p. 70.



*Of serous apoplexy.*—It was once supposed in certain cases not attended with evidence of vascular excitement, that the symptoms were owing to an *effusion of serum*; hence they were called serous apoplexies; but this distinction is now abandoned.

*Diagnosis between serous and sanguineous apoplexy.*—The sanguineous was said to be distinguished by flushing of the countenance, and strong pulse, and by occurring in persons in the vigour of life; the serous, on the other hand, was said to attack the aged and infirm, the countenance being pale, and the pulse weak, in such cases. But there are many cases whose symptoms and circumstances come exactly within the description of the *serous apoplexy*, but still after death present the vascular engorgement, &c., of the sanguineous, whilst no serous fluid is effused. Speaking of these distinctions, Dr. Abercrombie observes, “it will be found that many of the cases which terminate by serous effusion, exhibit in the early stages all the symptoms which have been assigned to the sanguineous apoplexy; while many of the cases which are accompanied by paleness of the countenance and feebleness of the pulse will be found to be purely sanguineous.”

*Morbid appearances.*—Effusion of blood within the cranium may take place in the brain or cerebellum; in their crura; in the pons Varolii, and in the medulla oblongata; in the corpus callosum; in the ventricles; on the surface of the brain beneath the pia mater; in the cavity of the arachnoid; between this membrane and the dura mater, which it lines; and between the dura mater and cranium.

It has been found that certain parts of the brain are much more liable to sanguineous effusions than others.

*M. Rochoux's Dissections.—Forty-one cases.*

Extravasation of blood on the <i>left side</i>	. . . . .	18
Do. do. <i>right side</i>	. . . . .	17
Do. do. <i>both sides</i>	. . . . .	6
		<hr/>
		41

*Of the Situations of the Effusions.*

In the corpora striata	. . . . .	24
— optic thalami	. . . . .	2
In both these situations	. . . . .	1
Under the corpus striatum	. . . . .	1
In the middle of the hemispheres	. . . . .	5
— posterior part of the ventricles	. . . . .	2
— anterior and interior part of the hemisphere	. . . . .	2
— posterior and interior part	. . . . .	3
— middle lobe	. . . . .	1
		<hr/>
		41

By this table it is shown that out of forty-one cases of effusion, twenty-eight were in the corpora striata and their vicinity.

*A summary of the result of 386 cases of apoplexy, from the Précis d'Anatomie Pathologique of Andral.*

*Seats of the Effusion.*

In the substance of the hemispheres, on a level with the corpora striata and optic thalami . . . . .	202
In the corpora striata . . . . .	61
— optic thalami . . . . .	35
— hemispheres above the centrum ovale . . . . .	27
— lateral lobes of the cerebellum . . . . .	16
— brain, anterior to the corpus striatum . . . . .	10
— meso-cephalon . . . . .	9
— spinal cord . . . . .	8
— posterior lobes of the brain . . . . .	7
— middle lobe of the cerebellum . . . . .	5
— peduncles of the brain . . . . .	3
— olivary bodies . . . . .	1
— peduncles of the cerebellum . . . . .	1
— pituitary gland . . . . .	1
	386

On reference to this table, it will at once be observed the vast preponderance of cases in which effusion has occurred into the hemispheres of the brain, the corpora striata, and the optic thalami.

*Treatment.*—In the treatment of apoplexy, with active determination to the head, full labouring pulse, carotids beating strongly, &c., the first indications are to relieve the head from the accumulation of blood, to prevent further congestion, and to obviate inflammatory action: and for these purposes the only efficient means is *bleeding*. A full bleeding, then, must be immediately employed; the head should be shaved and freely leeched, and the patient may be cupped on the temples or the back of the neck. The administration of brisk *drastic cathartics* is attended with the best results, their *derivative* action being a powerful means of relieving the coma. Croton oil is the purgative generally used in these cases; but where the patient can swallow, other drastic cathartics may be given. Where the patient has completely lost the power of deglutition, the croton oil should be mixed with a little castor oil or mucilage, and passed into the œsophagus by means of an elastic tube. Drastic *enemata* will also be found beneficial. The head must be kept cool by means of *cold lotions, iced waters*, or by pouring a small stream of cold water on the scalp occasionally. When the coma is persistent, *blisters* should be applied to the nape of the neck, or to the head; sinapisms to the feet are also indicated. But it must yet be remembered that there is a certain injury done to the brain; that a portion of its substance has been torn up, and compressed by a clot of blood; and that a certain amount of injury has to be repaired. Hence a butcherly, indiscriminate use of the lancet, draining the patient's veins after all active congestion has ceased, is much to be repro-

bated. Something must be allowed to time, and the powers of nature.

