First aid to the injured and sick: an advanced ambulance handbook, by F.J. Warwick and A.C. Tunstall

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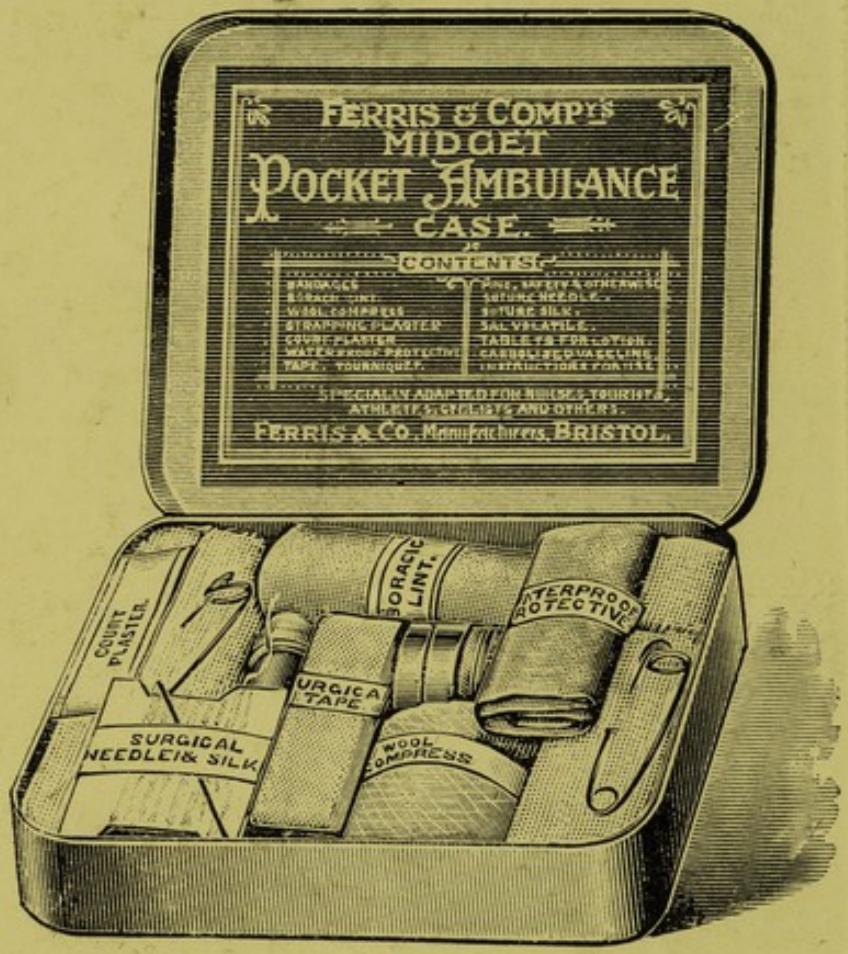

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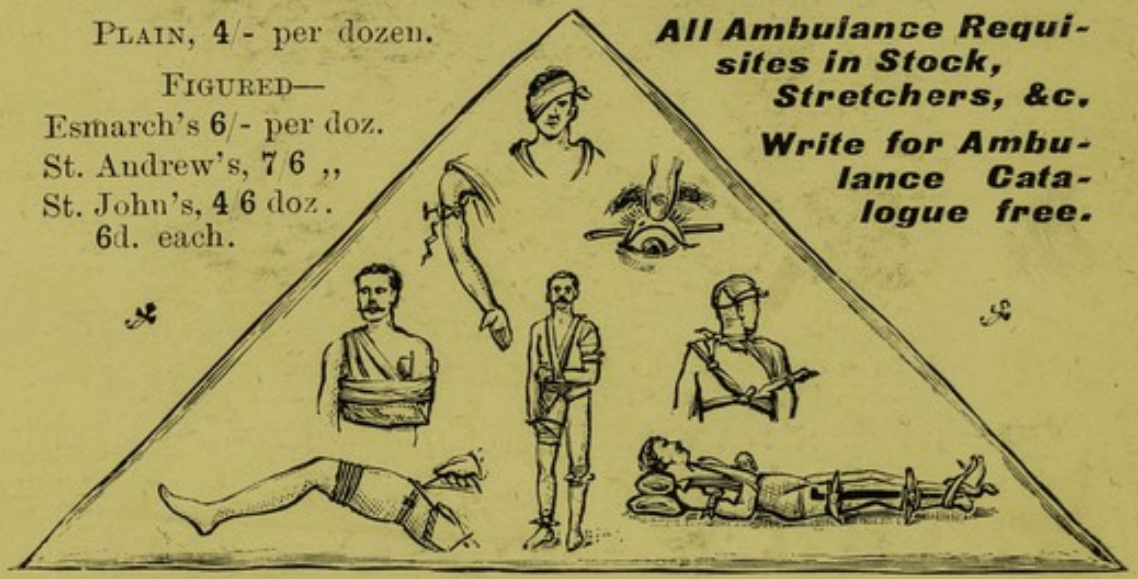

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"FIRST AID"

TO

THE INJURED AND SICK.

AN

ADVANCED AMBULANCE HANDBOOK.

BY

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PREFACE TO THE THIRD EDITION.

THE very favourable manner in which "First Aid to the Injured and Sick" has been received both by readers and reviewers, necessitated an almost immediate second printing without alteration.

In now issuing a third and revised edition, the authors feel gratified to see in that fact sufficient justification for its original publication.

They have taken this opportunity not only to embody several minor alterations and corrections which have been suggested since the book was first published, but also to improve some illustrations, viz.: *Figs.* 12, 36*b*, 84, 85, 92, 108, 137*a*, 139, 140, 143, 144, 152, and 153; and to add others, viz.: *Figs.* 50, 50*a*, 50*b*, 50*c*, 123, 131, 131*a*, 131*b*, 131*c*, 131*d*, and 132.

The illustrations in the book will now be found to correspond with the illustrations in the Large Sheet "First Aid" Diagrams published by the authors.

F. J. W.
A. C. T.

December, 1902.

PREFACE.

THOUGH there are several excellent text-books on "First Aid," the authors, in lecturing on the subject, have felt the want of a concise and fairly well illustrated text-book, and they have endeavoured, therefore, to meet this want.

The illustrations are original with the exception of *Figs.* 102, 104, 144, 145, 148, 149, 150, 151 and 152; the blocks for these have been kindly supplied by Messrs. Evans & Wormull, The St. John Ambulance Association, and the Military Equipment Company.

The authors wish to express their indebtedness to Surg.-Lieut.-Col. J. Edward Squire, V.D. (commanding the London Companies Volunteer Medical Staff Corps), and to Surg.-Capt. Rory Fletcher (22nd Middlesex R.V.), for many valuable hints and suggestions, and also to those who have assisted in bandaging for the illustrations and in reading the proofs.

F. J. WARWICK.
A. C. TUNSTALL

LONDON, *January*, 1901.

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ARTIFICIAL RESPIRATION AND TRANSPORT OF SICK AND INJURED.

INTRODUCTION.

The scope of First Aid is not to supersede *medical* or *surgical* treatment, but to render *immediate temporary assistance* to a person suffering from an accident or sudden illness until the arrival of a doctor.

The importance of First Aid will be apparent in such cases as—Hæmorrhage from a wounded artery, Drowning, or a severe case of Fracture; in any one of the above it might make all the difference in saving the life or limb of a patient as to whether immediate treatment was rendered efficiently or improperly.

First Aid should teach us how to render temporary assistance by improvised means for the relief of the patient, and the methods by which he can be removed to a place of safety. With these objects in view, the following pages contain, first of all, in Part I a brief outline of the *structure* and *functions* of the human body. To render efficient First Aid we must have at least some knowledge of anatomy and physiology.

Part II naturally begins with the *Application of Bandages*, the Triangular Bandage being described first, as this is most suitable for extemporised dressings; then comes the chapter on the *Immediate Treatment of Hæmorrhage*,—from a First Aid point of view this is a subject of the greatest importance; if proper help is not at hand a patient with a wounded artery might bleed to death in a few minutes. Then follow the chapters on the *Immediate Treatment of Wounds, Dislocations and Fractures; Asphyxia, Poisoning, Insensibility, Burns and Scalds, etc.; The Transport of the Sick and Injured;* and finally, *Preparation for the Reception of a case of Accident or Sudden Illness.*

"FIRST AID":
TO THE INJURED AND SICK.

PART I.

CHAPTER I.

THE CONSTRUCTION OF THE HUMAN BODY.

The Cell—Its Structure and Properties—The Tissues—Kinds of and how formed—The Organs—How formed—Their different groups.

THE human body, like that of all animals, is built up of *cells*, which may be regarded as the primary or fundamental units of its construction.

The Structure and Properties of a Cell. — A cell is of microscopic dimensions, and in its simplest form, *e.g.*, a white blood corpuscle, is seen to consist of two distinct parts, viz. :—

(i,) *The Main Substance of the Cell.*—This is termed *protoplasm*, and is a clear jelly-like mass ;

(ii,) *The Kernel of the Cell.*—This is termed the *nucleus*. It is generally placed near the centre of the cell and is denser in structure than the main substance. Some cells contain more than one nucleus.

Cells vary in shape and size, the shape depending upon the position and the functions they have to perform. Thus, cells may be round, long, oval, stellate, ciliated (furnished with hairs) or flaky.

A cell possesses the power of reproducing itself by division, of moving about, of taking in nourishment and digesting it, and of excreting waste material. Every cell is therefore practically a living organism.

The Elementary or Simple Tissues of the body are formed by the aggregation of similar cells.

They comprise the following :—

1, *Epidermal* or *Epithelial Tissue* (epidermis and the cellular lining of mucous membranes).

2, *Connective Tissue* (fat and tendon).

3, *Cartilaginous Tissue* (gristle).

4, *Osseous Tissue* (bone).

5, *Muscular Tissue.*
6, *Nervous Tissue.*
7, *Blood.*

When several of the elementary tissues are combined together they form

The Compound Tissues, these comprise the following :—

1, *The Blood Vessels* (which consist of connective, muscular and nervous tissue).

2, *The Lymphatics* (which consist of connective and muscular tissue).

3, *The Skin* (which consists of connective, muscular, nervous and epidermal tissue).

4, *The Serous, Synovial and Mucous Membranes* (which consist of connective, epithelial, nervous, and muscular tissue).

When several tissues combine together to form a special structure, having peculiar and definite functions, there is produced what is termed an *organ*.

The Organs of the Body may be arranged into *groups* or *systems* according to their special functions, thus :—

1, *The Organs of Locomotion*, these comprise the bones and muscles.

2, *The Organs of Circulation*, these comprise the heart and blood vessels.

3, *The Organs of Respiration*, these comprise the lungs and air passages.

4, *The Organs of Digestion*, these comprise the mouth, gullet, stomach, and intestines.

5, *The Organs of Secretion*, these comprise the liver, pancreas (sweet bread), salivary glands, and mucous glands.

6, *The Organs of Excretion*, these comprise the skin and kidneys.