If the patient's face is cold, the carotids beating feebly, and the patient approaching a state of syncope, considerable caution must be used in abstracting blood. Purgatives should first be given, with small doses of ammonia, and sinapisms be applied to the feet—when the circulation has recovered its force, blood may be taken by cupping from the nape of the neck, and blisters be applied behind the ears, or to the nape of the neck.

When an attack of apoplexy is known to follow habitually if the stomach is loaded with indigestible food, an emetic of sulphate of zinc may be given, as it evacuates the stomach with the least possible straining.

#### PARALYSIS.

The most characteristic symptom of cerebral hemorrhage is paralysis. Very slight effusion produces this effect, and in general its intensity is in the direct ratio of the extent of the effusion. Paralysis may also arise from diseases of the brain, or its membranes, injuries of the brain or the spinal cord, diseases of the spinal cord or its membranes, pressure on, or injury of, the large nervous plexuses, the action of lead, &c.

Paralysis has been divided into several varieties:—1st, paralysis of the nerves of motion; 2d, paralysis of the nerves of sensation; 3d, *hemiplegia*, which implies the existence of paralysis on one side of the body; 4th, *paraplegia*, which signifies that the lower extremities are paralysed; and 5th, *partial* paralysis, as of the muscles of the mouth, or of an extremity; 6th, *general* paralysis, when the two sides of the body, whether in their entire extent or in some of their parts, are at once deprived of motion.

#### PARALYSIS FROM CEREBRAL HEMORRHAGE.

This form of paralysis develops itself at the very moment the effusion of blood takes place in ordinary apoplexy; acquires all at once its highest degree of intensity; then remains stationary, or begins to diminish. Sometimes the paralysed part has not previously experienced any disturbance with respect to either sensation or motion; sometimes, on the contrary, the patient has experienced in these parts pricking sensations, numbness, permanent or transient, an unusual feeling of cold, a sense of weight, and a certain degree of debility. These different phenomena may announce two things—either the existence of constant lesion in the same point of the brain where, at a later period, the hemorrhage shall take place,—as simple habitual sanguineous congestion; a softening which is still inconsiderable; or a tumour; or else the more or less frequent return of a more serious congestion in the part of the brain where the blood is to be effused.

The paralysis following cerebral hemorrhage presents great varieties with respect to its seat, and pathological anatomy is far indeed from being always able to assign the cause of such numerous varieties.

There has not as yet been established any *special* relation between the seat of the effused blood and the paralysis of particular organs. It has been asserted that paralysis of the *superior* extremities depends on the effusion taking place in the *thalami*, or in the cerebral substance situated on a *level* with, and *posterior* to them; and that paralysis of the *inferior* extremities depends on the effusion taking place in the *corpora striata*, or in the cerebral substance situated on a *level* with, or *anterior* to them. It is certainly true that cases occur in which the relation of the effusion and the paralysis as above stated holds good; but again, there are numerous cases which fully demonstrate, *that paralysis of the extremities has no necessary connexion with effusion into these portions of the brain.*

It has also been asserted that *loss of speech* depends on the effusion occupying the *anterior lobes* of the brain; but this observation derives still less support from actual experience than the former, for *blood may be effused in the anterior lobes of the brain without giving rise to any modification of speech.*

The best established facts regarding the seat of cerebral hemorrhage, and the relation which exists between it and paralysis, are the following:—

1. That the paralysis almost always occupies the side of the body opposite to that of the brain or cerebellum in which the effused blood is situated.

2. That the paralysis affects only one side of the body when the effused blood is confined to one hemisphere of the brain, or one of the lateral lobes of the cerebellum.