7, *The Nervous Organs*, these comprise the brain, spinal cord and nerves (including the organs of special sense, *i.e.*, sight, hearing, smell, taste, and touch).

8, *The Organs of Reproduction.*

CHAPTER II.

THE BONES AND JOINTS.

The Bones—Their Composition, Structure and Nourishment—Forms of Bones—The Structure of a Long, a Flat and a Short Bone—Growth of Bone. The Human Skeleton—The number of Bones composing it—Its Uses—The Parts into which it is divided—The Number and Names of the Bones which enter into its different parts—The Bones of the Head, the Spine, the Thorax, the Pelvis, the Shoulder Girdle and Upper and Lower Extremity. The Joints—The Structures which enter into the Formation of a Joint—Kinds of Movement effected by Joints, and Kinds of Joints.

THE BONES

Composition of Bone.—Bone is composed of the following constituents, viz. :—

(i,) *A Basis of Animal Matter*, consisting of gelatin, albumin, fibrin and blood vessels.

(ii,) *Earthy Salts* (chiefly the phosphates of lime and magnesia and carbonate of lime) which impregnate the matrix.

Bones of adults contain two parts of earthy salts to one part of animal matter.

Bones of young children contain the earthy salts and animal matter in equal proportions. The bones in this stage do not easily break, but rather bend, producing the *green stick* variety of fracture.

Bones of elderly people contain seven parts of earthy matter and one part of animal matter. These bones are more easily fractured and reunite with difficulty.

Structure of Bone.—Bone is composed of two layers of tissue, viz. :—

(i,) An outer layer, which is dense in structure like ivory, and is termed *Compact Tissue.*

(ii,) An inner layer, which consists of slender fibres interlaced like lattice work. This is termed *Cancellous or Spongy Tissue.*

During life and in fresh bones, the spaces between the cancellous tissue are filled up with blood vessels and red marrow. The external surface of bone is covered by a tough fibrous membrane termed the *periosteum*, which is richly supplied with blood vessels and nerves. In the union of a bone after fracture the periosteum is the chief agent of repair. On the surface of bones there are numerous small openings termed *foramina.* Into these the periosteum dips down, carrying with it blood vessels and nerves which pass into the interior of the bone. Bone is also lined by a very delicate membrane which is termed the *endosteum.*

Nourishment of Bone.—Bone is nourished chiefly by one large vessel termed the *nutrient artery*, which passes by an opening into the centre of every bone, and also by the several small vessels which dip into its surface with the periosteum.

Forms of Bones.—These are four, viz. :—

(i,) *Long Bones*, such as the bones of the extremities. These serve the purpose of locomotion.

(ii,) *Flat Bones*, such as the bones of the head and the sternum. These serve the purpose of protection.

(iii,) *Short Bones*, such as the bones of the wrist and ankle. These are placed where strength and limited action are required.

(iv,) *Irregular Bones*, such as the vertebræ.

The Structure of a Long Bone.—A long bone consists of a central part, the *shaft*, which widens into an enlargement at each end.

The upper end or enlargement is termed the *head* of the bone.

During life the ends are covered with gristle or *cartilage* and form parts of the joints.

When a long bone is sawn longitudinally the ends are seen to consist of *cancellous tissue* filled with red marrow and are covered externally by a thin layer of *compact tissue*. (*Fig.* 1.)

Fig. 1.—Longitudinal Section of a long bone (the Humerus).

The shaft of the bone consists of a central canal the *medullary cavity*, which, during life, is filled with yellow marrow.

The walls of the canal are composed of dense bone of the *compact* variety.

Long bones by being hollow are light and at the same time strong, a hollow cylinder being stronger than a solid rod.

The Structure of a Flat Bone.—Flat bones, such as those of the head, are composed of three layers of tissue, *viz.* :—A thin outer and a thin inner layer of *compact tissue* (the latter, very brittle), designated respectively the *outer* and *inner tables*, and an intervening layer of *spongy* or *cancellous* tissue, which acts as a buffer, and is termed the *diploë*.

Structure of a Short Bone.—Short bones are composed of *cancellous* or *spongy* tissue, encased by a thin layer of *compact* tissue.

Growth of Bone.—*Long Bones* grow in *length* by new layers of bone being deposited in the cartilage, which is situated at the ends between the extremity and the shaft of the bone;

and in *thickness* by new bone being deposited on the surface of the bone from the periosteum.

Flat Bones grow in *thickness* by deposit of new bone from the periosteum.

THE HUMAN SKELETON.

The number of distinct bones contained in the human skeleton is 200, omitting the *auditory ossicles* or the small bones of the ear, and several other small bones termed *sesamoid bones* (grain-like) which are placed in some of the tendons.

The skeleton serves the following purposes, viz. :—

(i,) It forms a strong frame work for the body.
(ii,) It carries and supports the soft parts.
(iii,) It protects the vital organs.
(iv,) It gives attachment to the muscles.
(v,) It forms joints and helps locomotion.

The skeleton may be divided into the following parts, viz. :—

1. *The Head*, which comprises the skull or cranium and the face.
2. *The Trunk*, which comprises the thorax and the abdomen.
3. *The Extremities*, which comprise the upper and lower pair of limbs.

The **number** and **names** of the bones which enter into the different parts of the human skeleton (*Figs.* 2 and 3) are as follows (*see pages* 6 and 7) :—

- The HEAD is made up of
  - (*a*,) The *Skull* or *Cranium*, which contains 8 bones, viz. :—
    - 1 *Frontal* bone.
    - 2 *Parietal* bones.
    - 1 *Occipital* bone.
    - 2 *Temporal* bones.
    - 1 *Sphenoid* bone.
    - 1 *Ethmoid* bone.
  - (*b*,) The *Face*, which contains 14 bones, viz. :—
    - 2 *Superior Maxillary* bones.
    - 1 *Inferior Maxillary* bone
    - 2 *Nasal* bones.
    - 2 *Malar* bones.
    - 2 *Lachrymal* bones.
    - 2 *Palate* bones.
    - 1 *Vomer*.
    - 2 *Turbinated* bones.
- The TRUNK is made up of
  - (*a*,) The *Spine*, which contains 24 bones, viz. :—
    - 7 *Cervical* vertebræ.
    - 12 *Dorsal* vertebræ.
    - 5 *Lumbar* vertebræ.
  - (*b*.) The *Thorax*, which contains 25 bones, viz. :
    - 12 *Costæ* or ribs on each side.
    - 1 *Sternum* or breast bone.
  - (*c*,) The *Pelvis*, which contains 4 bones, viz. :—
    - 2 *Ossa innominata* or haunch bones.
    - 1 *Sacrum*.
    - 1 *Coccyx*.

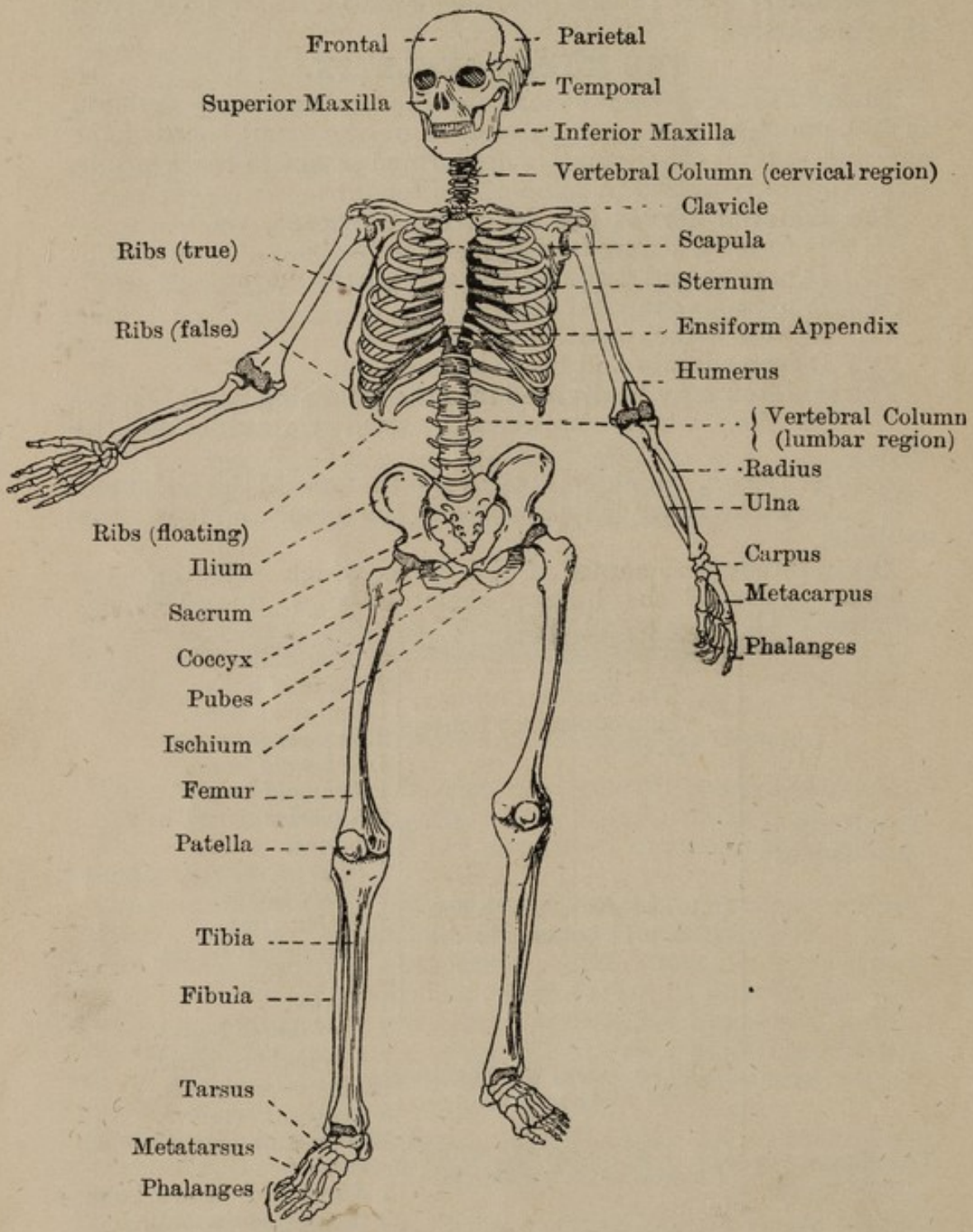


Fig. 2.—The Skeleton (front view).

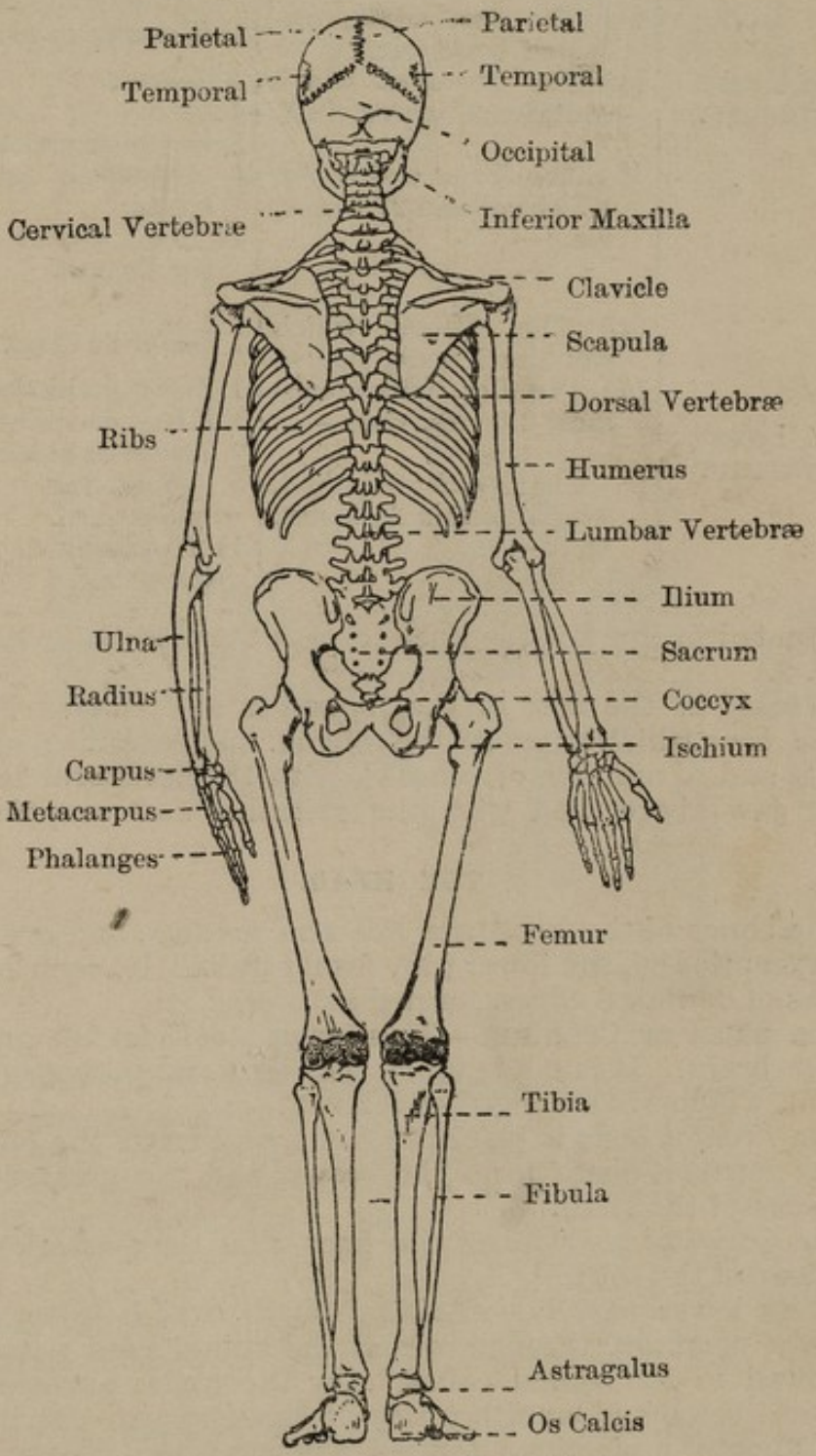


Fig. 2.—The Skeleton (back view).

The Upper Extremity	(*a*,) The *Shoulder girdle*, which contains 2 bones, viz. :—	1 *Scapula* or shoulder blade. 1 *Clavicle* or collar bone.
	(*b*,) The *Arm*, which contains 1 bone, viz. :—	1 *Humerus* or arm bone.
	(*c*,) The *Forearm*, which contains 2 bones, viz. :	1 *Radius*. 1 *Ulna*.
	(*d*,) The *Wrist* and *Hand*, which contain 27 bones, viz. :—	8 *Carpal* or wrist bones 5 *Metacarpal* or hand bones. 14 *Phalanges* or bones of the fingers.
The Lower Extremity	(*a*,) The *Thigh*, which contains 1 bone, viz. :—	1 *Femur* or thigh bone.
	(*b*,) The *Leg*, which contains 2 bones, viz. :—	1 *Tibia* or shin bone. 1 *Fibula* or splint bone.
	(*c*,) The *Ankle* and *Foot*, which contain 26 bones, viz. :—	7 *Tarsal* or ankle bones. 5 *Metatarsal* or foot bones. 14 *Phalanges* or bones of the toes.

Situated in front of the knee joint is the *Patella* or knee cap. (*Fig.* 2.)

Situated at the root of the tongue is a U-shaped bone, the *Hyoid bone*, which supports the tongue, and is connected by ligaments and a number of muscles with the temporal bone and lower jaw above, and with the sternum and scapula below.

THE HEAD.

The bones of the head are *flat* and *tabular*, and are all with the exception of the lower jaw, firmly united to each other by means of dentated edges, termed *sutures*.

The Skull or Cranium.—This forms a case for the protection of the brain. It is made up of the eight cranial bones (*Figs.* 4 and 5), which are arranged as follows:—

The *Frontal* bone is placed in front, and forms the forehead.

The *Parietal* bones form the crown and the greater part of the sides of the skull.

The *Occipital* bone forms the back and the posterior part of the floor of the skull.

At its lower part it contains a large oval hole termed the *foramen magnum*, through which the spinal cord passes from the skull to the spinal canal. On the under surface of the occipital bone, and on either side of the foramen magnum are two smooth projections termed the *condyles*. These rest in depressions upon the upper surface of the first cervical vertebra, the *atlas*, and form the joint between the head and neck.

The *Sphenoid* bone forms the greater part of the base, and the lower front part of the sides of the skull.

The *Temporal* bones surround the ears and contain in their interior the *organ of hearing*. Each temporal bone has two processes given off from its external surface—one termed the *zygoma*, passes from the centre horizontally forwards and joins the malar bone to form an arch; the other forms a nipple-like projection at the side, and is termed the *mastoid process*.

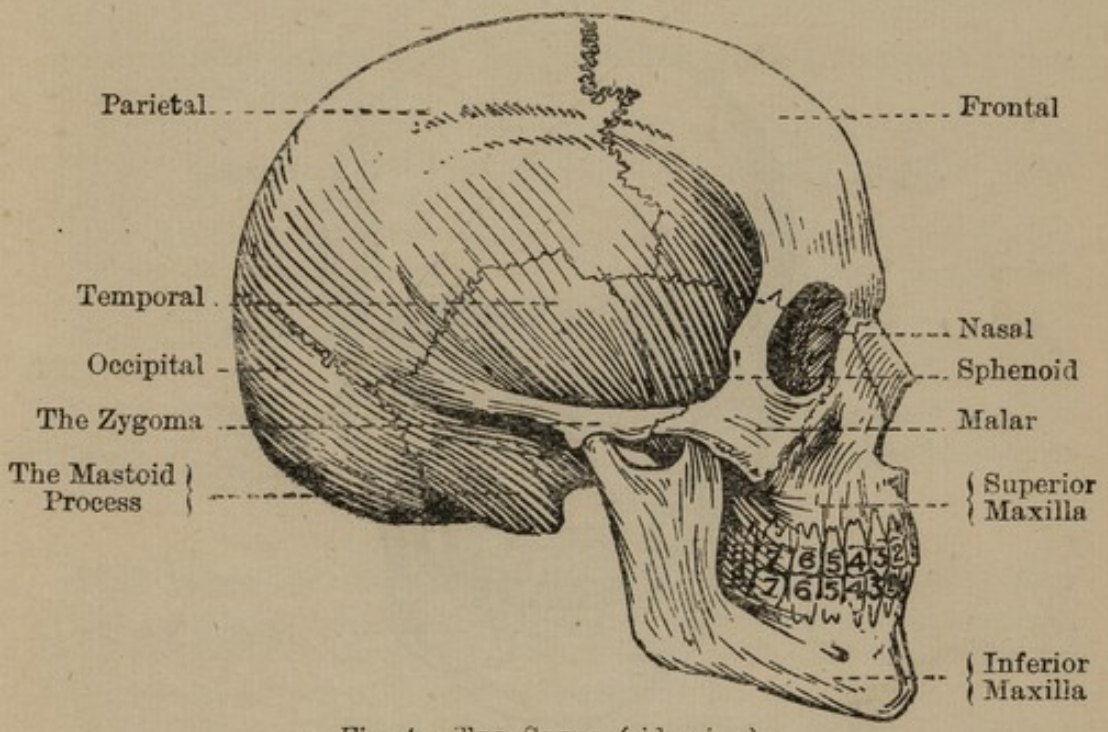


Fig. 4.—The Skull (side view).

Behind the zygoma there is a deep groove termed the *glenoid cavity*, for the articulation of the condyle of the lower jaw.

The *Ethmoid* bone is placed at the root of the nose. It is perforated by numerous small holes through which pass the branches of the *olfactory nerve* (*nerve of smell*).

When the top of the skull-cap is removed and the interior is examined, it is found that the side walls and vault are fairly smooth, but the floor or base is irregular, and is divided into three depressions or *fossæ*, in which the brain rests, these fossæ are:—

The *Posterior* (the deepest), the *Middle* (which comes next in depth), and the *Anterior* (which is the shallowest); the floor has in it, besides the *foramen magnum*, numerous other *openings* which serve for the exit of nerves and the passage of

blood vessels; these different cavities contain respectively the posterior, middle, and anterior parts of the cerebrum, or large brain; and the cerebellum, or small brain.

In infancy the bones of the skull do not quite meet at the top and sides, but leave open spaces through which the brain can be felt pulsating. These spaces are termed *fontanelles*.

The Face.—The fourteen bones of the face (*Fig.* 5), are arranged as follows:—

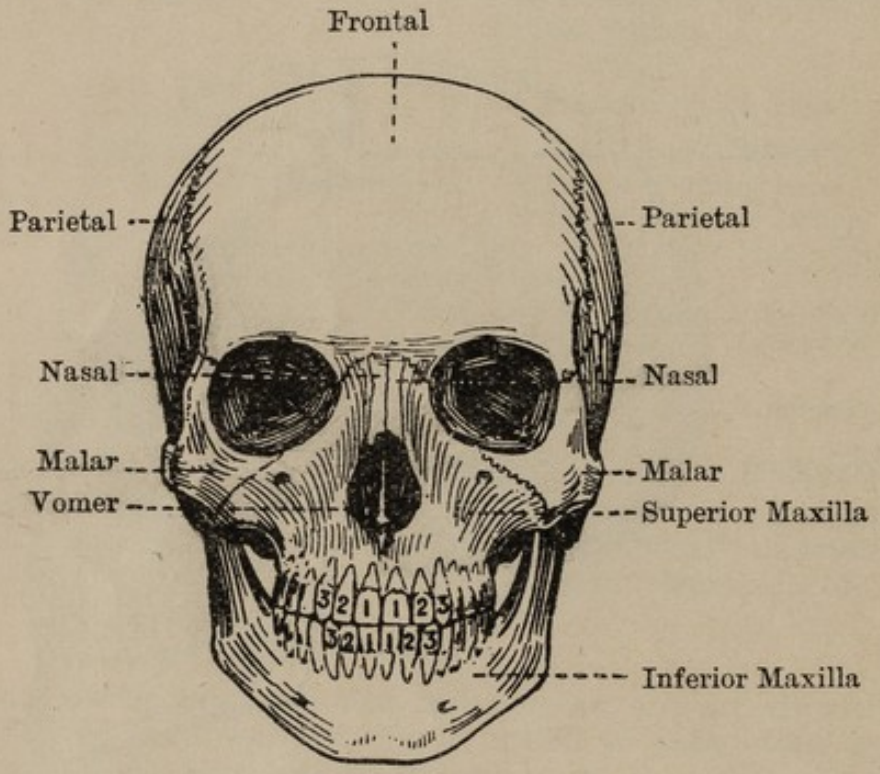


Fig 5.—The Skull (front view).