3. That the paralysis exists on both sides of the body when the hemorrhage has taken place in both hemispheres of the brain, or both lateral lobes of the cerebellum, into the ventricles, the pons Varolii, the medulla oblongata, and on the surface of the brain.

4. That paralysis of both sides of the body may also take place when the hemorrhage is confined to one hemisphere of the brain or lateral lobe of the cerebellum, but is so extensive as to produce compression of the opposite hemisphere or lobe.

A most remarkable circumstance, connected with cerebral hemorrhage, has been observed by Andral—viz., hemorrhage of one of the lobes of the cerebellum, like that of one of the hemispheres of the brain, gives rise to paralysis of the opposite side of the body; but if hemorrhage takes place into the *left* lobe of the cerebellum, and *right* hemisphere of the cerebrum, the paralysis is found to exist on that side opposite to the hemisphere of the cerebrum, which is the seat of the effusion, the other side remaining unaffected by the effusion in the cerebellum.

When blood is effused into the substance of the brain, its colour gradually changes from red to black; and in successive transitions to brown, dull green, orange, pale yellow, or yellowish white. When the clot has undergone the latter changes of colour, and the fibrine, separated from the other constituents of the blood has assumed a fibrous or laminated appearance, the blood-vessels are observed to form it. The fibrine may retain its distinctive characters for some time, and then become converted into firm fibrous tissue, which, gradually diminishing in bulk, forms eventually a small cicatrix; or, the organized fibrinous substance may be converted into a loose cellular tissue, filled with a serous fluid, (the *apoplectic serous cyst*,) and traversed by a considerable number of blood-vessels. Should the case, under these circumstances, proceed favourably, the serum of the cyst becomes absorbed, the walls approximate, and a cicatrix is formed. Finally, if a complete cure of the paralysis is effected, the cicatrix, whether formed by the first or last process described, disappears.

*Treatment.*—The treatment of paralysis dependent on cerebral hemorrhage consists at first in the treatment proper for the different varieties of apoplexy; and afterwards in the use of derivatives, and finally, general and local stimulants. The patient should be restricted in his diet, and all causes of cerebral excitement, whether physical or moral, should be avoided; the chief object in the first part of the treatment being to promote the absorption of the clot, which is best effected by moderately lowering the cerebral circulation. Much advantage is derived from the insertion of a seton, or an issue, in the neck, which establishes a kind of drain in the vicinity of the disease. The bowels should be well acted upon, and the condition of the bladder attended to. When the organic disease of the brain is removed, and all symptoms of vascular excitement or congestion have disappeared, we may have recourse to *strychnia*. This substance, being a powerful medicine, should be given in doses of one-sixteenth of a grain at first; however, it may be gradually increased to half a grain, or even a grain in a day. Whenever it produces headache, vertigo, sickness of the stomach, and violent spasmodic twitchings, it must be discontinued.

The *local treatment* consists in rubbing the parts with stimulating liniments, applying blisters to the spine, or along the course of the nerves, sprinkling the abraded surface with strychnia, and, finally, in using electricity. The use of the moxa has been strongly recommended; if the paralysis exists in the lower extremity, it may be applied in the course of the great sciatic nerve; if in the upper extremity it may be applied to the back of the neck, corresponding to the junction of the brachial nerves with the spinal cord.

## EPILEPSY.

*Causes.*—Epilepsy appears to be occasionally hereditary, but it is more frequently an acquired disease. It generally arises from excessive nervous irritation, either induced by sympathetic influences, or by direct causes. As examples of the former, may be enumerated, gastro-intestinal disturbance from indigestible food, worms, &c.; difficult dentition; uterine irritation; excessive sexual intercourse and masturbation; the abuse of spirituous and fermented liquors; the presence of calculi in the kidney, ureter, or bladder, or of gall stones in the excretory duct of the liver. The direct causes are—injuries of the head or spine; diseases of the cranial bones or of the vertebræ; tumours growing on the bones, or spiculæ of bone protruding into the brain; ossific deposition in the dura mater or its processes; ossification of the arteries of the brain; concussions of the brain or spinal cord; and metastasis of gout or rheumatism to the encephalon. Dr. Meade is convinced that the relative frequency of disease of the spinal cord and its membranes in this affection is underrated; and that much may be done for the patient in many instances by attending to the state of this part of the nervous system. The other causes which have been enumerated are—fright, fits of passion, distress of mind, appalling sights, seeing others in the paroxysm, excessive hemorrhage, immoderate depletion, hypercatharsis, the suppression of eruptions, irritation of remote nerves, and the syphilitic and mercurial poisons. Its causes may be divided into, 1st, the *centric*, consisting of disease, or causes of irritation in the nervous centres; 2d, the *eccentric* or *peripheral*, consisting in causes of irritation in the viscera or external parts.

*Symptoms.*—Epilepsy is generally a chronic disease, and frequently ends in insanity; it sometimes, however, proves fatal during a paroxysm. It consists in fits of *unconsciousness* and *convulsions*. The epileptic fit is *occasionally preceded by certain warnings*, such as stupor, a sense of coldness, or creeping, or of a gentle breeze (*aura epileptica*) proceeding from a particular part of the body towards the head. M. Georget states, “that warnings do not occur in more than five cases in a hundred;” this is, however, underrating their frequency.

In most cases, the patient utters a cry and suddenly falls senseless; the eyes are opened widely, the pupils are fixed, the face is drawn to one side, and the jaws are firmly closed; after some minutes, the muscles of the neck become rigid, the jugular veins distended, and the face is in a state of livid turgescence; the muscles of the face are now seized with frequent spasmodic contractions; there are convulsive movements of the extremities, particularly the superior; the thorax is fixed, and the respiration is exceedingly difficult. The

tongue is sometimes thrust with violence out of the mouth, and is occasionally caught between the teeth, and severely bitten; in this case the frothy matter expelled from the mouth is tinged with blood. To this state, which may last from a few minutes to a quarter, or even half an hour, succeeds a deep sleep, general relaxation of the muscular system, paleness of the countenance, and a gradual return of free respiration; the countenance for some time retains an expression of stupidity; the intellectual and sensorial faculties, however, gradually resume their activity, the patient at the same time experiencing a creeping sensation all over his body. Occasionally it happens that one fit succeeds another, till the patient becomes comatose, and dies; but, comparatively few die during a fit, unless the disease has existed for a considerable time. In some cases, the attack is much less violent, and consists merely of a momentary loss of sense, with slight and partial convulsions of the eyes, mouth, upper extremities, or fingers, and may or may not be accompanied by a fall.

The most frequent *complications* of epilepsy are, apoplexy, mania, paralysis, chorea, hysteria, and catalepsy; hence the morbid appearances are infinitely various.

*Morbid appearances.*—Epilepsy may be connected with any of the organic lesions which occur in the brain and cranium. When a patient dies in a fit of simple epilepsy, the substance and the membranes of the cerebrum and cerebellum are found gorged with black blood. In complicated cases of epilepsy, especially with mania, the medullary substance of the brain is found indurated, and its vessels enlarged; occasionally, however, with dilatation of its vessels, it is softened and flabby. These structural changes are generally limited in extent. The cortical structure also occasionally presents evidence of chronic inflammation, and is, in some instances, adherent to the membranes. The medulla oblongata and spinal cord present, in many cases, alterations similar to those found in the encephalon. The Wenzels found the *pituitary gland* and *infundibulum* variously altered in colour, size, and consistence, in nearly all the cases of epilepsy which they examined; and the *crista galli* of the ethmoid, and the *clinoid processes* of the sphenoid bone, more or less prominent, or otherwise changed in position and shape, in most of them. In the larger proportion of cases, the *pineal gland* was also changed in colour, and softened. Caries, thickening, internal exostoses, *spiculæ*, malformations, and malpositions of the bones at the base of the skull, with various changes of the membranes, were met with in the larger proportion of cases. The heart, pericardium, lungs, liver, and kidneys, have been found diseased in rare instances.