The *Two Superior Maxillæ*, form the greater part of the face between the orbits and the mouth, and contain the *upper row of teeth*, eight in each maxilla, placed in depressions or sockets.

The *Inferior Maxilla* forms the lower jaw, and contains the *lower row of teeth*, 16 in number, also placed in depressions or sockets. It presents the appearance of a horse-shoe and is the strongest and thickest bone in the face. It consists of a larger horizontal part termed the *body*, and of two ascending branches termed the *rami*. The union on each side of the horizontal with the vertical part is termed the *angle of the jaw*.

The ramus is surmounted at its upper and posterior part by an articular process termed the *condyle*, which fits into the glenoid cavity in the base of the skull.

The Teeth.—In middle life there are 32 teeth, viz.:—Eight

incisors (four in each jaw), four *canine* or eye teeth (two in each jaw), and twenty *molars* (ten in each jaw). See Figs. 4 and 5 where the numbers indicate the teeth as follows:—

	Incisors.	Canine.	Molars.	
Upper Jaw	2, 1, 1, 2	3, 3,	4, 5, 6, 7, 8	Figured only on one side.
Lower ,,	,,	,,	,,	

The *Nasal* bones form the bridge of the nose.

The *Malar* bones form the prominences of the cheeks.

The *Lachrymal* bones are placed at the inner angle of the orbit. They are the smallest and most delicate bones in the body.

The *Palate* bones form the posterior part of the arch of the cavity of the mouth.

The *Vomer*, or plough-share bone, forms the back part of the *septum* or middle partition of the nose and divides the nasal cavity into two halves.

The *Turbinated* bones form convoluted surfaces inside the nostrils, they are covered by the *nasal mucous membrane*, to which they give a greater surface of attachment.

The bones of the face and the skull together enclose *cavities* for the reception of the organs of special sense, viz. :—The *orbits* for the eyes, the *nasal cavities* for the nose, the *mouth* for the organs of taste and the *cavities* in the temporal bones for the organs of hearing.

THE TRUNK.

The Spine or Vertebral Column consists of twenty-four small bones, termed *vertebræ*, these are piled upon one another, to form a bony column and are joined to each other by means of cartilage or gristle and ligamentous bands.

The average *length* of the vertebral column is about twenty eight inches ; it supports upon its upper end the skull, and in the region of the back, the ribs; and it rests upon the sacrum. Besides forming an *organ of support*, it also forms an *organ of protection* for the spinal cord, and the *pivot or axis* upon which the body turns.

In shape the vertebral column resembles a *pyramid.* It forms *three curves*; in the cervical region it is *arched forwards*, in the dorsal region it is *arched backwards*, and in the lumbar region again *forwards.* These curves give grace and elasticity to the trunk and at the same time make the column less liable to injury. (*Fig.* 6.)

The Structure of a Vertebra. —A typical vertebra consists of the *body* or *centrum*, which is a thick solid mass of bone lying in front, and an irregular *bony arch*, the *neural arch*, springing from this behind. On the outer side of each arch there is a *bony projection* termed the *transverse process*, and

from the summit or back of each arch springs another bony projection termed the *spinous process*. The portion of the arch lying between the body and the transverse process on each

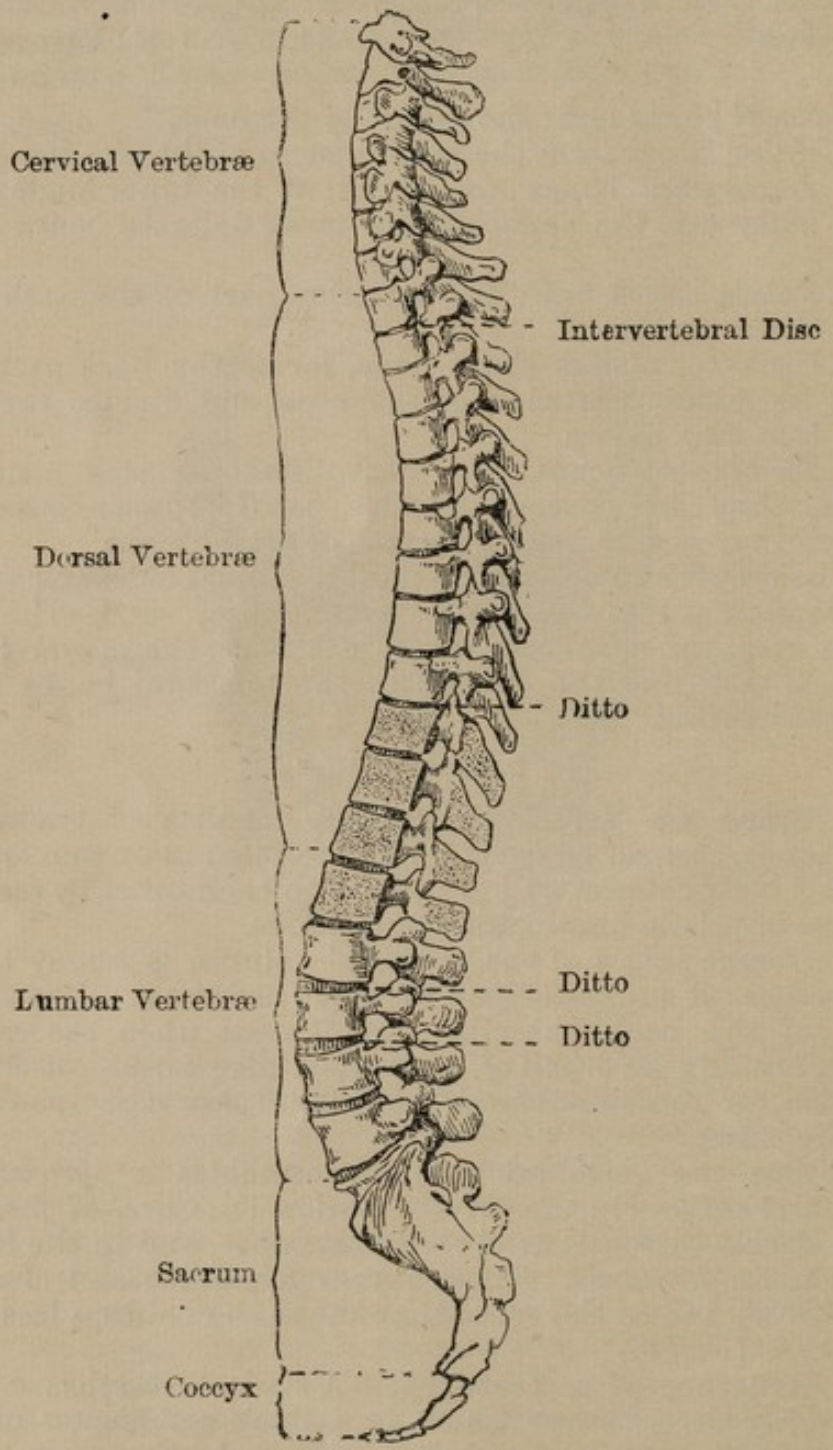


Fig. 6.—The Vertebral Column (side view). The bodies of the 10th, 11th, 12th dorsal and 1st lumbar vertebræ have been cut away to show the vertebral canal.

side is termed the *pedicle*, the part behind the transverse process on each side is termed the *lamina*. (*Figs.* 7 and 8.)

On the *upper* and *lower* sides of the arch are two *smooth surfaces*, by means of which contiguous vertebræ are joined together. Between the bodies of the vertebræ are placed *pads* of fibro-cartilage, about a quarter of an inch thick. These pads are termed the *intervertebral discs*. They are firmly attached above and below to the vertebræ. Their function is to unite the vertebræ to each other and to serve as cushions or buffers.

Since the arches of the vertebræ lie upon each other they form a *canal*—the *spinal canal*, which extends the whole length of the vertebral column and contains the *spinal cord*.

Between the pedicles of each two contiguous vertebræ there is an *orifice*—the *intervertebral foramen*, through which passes out a *spinal nerve* from the spinal cord.

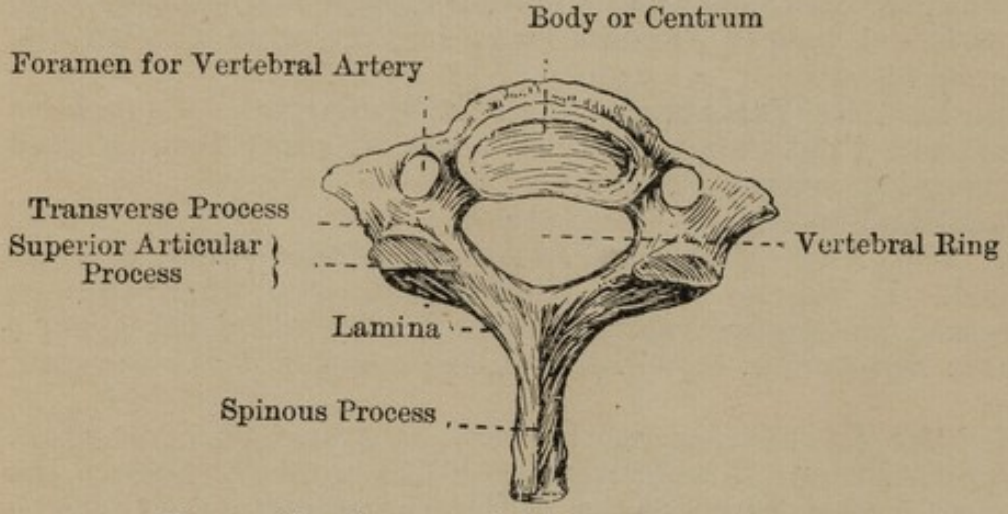


Fig. 7.—The Seventh Cervical Vertebra (top view).

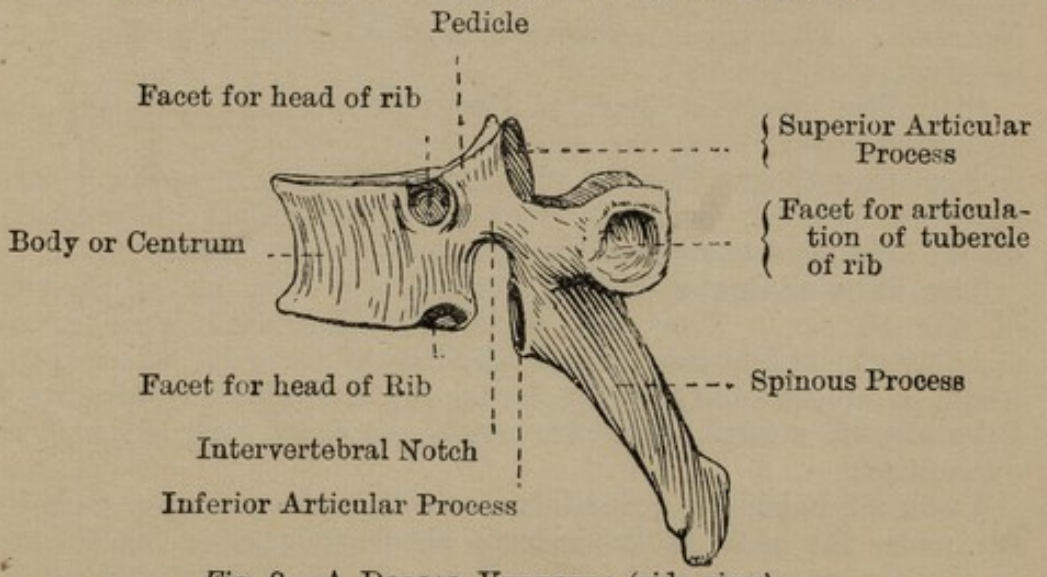


Fig. 8.—A Dorsal Vertebra (side view).

The Regions of the Vertebral Column.—The vertebral column is divided into three regions, viz. :—

1, The *Upper Part* or *Cervical* (neck) region, containing seven vertebræ.

2, The *Middle Part* or *Dorsal* (back) region, containing twelve vertebræ.

3, The *Lower Part* or *Lumbar* (loin) region, containing five vertebræ.

The Cervical Vertebræ.—These are the smallest. The transverse processes are perforated for the passage of blood vessels. The spinous processes are bifurcated and the bodies are thin.

The Dorsal Vertebræ come next in size to the cervical. The bodies are triangular with a *facet* or part of one, on each side for the heads of ribs. The laminæ are broad and thick, the spinous processes long and oblique, the transverse processes are clubbed and have a *facet* in front for articulation with the tubercle of a rib.

The Lumbar Vertebræ.—These are the largest. They have broad and thick bodies, strong pedicles, short laminæ, and horizontal spinous processes.

Peculiar Vertebræ.—These are—

(i,) The *First Cervical Vertebra* or *Atlas.*—This is ring-shaped. It has no proper body and a very small spinous process. On its upper surface there are *two elongated, slightly concave depressions*, in which rest the *condyles* of the occipital bone.

(ii,) The *Second Cervical Vertebra* or *Axis.*—This has from the upper surface of its body, a tooth-like projection termed the *odontoid process*, which passes behind the front part of the ring of the atlas, and is kept in apposition against it by a *transverse ligament*. This process serves as a pivot, round which the atlas revolves.

(iii,) The *Seventh Cervical Vertebra.*—This has a very long *spinous process*.

The Chest or Thorax Is formed by the twelve dorsal vertebræ behind, twelve ribs or *costæ* and their cartilages on either side, and the breast bone or *sternum* in front.

The Ribs or Costæ.—These form the greater part of the walls of the thorax. They are flattened, elongated, curved, and slightly twisted bones. Each rib has a posterior extremity or head, a constricted portion or neck, a rough prominence or tubercle, a sharp bend or angle, a shaft and an anterior extremity.

Each rib behind is joined in *two places* to a dorsal vertebra, *viz.* :—by the head, to the *side of the body*, and by the tubercle to the *transverse process*. The head of each rib, except that of

the first, the eleventh and twelfth, just touches the body of the vertebra above the one to which it belongs.

Each of the upper seven ribs is joined in front to the *sides* of the *sternum* or breast bone *directly* by cartilage, termed *costal cartilage*. These ribs are called the *sternal* or *true* ribs.

The five lower ribs are termed the *false* ribs. The *upper three* of these are first connected to each other by cartilage, which finally connects them to the sternum. The *lower two* are short in front, they are not connected with the sternum, and are only tipped with cartilage. These are termed the *floating* ribs.

The true ribs are less yielding than the false ribs, and are therefore more easily fractured.

The Breast-bone or Sternum.—This forms the front of the thorax; it is a flat bone somewhat dagger-shaped, ending at its lower extremity in a pointed piece of cartilage, and at its upper extremity in an enlargement, which has at its upper angle on each side a joint surface to articulate with the inner end of the clavicle. This point is termed the *sterno-clavicular* joint.

The Pelvis is a bony basin situated in the lower part of the trunk, it directs the weight of the body upon the extremities.

A plane passing horizontally through the upper border of the symphysis pubis in front, and the sacrum behind, divides the pelvis into two parts, the space above is termed the *false pelvis*, the space below the *true pelvis*.

The pelvis is made up of the *two innominate* bones, one on each side, and the *sacrum* and the *coccyx* (a continuation of the sacrum) behind.

The Ossa Innominata or Hip Bones.—The hip bone is a large irregular bone which springs from the sacrum behind, arches round the lower part of the abdomen, and meets its fellow in the middle line in front. The line where the two hip bones meet is termed the *symphysis pubis*.

Each hip bone has a large flat surface, which forms a portion of the side wall of the lower part of the abdomen.

On the outer lower aspect of the hip bone is a deep cup-shaped depression, the *acetabulum*, into which fits the head of the femur to form the hip joint.

The innominate bone consists really of three pieces, which remain separate till puberty, being joined to each other only by cartilage. These bones are :—

(i,) The *Ilium*, the flattened portion supporting the flanks.

The upper border of the ilium is termed its *crest*. This ends in front in a thick angle termed the *anterior superior spine* or *iliac spine*.

(ii,) The *Ischium*, the strong portion supporting the buttocks.

(iii,) The *Pubes*, the front portion supporting the external organs of generation.

The Sacrum.—This is a wedge-shaped bone (formed by the union of five vertebræ), with its base above and apex below. It is a direct continuation of the vertebral column. It is placed between the two innominate bones behind, and at its lower end it carries the coccyx.

The sacrum is curved with its concavity forwards, it has at its upper outer angle on each side, a rough surface, which articulates with the innominate bone.

The Coccyx, forms the termination of the spinal column, it consists of four vertebræ, which in the adult become united into a small cone-shaped mass of bone.

THE UPPER EXTREMITIES.

The Shoulder Girdle connects the arm to the trunk and is made up of the blade bone or *scapula* situated on the upper ribs behind, and the *clavicle* or collar bone situated in front.

The Blade Bone or Scapula.—This is a flat triangular bone placed at the back of the shoulder, with its base above and its apex below.

Across the upper end of the posterior surface of the scapula there is a prominent ridge termed the *spine*, which terminates in front in a process of bone, the *acromion* process, to which is joined the clavicle at its outer or external end.

At the outer upper angle of the scapula there is a shallow depression, the *glenoid cavity*, into which fits the head of the humerus to form the shoulder joint.

Strong muscles attach the scapula to the spinal column and ribs.

The Collar Bone or Clavicle.—This bone resembles somewhat an ancient key *(clavis)*, hence its name It is placed horizontally across the upper part of the chest above the first rib, its inner end being joined to the sternum and its outer end to the acromion process of the scapula. The clavicle acts as a prop to the arm and forms a protecting arch over the large blood vessels and nerves, which pass out of the thorax to the neck and the upper limb.

The Arm.—This consists of one bone, the *humerus*, the largest and longest bone in the upper extremity. It is composed of a *shaft* and *two ends*, an *upper* and a *lower*.

The *upper end* has a large rounded *head*, which fits into the *glenoid cavity* of the scapula to form the *shoulder joint*, the head is joined to the shaft by a constricted portion termed the *neck*.

The *lower end* is flattened, and is curved slightly forwards, it has two rounded joint surfaces, which articulate with the radius and ulna.

The Forearm.—This consists of two long bones—the *radius* and *ulna* placed side by side.

The Radius is placed along the outer or thumb side of the forearm. It is small above where it articulates with the humerus, and large below where it articulates with all the first row of the wrist bones.

The Ulna is an irregularly shaped long bone which is placed along the inner or little finger side of the forearm. It is large above and small below. At its upper end in front there is a deep cavity, the *sigmoid cavity*, which articulates with the humerus to form the *elbow joint*, and behind a projection the *olecranon*, which forms the point of the elbow.

The Wrist and Hand.—The bones which enter into the formation of these are:—Eight bones in the wrist, the *carpal bones*; five bones in the palm of the hand, the *metacarpal bones*; and fourteen bones in the fingers and thumb, the *phalanges*. (*Fig.* 9.)

The Wrist or Carpus.—This consists of eight small irregular bones placed in two rows, an upper and lower, and bound together by ligaments.

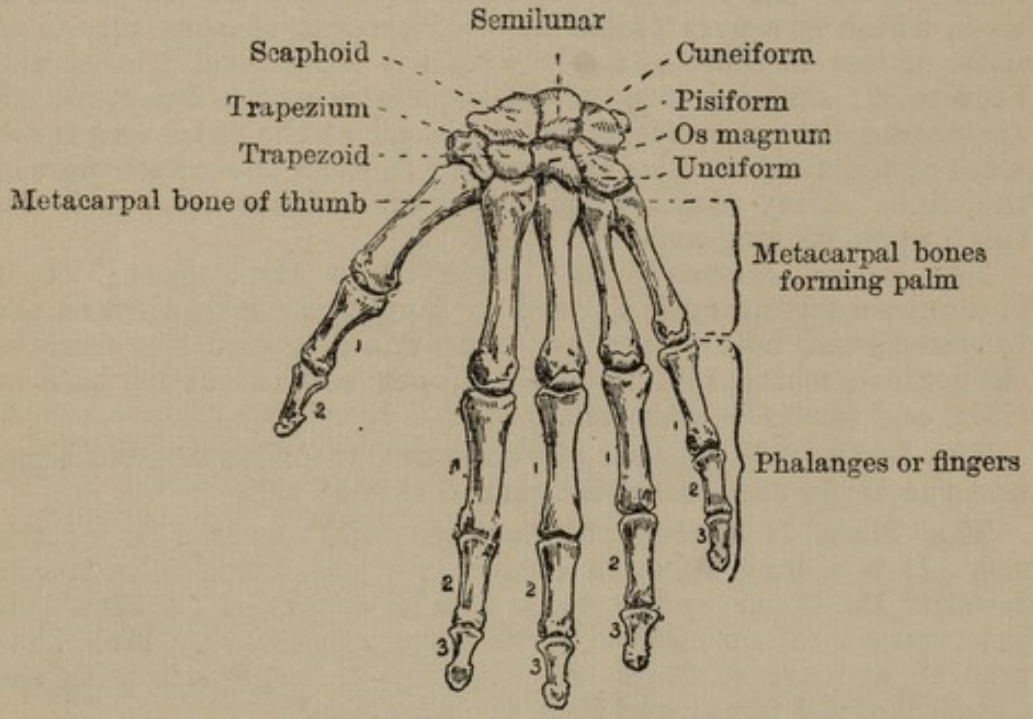


Fig. 9.—The Bones of the Left Hand (back view).