*Treatment.*—But little can be done for the patient during the paroxysm, except placing him in the horizontal position, and preventing

his being injured by the violence of his muscular exertions. One of the first things to be done is to put something between the teeth, to prevent injury to the tongue, and the dress must be loosened, particularly stays and neckcloths. *Bloodletting* has been recommended in the paroxysm; but unless the fits are attended by marked plethora or cerebral congestion, or in the first attack, especially when produced by the suppression of some sanguineous evacuation, it should be deferred. It is in the convulsive stage of the paroxysm that bleeding is particularly indicated: it cannot, however, be easily performed in this stage. *Cold affusion* to the head has been recommended by Brera; it is not very efficacious, except in those cases complicated either with hysteria or uterine disease. *Antispasmodic* and *purgative enemata* are perhaps the most efficacious means during the fit; if there be not much determination to the head, assafœtida injections and castor oil may be employed; but when this symptom is present, turpentine should be preferred.

After the paroxysm is over, the patient should be kept quiet, the bowels opened as quickly as possible, and light nourishing diet in moderate quantity is to be used; the abuse of stimulants is to be abstained from; and every cause, corporeal as well as mental, which can possibly have the effect of disturbing the balance of the circulation, or exciting the nervous system, is to be avoided. If there be evidence of much disturbance in the cerebral circulation, the treatment must be more active; if the patient's strength will admit of it, *general bleeding* from the arm may be useful, or occasional *cupping* may be had recourse to, together with keeping the head shaved, applying cold lotions, acting briskly on the bowels, and placing moxas or blisters behind the ears, or setons in the neck. In this form of the affection, Dr. Cheyne recommends *James' powder* to be taken at bedtime, beginning with two or three grains, and increasing the dose every night, until a sensible effect is produced on the skin, stomach, or bowels. When chronic inflammatory action is suspected, the *potassio-tartrate of antimony ointment* should be applied along the spine, or over the nape of the neck, until it produces a copious eruption of pustules. Where this disease arises from an affection of the spinal cord or its membranes, it will necessarily require either vascular depletions or tonics, or both, according to the degree in which plethora, increased action, or deficient power, is inferred to be present. Where incited action exists, cupping, the application of leeches, and dry cupping in the course of the spine, the insertion of setons or issues a little below the seat of the pain, or application of moxas, are the most efficient means. The effects of these means are increased by absolute rest, the antiphlogistic regimen, and active purges. In some cases, associated with deficient power, whilst moderate local depletion, dry cupping, external deriva-



tion, &c., are resorted to, *tonics* and *antispasmodics*, such as valerian, castor, myrrh, cinchona, camphor, and the preparations of iron, should be prescribed. This state of disease is often induced by masturbation; in which case cold aspersion of the genitals night and morning, sponging the spine with cold salt water or vinegar and water, and the internal use of the preparations of iron, will prove beneficial. Where epilepsy occurs in a scrofulous habit, the iodide of iron, or the iodide of potassium, may be given. If worms be suspected, turpentine and other anthelmintics must be exhibited. The diseases of the digestive organs, and the other complications of epilepsy, should be treated on general principles.

Some medicines have been much lauded in the treatment of epilepsy; the principal of these are—the nitrate or oxide of silver, the ammonio-sulphate of copper, arsenite of potash, sulphates of iron, zinc, or copper, quinine, extract of nux vomica, and strychnia. Among the antispasmodics employed are, ether, ammonia, camphor, musk, castor, assafoetida, galbanum, valerian, and serpentaria.

#### CHOREA.

This disease is popularly named St. Vitus's dance, *Chorea Sancti Viti*; the French call it the dance of St. Guy; and the Germans, the dance of St. Weit.

*Causes.*—The most common are, intestinal irritation from worms or morbid accumulations, and fright. It may also be caused by injuries to the nervous system from blows or falls; by suppression of eruptions, or vicarious discharges; by rheumatic metastasis to the membranes of the spinal cord; by violent mental emotions; by excessive venery; by masturbation, &c.

*Symptoms.*—Generally speaking, convulsive movements, or rather twitches, of the fingers and muscles of the face are first observed; after a short time, the convulsive movements become more marked; strange contortions of the features take place; the disease extends to the voluntary muscles of all parts of the body, and frequently those of the lower extremities are so continually excited that the patient appears to be dancing, which makes his gait very unsteady; he is chiefly affected when he is most desirous to control his actions. The disease is sometimes confined to one side of the body, or it is more perceptible on one side than the other; the muscles are also affected with a sensation of pricking, creeping, or of numbness. At first there is no constitutional derangement, there being no fever, and all the functions being properly performed, with the exception of the bowels being torpid; but after the disease has continued some time, the general health becomes impaired, and occasionally the mental faculties suffer. This affection is much more common in the

female than the male, the proportion being, according to the best authorities, three of the former to one of the latter. It most frequently appears between the age of seven and fifteen.

The *nature of the disease* is but very little understood; by several writers it is attributed to inflammatory action of some part of the cerebro-spinal axis; and Dr. Hamilton ascribed it to the disordered functions of the bowels affecting the muscular actions sympathetically.

The *seat* of this disease is quite as obscure as its nature. M. Serres considers the *corpora quadrigemina* to be the seat of chorea, while MM. Bouillaud and Magendie conceive that it is seated in the *cerebellum*, the functions which they ascribe to this organ being those chiefly affected in this disease; it is, however, much more probable that the affection depends on disturbed function of the nerves arising from the spinal marrow.

*Treatment.*—This consists in removing morbid secretions and faecal accumulations; in subduing, when evidently present, excited action of the vessels of the spinal cord or brain; and, finally, in rousing the energy of the organic nervous system. *Purgative medicines* have been prescribed with the best effects in this disease; a full dose of calomel should be given at first, and in a few hours after a brisk cathartic ought to be exhibited. Calomel and jalap are a common combination in this disease; and Dr. Hamilton recommends aloetic pills on the days when these are not employed. The compound infusions of gentian and senna, with a little sulphate of magnesia, may be given in the morning occasionally. The oil of turpentine also forms an excellent medicine in chorea, and is particularly indicated where the presence of worms is suspected. The diet should be light and nourishing; every indigestible substance should be carefully avoided. Dr. Wood recommends the use of black-snakeroot, having frequently found it of itself adequate to the cure of the disease.

If there be evidence of cerebro-spinal irritation, our attention must necessarily be directed to its removal; this is best effected by cupping, leeches, and powerful counter-irritation, over the parts particularly implicated. Attention to the mental emotions, warm woollen clothing on the lower extremities, cold affusion on the head or on the spine, or the shower-bath, constitute important parts of the treatment.

Boys are said to be more easily cured than girls. In obstinate cases, tonics must be employed, and those generally used in this disease are, bark, disulphate of quinine, arsenical solution, nitrate of silver, sulphate of zinc, the preparations of iron, and the ammonio-sulphate of copper; of the efficacy of the last substance, Dr. Burns speaks highly. The experiments of M. Baudelocque, at the

Children's Hospital, Paris, demonstrate that the disease may generally be cured by a persevering use of sulphur-baths. Baron Dupuytren employed cold affusion with much success. The same mode of treatment has been found very efficacious at the Hôpital des Enfants Malades.

## HYSTERIA.

This is an apyrexial convulsive disorder, affecting females almost exclusively. The seat of this disease is altogether unknown.

*Symptoms.*—Hysteria is an intermittent, irregular, chronic disease, which comes on by fits, and usually attacks females from the age of puberty to the critical period; it very commonly occurs on the suppression or diminution of the menses, particularly in persons of a nervous or irritable temperament. In the slighter forms, the patient, without any assignable cause, bursts into a fit of weeping, which perhaps is soon followed by convulsive laughter, which may last for a few minutes; and before composure takes place, the patient gives several loud sobs; one of these fits may succeed the other, till the patient falls asleep. The fit sometimes begins with a yawning, numbness of the extremities, involuntary laughing and crying, alternations of pallor and redness of the face, and a sensation as if a ball (*globus hystericus*) commencing at the hypogastrium, ascended through the abdomen and thorax to settle at the throat, where it produces a violent sense of constriction, and of impending suffocation. In more severe instances of hysteria, there are convulsive movements, particularly of the hands, face, jaws, and muscles of respiration; they are of a clonic character. The pupils are dilated; and occasionally the paroxysm has a close resemblance to epilepsy, only that the insensibility is rarely complete. In this disease there is a remarkable deficiency of the organic matters in the urine, and this fluid is very watery. Hysteria does not tend essentially to increase, nor does it determine as a consequence, mania or idiotcy.