The first row has four bones; these from without inwards are
- The *Scaphoid* (boat-like).
- The *Semilunar* (half-moon).
- The *Cuneiform* (wedge-shaped).
- The *Pisiform* (pea-shaped).

The second row has four bones; these from without inwards are
- The *Trapezium* (square).
- The *Trapezoid* (table-shaped).
- The *Os magnum* (large bone).
- The *Unciform* (hook-shaped).

Greater mobility is imparted to the wrist by the number of bones which compose it.

The Palm of the Hand or Metacarpus.—This consists of five small shafted bones. They articulate above with the second row of carpal bones, and below with the first bone of the thumb and of each of the fingers.

The Fingers or Phalanges consist of fourteen small shafted bones placed one above the other. Each finger has three, in the thumb there are only two.

THE LOWER EXTREMITIES.

The Thigh.—This consists of one bone, the *femur*, the longest and strongest bone in the body; it has a shaft and *two extremities*.

The *upper extremity* is made up of a *head*, which is globular in shape, and fits into the *acetabulum* to form the *hip joint*; a *neck*, which is a pyramidal flattened process of bone placed at more or less an oblique angle with the shaft, and joining the head to it; and *two trochanters*, a *greater* and a *lesser*, which are prominent processes of bone placed at the outer and inner sides of the neck at the spot where it joins the upper part of the shaft. They afford leverage to the muscles which rotate the thigh upon its long axis.

The lower extremity is larger than the upper; it is of a cuboid form, and is divided by a central notch, termed the *intercondyloid* notch, into two eminences termed the *condyles* (knuckles), which rest upon the upper end of the leg bone or *tibia*, and form the *knee joint*.

The Leg.—This consists of two bones, the *tibia* or *shin* bone, and the *fibula* or *splint* bone, placed side by side.

The Tibia is placed at the front and inner side of the leg. It is a long bone, in length and size being next to the femur. Its upper end is large and is expanded on each side into two lateral eminences, termed the *tuberosities*, which have smooth concave surfaces on their tops to articulate with the *condyles* of the femur and form the *knee joint*.

The lower end of the tibia is smaller than the upper and forms the *internal malleolus* or *inner ankle*.

The Fibula is placed along the outer side of the leg. The upper end is small and lies a little below the knee joint; the lower end forms the *external malleolus* or *outer ankle*.

The Patella or Knee-Cap is a small triangular bone placed in front of the knee joint. It is connected by strong ligaments to the tibia below.

The Ankle and Foot.—The bones which enter into the formation of these are, seven bones in the ankle—the *tarsal bones*, five bones in the sole of the foot—the *metatarsal bones*, and fourteen in the toes—the *phalanges*. (*Fig.* 10.)

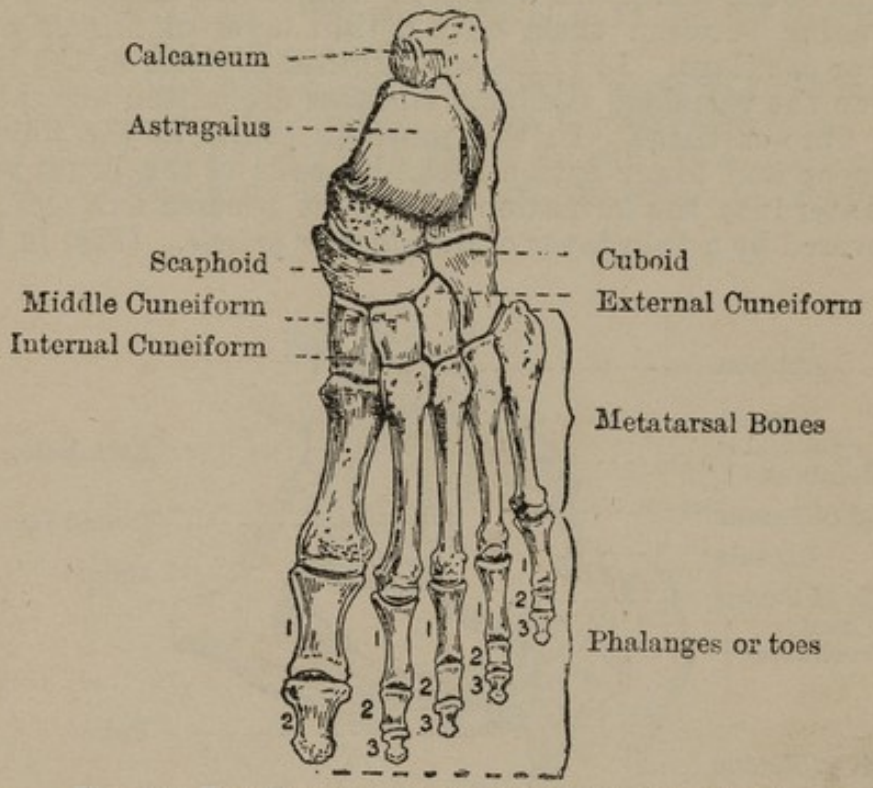


Fig. 10.—The Bones of the Left Foot (top view).

The Ankle or Tarsus.—This consists of seven small irregular bones bound together by ligaments (*Fig.* 10), viz. :—

The *Calcaneum* or *Os calcis*, which forms the heel.
The *Astragalus*, which forms the ankle joint.
The *Scaphoid* (boat-shaped).
The *Cuboid* (cube-shaped).
The *Internal Cuneiform*, The *Middle Cuneiform*, The *External Cuneiform* } (wedge-shaped).

The Sole of the Foot or Metatarsus.—This consists of five small shafted bones, which are joined behind to the tarsus, and in front to the first bone of the toes.

The Toes or Phalanges consist of fourteen small shafted bones placed one above the other, there being two in the big toe and three in each of the other toes.

THE JOINTS.

Where two or more bones come into contact they form a *joint* or *articulation.*

The **Structures** which enter into the formation of a joint are —bone, cartilage, fibro-cartilage, ligaments and synovial membrane. In immovable joints as those between the cranial bones, the ends of the bones are either in immediate contact or have intervening between them only a thin layer of fibrous membrane or cartilage. In joints with limited motion, as the joints between the vertebræ, the bony surfaces are united together by tough fibro-cartilage. In the movable joints as the joints of the upper and lower extremities, the ends of the bones where they enter into the formation of a joint become enlarged, and are covered by a thin layer of *cartilage or gristle.* (*Fig.* 11.)

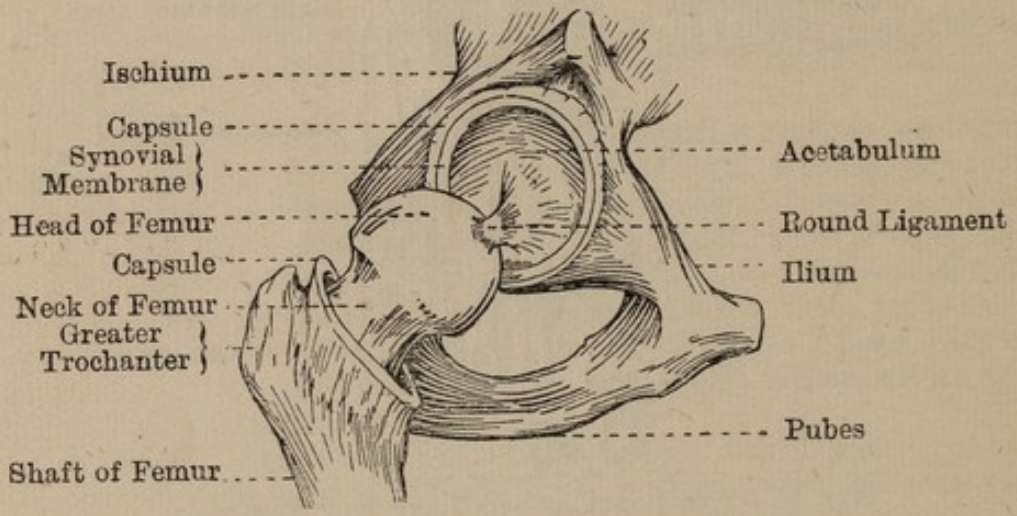


Fig. 11.—The Hip Joint (laid open).

The Synovial Membrane.—This consists of a thin layer of connective tissue, and forms a sac to enclose the joint. It is richly supplied with nerves and blood vessels, and secretes an oily fluid termed *synovial fluid*, which lubricates the interior of the joint and affords easy movement to it.

The Ligaments.—These are composed of fibrous tissue, and are arranged—

(i,) In the form of a firm bag termed the *capsule*, which surrounds the joint.

(ii,) As strong bands which bind and keep in place the ends of the bones.

Kinds of Joint Movement.—Joints may permit the following kinds of movement:— Abduction, adduction, circumduction, extension, flexion and rotation.

Kinds of Joints.—These are two :—

1, *Immovable Joints*, where the bones are interlocked so as to permit of no movement, *e.g.*, the bones of the head and face.

2, *Movable Joints.*—These are classed according to the kind of movement they allow, *viz.* :—

(i,) *Gliding Joints.*—Where there is only a small amount of movement, as between the bodies of the vertebræ.

(ii,) *Hinge Joints.*—Where there is a to and fro movement, as the ankle, knee, and elbow.

(iii,) *Ball and Socket Joints.*—Where there is movement in all directions and also rotation, as the hip and shoulder.

(iv,) *Pivot Joints.*— Where there is only the movement of rotation, as the atlas on the axis, and the radius on the ulna.

CHAPTER III.

THE SOFT PARTS COVERING THE SKELETON.

The Skin, its structure—The Glands of the Skin—Nails and Hair—The Functions of the Skin—The Layer of Subcutaneous Tissue and Fat, its structure and functions—The Muscles—Voluntary Muscles, their distribution and structure—Involuntary Muscles, their distribution and structure—The Function of Muscle—Rigor Mortis.

THE soft parts covering the Skeleton are:—

1, *The Skin.*

2, *The Layer of Subcutaneous Tissue and Fat.*

3, *The Muscles.*

1. The Skin.—This forms a protecting covering to the body.

Its Structure.—The skin consists of two layers:—

(i,) An outer layer, termed the *Epidermis*, or cuticle.

(ii,) An inner layer, termed the *Dermis*, or *true* skin.