*Treatment.*—In those cases where there is reason to suspect any congestion or inflammation of the uterus, or of any portion of the brain, then blood should be drawn by cupping from the back of the head or loins. During a paroxysm, the stays and all tight strings should be loosened, and the free admission of air procured; the face is to be sprinkled with cold water, volatile salts are to be held to the nostrils, and, if the patient can swallow, a drachm of the aromatic spirit of ammonia, or the same quantity of ammoniated tincture of valerian, may be given in a wineglass-full of water. In the severer forms of the disease, the application of cold to the body is often a most effectual means of putting a stop to the paroxysm. The bowels should be kept regularly open, and the best purge in these cases is

castor oil with oil of turpentine, given every, or every second morning, according to circumstances; enemata containing assafœtida are also useful. The prevention of the recurrence of the symptoms is to be attempted by keeping up an action on the bowels, and administering tonics, such as the disulphate of quinine, the preparations of iron, &c. Fœtids, such as assafœtida, castor, valerian, &c., are sometimes, but not invariably, useful. The menstrual action, if irregular, must, if possible, be rectified by appropriate means. The diet should be light, and every attention paid to the improvement of the general health.

## APPENDIX.

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WE append the following on the treatment of Typhoid Fever; though out of place, its importance, we think, will warrant our placing it here.

### TREATMENT OF TYPHOID FEVER.

Of the diaphoretics, the neutral mixture, with tartarized antimony, or sweet spirits of nitre, may be given in the early stages of the disease, and the spiritus mindereri with nitre, in the latter stages. Cold sponging, if it do not chill the patient, is an important remedy, and the internal use of ice is often very grateful. If the patient be very feeble, spirits and water may be substituted for pure water.

Cold applications to the head, by means of ice in a bladder, are very serviceable in relieving the pain and delirium. The hair should also be taken off; and if the head be cold, while delirium is present, Chomel recommends the application of warm poultices. Should there be much abdominal tenderness, a few ounces of blood should be taken by leeches, followed by the application of warm fomentations. If the diarrhœa should be profuse, it should be checked by opium, either alone or in combination with ipecac., or some astringent. Nervous symptoms may be combated by the use of Hoffman's anodyne, camphor water, or opium, if not contra-indicated.

In the advanced stage of the disease, when the tongue is dry, the urine scanty, and the skin parched, and there is delirium, or increased stupor, with an abatement of the vital actions, no remedy is so effectual as mercury, given so as slightly to affect the gums. Either blue mass or calomel may be used.

Should the disease not yield, especially if the tongue remain dry, and the abdominal distension undiminished, Dr. Wood strongly recommends the oil of turpentine, particularly in that stage of the disease when the tongue, instead of cleaning gradually from the edges and tip, parts rapidly with its fur, first from the middle or back part of its surface, which is left smooth and glossy, as if deprived of its papillæ. It should be given in doses of from five to twenty drops every hour or two.

If the debility increase, the patient's strength should be supported by cordials and stimulants. Beef tea, or beef essence, wine whey, milk punch, together with the use of quinine, opium, serpentaria, &c., as the exigencies of the case may demand. Sloughing must be prevented by obviating pressure. Profuse epistaxis by plugging the nostrils. And in case of perforation of the intestine recourse must be had to large doses of opium.

Some practitioners use quinine throughout the disease. Others rely upon bleeding, "*coup sur coup*" (Bouillaud). Others upon purging throughout (Delarocque). Professor Mitchell has great confidence in the internal use of nitrate of silver, beginning in doses from  $\frac{1}{8}$  to  $\frac{1}{4}$  of a grain, and increasing it till a metallic film appears upon the fæcal evacuations. He speaks confidently of its controlling influence upon the diarrhœa and the nervous symptoms. By some it is supposed to act by coming in contact with the ulcerated plates of Peyer, upon which it exercises its specific astringent and sedative influence. Alum has been recommended for the same purpose.

The diet should be mild and unirritating in the early periods of the disease, gradually becoming more nutritious as the disease advances, and the debility increases.

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