(i,) *The Epidermis.*—This is composed of a number of layers of cells, which vary in shape from above downwards. The cells in the surface layers are flat, and resemble scales. Those in the layers lower down are round or many sided; while the cells in the deeper layer are soft and highly vital.

(ii,) *The Dermis.*—This is composed of a mass of fibres, which can be divided into two layers, viz.:—

(*a*,) *An Outer Layer*, which is raised into a great number of conical or finger-like projections, termed *Papillæ*. Each papilla contains bloodvessels, and nerve endings, and also the rudiment of a hair.

(*b*,) *An Inner Layer*, consisting of bands of connective tissue interleaving with each other, and permeated by blood vessels, glands, and fat.

The Glands of the Skin.—The skin contains two sets of glands, viz.:—

(i,) *The Sudoriferous*, or sweat glands. These are minute spiral or cork-screw-like tubes, which open into cup-shaped depressions upon the surface of the skin, and have their ends coiled up in the deeper parts. These coiled-up ends are surrounded by a network of capillaries.

There are between two and three million sweat glands upon the surface of the whole body.

The sweat glands secrete the sweat from the blood.

(ii,) *The Sebaceous* (*sebum*=lard), or fat glands. These are smaller than the sweat glands. Each consists of a short duct, ending in a small sack-like dilatation. These glands are connected with the hair follicles, and open upon the surface of the

skin. They pour out a thick fatty secretion which moistens the surface of the hair.

Nails and Hair.—These are modifications of the epidermis.

The Functions of the Skin.—The purposes the skin serves are:—

(i,) To enclose contained parts.
(ii,) To protect subjacent organs.
(iii,) To locate the sense of touch (*see* chapter IX).
(iv,) To excrete certain waste products, viz.: *Perspiration*, which consists of water and a small quantity of mineral matter (salts) dissolved in it, and a small quantity of carbonic acid.

The greater part of the water passes off from the skin as invisible aqueous vapour. This is known as *Insensible Perspiration.* When the loss of water is copious it appears as drops upon the surface of skin, and is then known as *Sensible Perspiration.*

In an adult the amount of sweat has been calculated to average about 2 lbs. in twenty-four hours.

The Layer of Subcutaneous Tissue and Fat.—Under the skin, and between it and the muscles there is a more or less thick layer of fat and subcutaneous tissue. In structure this consists of a network of fine fibrous threads, which unite the skin to the superficial muscles, and in which are embedded minute cells, each containing a drop of fat.

The functions of the fat are:—

(i,) To serve as a cushion and protection for the underlying parts.
(ii,) To give roundness to the limbs.
(iii,) To maintain and retain the body heat.
(iv,) To serve as a reserve of nourishment upon which the system can draw.

The Muscles.—The muscles or flesh form two-fifths of the body by weight, and to them the body chiefly owes its contour. They possess the special property of *contracting* or shortening themselves under the influence of a stimulus, and by their contractions they produce the movements of the body and its parts.

The muscles are of two varieties, viz.:—

(i,) Voluntary Muscles.—These act under the influence of the will. They number about 240; they are symmetrical and, with few exceptions, are arranged in pairs, one on each side, and are attached mostly to the bones. Muscles are attached to the bones, either *directly* or by the intervention of a band of tissue known as a *tendon.*

The attachment of a muscle to a stationary bone is termed its *origin*, and its attachment to a movable bone its *insertion.*

A typical voluntary muscle, like the biceps of the arm, has a *tendinous extremity* at either end, and a central fleshy mass called the *belly.*

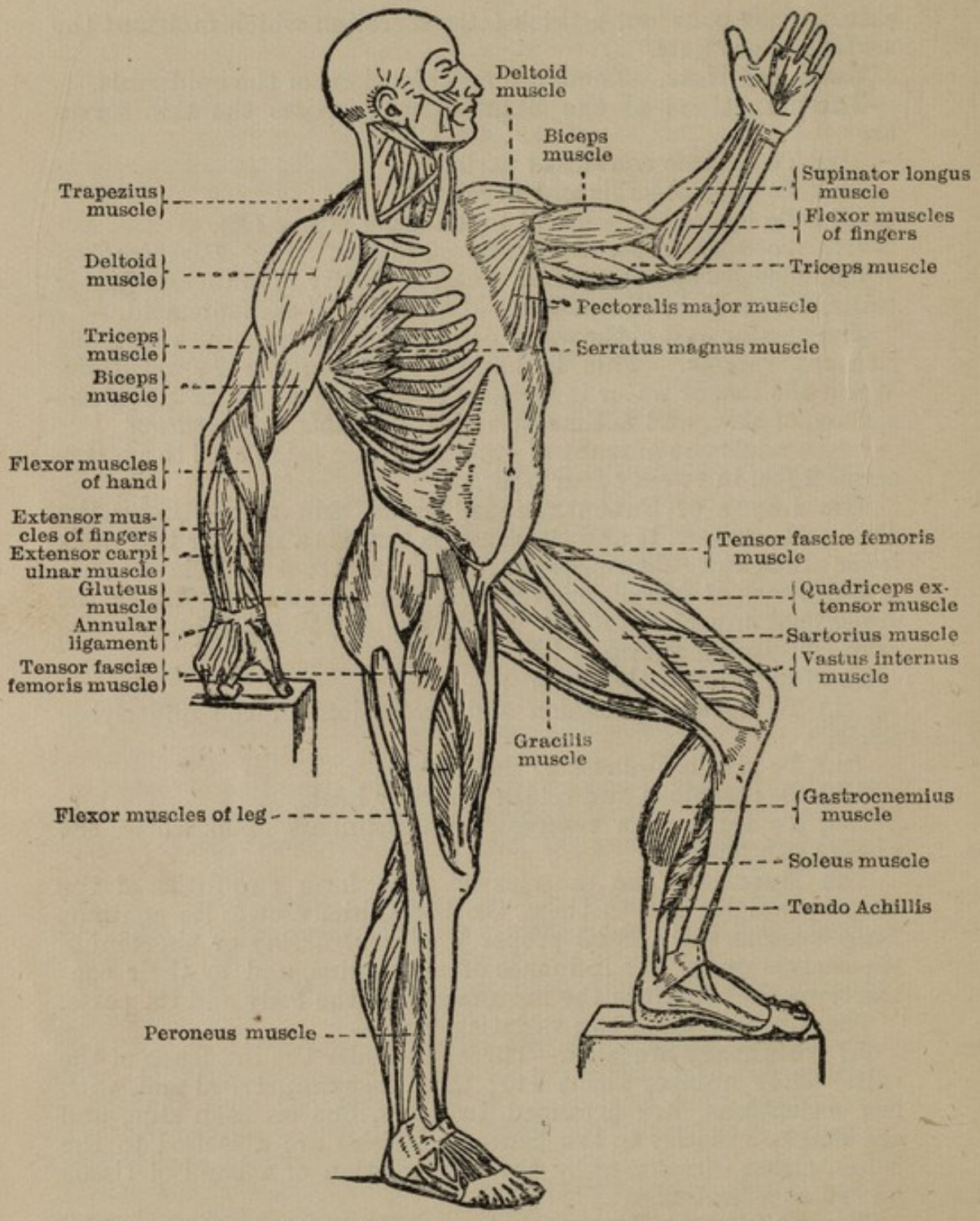


Fig. 12.—The Chief Superficial Muscles of the Human Body.

The Structure of Voluntary Muscle.—A voluntary muscle is composed of reddish fibres, termed *fasciculi*, enclosed in a delicate membrane. Each fasciculus again is made up of a

number of bundles of fibres which run parallel with each other. The fibres are further made up of a number of filaments, or fibrillæ, enclosed in a sheath of membrane. The fibres are cylindrical in shape, and are marked by very fine lines or *striæ*—hence voluntary muscles are termed *striated*, or *striped*.

(ii,) **Involuntary Muscle.**—These muscles are independent of the will. They are not attached to the bones but exist chiefly in the internal organs, *e.g.*, the heart, the muscles of the alimentary canal, the arteries, and the viscera.

The Structure of Involuntary Muscle.—Involuntary muscle is composed of spindle-shaped or penniform cells collected into *fasciculi* lying side by side and held together by connective tissue. The fibres are not striped; hence these muscles are termed *plain* or *unstriated*.

The Function of Muscle.—Muscular tissue possesses the power of *contractility*. When a muscle contracts it also becomes thicker and harder; its ends are drawn nearer together, and in this way it moves one or both of the bones to which its ends are attached. This power of contraction in muscle is described as its *tone*.

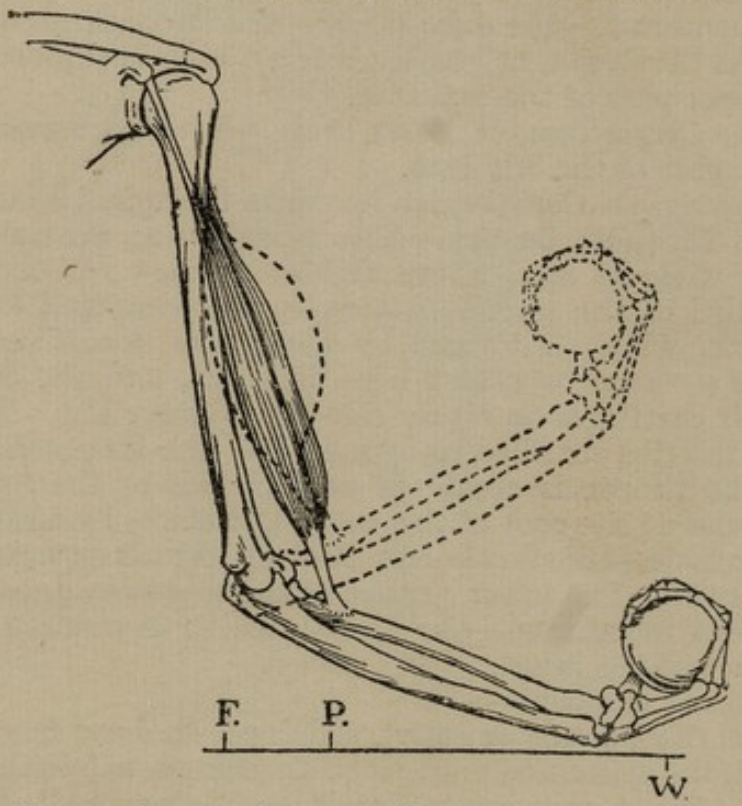


Fig. 13.—Flexion (bending) of the Forearm upon the Arm by the Contraction of the Biceps Muscle.

Rigor Mortis.—Soon after death the muscles by reason of certain chemical changes become stiff and rigid; this stiffening is termed *rigor mortis*, and after some hours it passes off.

CHAPTER IV.

THE CAVITIES OF THE BODY AND THEIR CONTENTS.

The Cerebro-spinal Cavity, its formation and contents—The Thoracic Cavity, its formation and contents—The Abdominal Cavity, its formation, contents, and the relative position of the abdominal organs—The Pelvic Cavity, its formation and contents.

THE cavities of the body include:—

1, *The Cerebro-spinal Cavity* (brain and spine cavity).

2, *The Thoracic Cavity* (chest cavity).

3, *The Abdominal Cavity* (belly cavity).

1. The Cerebro-Spinal Cavity.—This cavity is walled in by the eight bones of the cranium, and the bones of the spine respectively (*see* chapter II.). It is lined internally by a tough fibrous membrane—the *dura mater*—and it contains:—

(*a*,) *The Cerebrum*, or greater brain, which occupies the whole of the upper part of the cranium.

(*b*,) *The Cerebellum*, or lesser brain, which occupies the lower and back part of the cranium.

(*c*,) *The Spinal Cord*, which occupies the spinal canal.

2. The Thoracic Cavity.—The *Thorax* is an air-tight conical chamber with its apex above and base below; it occupies the upper third of the trunk. Its walls are composed of a bony framework, which is formed by the *twelve dorsal vertebræ* behind, the *sternum* or breast bone in front, and the *twelve ribs* with their cartilages on either side (*see* chapter II.). The spaces between the ribs are filled in by muscles—the *intercostal muscles*. Above, the thorax is closed in on each side by the first rib and the muscles at the root of the neck, and below by a large dome-shaped muscle—the *diaphragm* (midriff), which separates it from the abdomen. The inner surface of the thorax is lined by a thin transparent membrane—the *pleura*, which is also reflected over the surface of the lungs.

The thorax contains:—

(*a*,) *The Œsophagus* or gullet, which passes down from the neck in front of the spine, and pierces the diaphragm to join the stomach

(*b*,) *The Two Lungs*, one placed in each lateral half of the chest.

(*c*,) *The Heart* (surrounded by its membranous bag, the *pericardium*), placed between the lungs and lying obliquely across the lower two-thirds of the sternum.

(*d*,) Part of the *Trachea* or wind pipe, which passes down in front of the œsophagus.

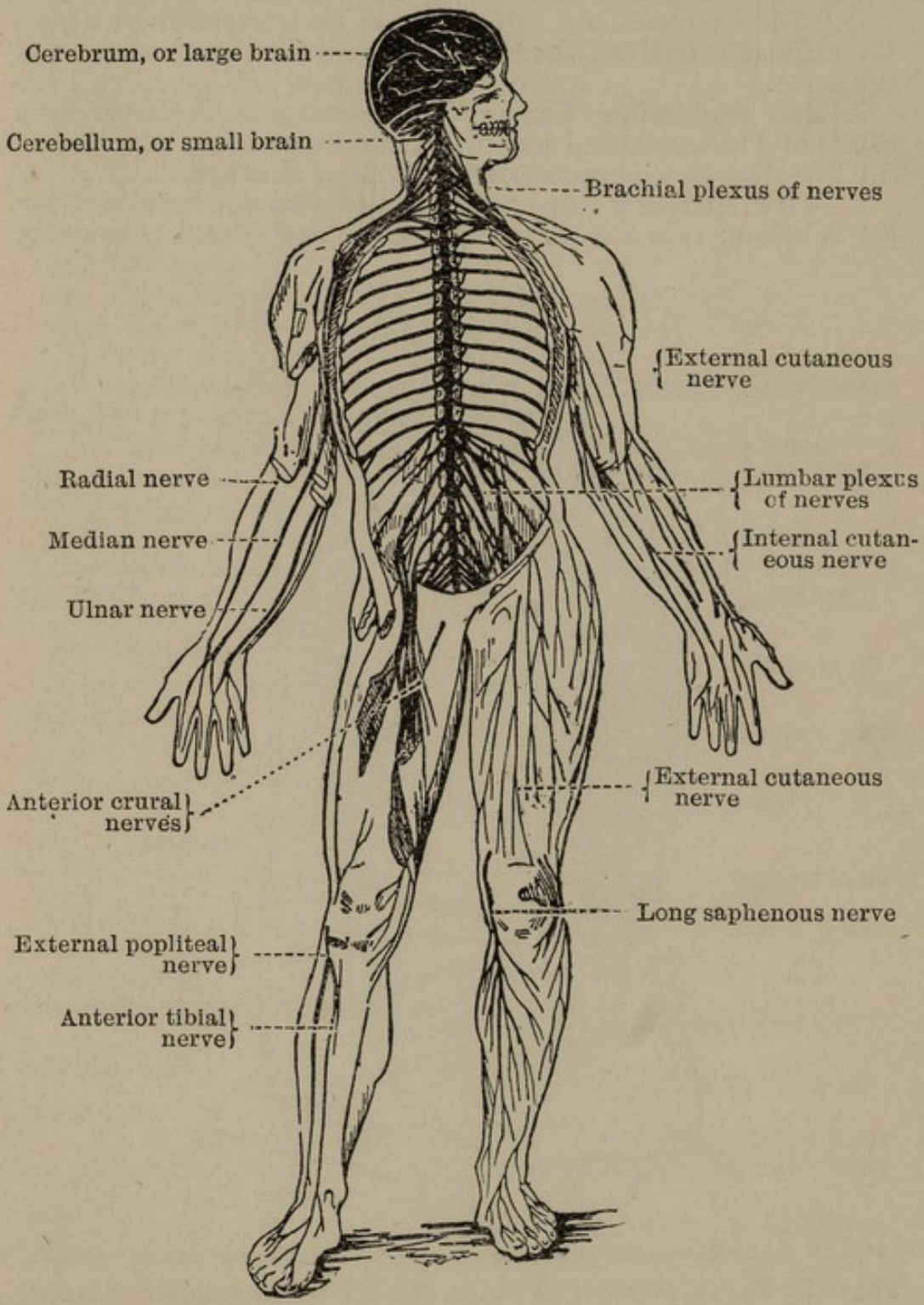


Fig. 14.—The Brain—Spinal Cord, and Spinal Nerves.

(*e*,) The roots and terminations of the *large Blood vessels* connected with the heart.

(*f*,) Some *large Nerves*.

(*g*,) *The Thoracic Duct*, which passes up into the thorax from the abdomen, and is placed along the front of the spine close to the aorta.

3. The Abdominal Cavity.—This occupies the lower two-thirds of the trunk, and may be divided into two parts, viz.:—(i,) *The Abdomen proper* above; (ii,) *The Pelvis* below.

I.—The Abdomen lies between the thorax above and the pelvis below; it is a flattened cylindrical cavity, and is bounded

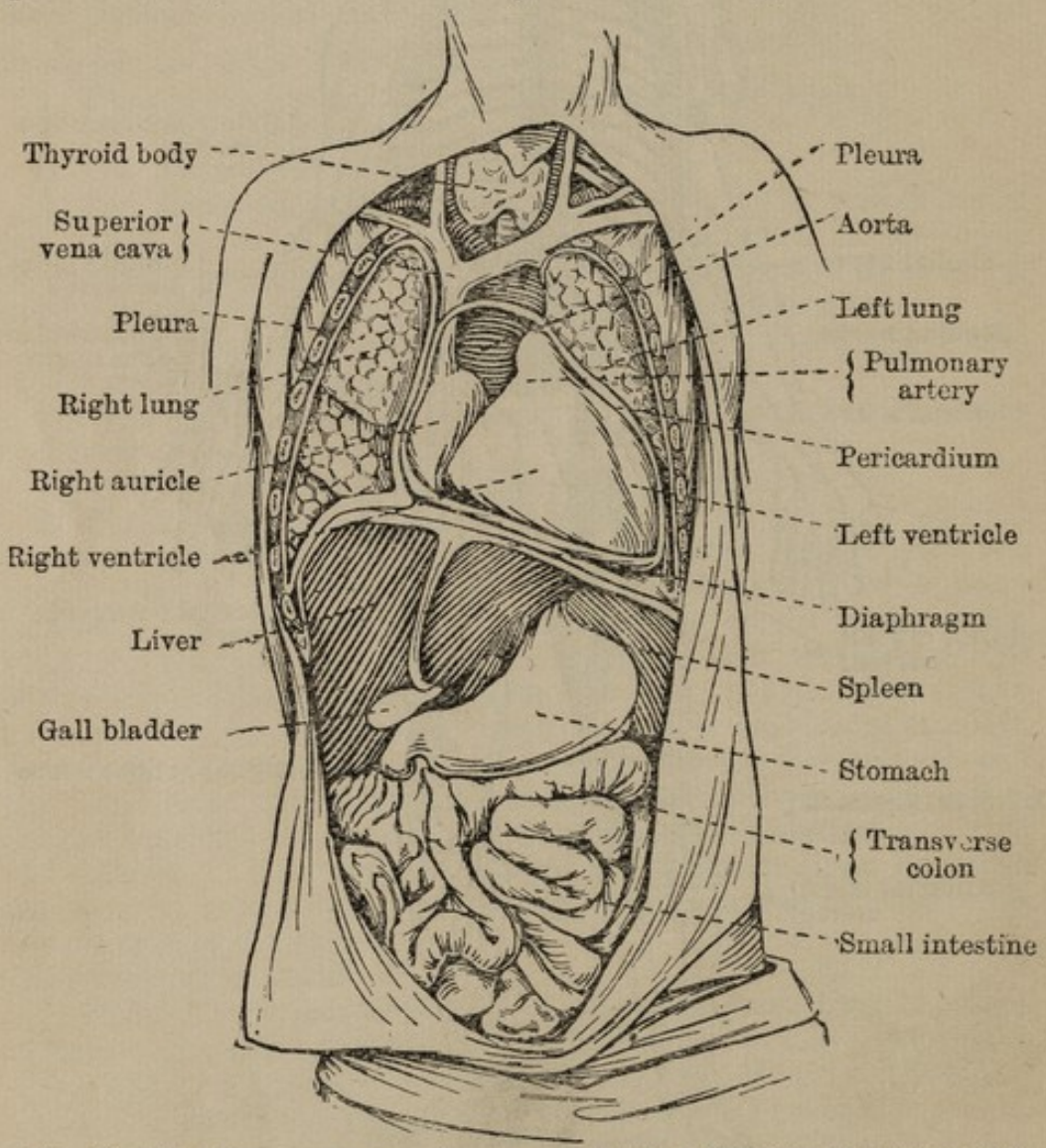


Fig. 15.—The Thoracic and Abdominal Organs (Slightly diagrammatic).

above by the *diaphragm* and *ribs*, behind by the *lumbar vertebræ*, and in front and at the sides by the *abdominal muscles*; its floor is formed by the *pelvic bones*. The inner surface of the abdomen is

lined by a thin transparent membrane—the *peritoneum*– which is also reflected over the abdominal organs.

The abdomen contains the following organs:—

(*a*,) *The Stomach.*

(*b*,) *The Small Intestine*, which consists of three parts, viz.:—the duodenum, the jejunum and the ileum.

(*c*,) *The Large Intestine*, which consists of six parts, viz.:—the cæcum, the ascending colon, the transverse colon, the descending colon, the sigmoid flexure, and the rectum.

(*d*,) *The Spleen* (milt).

(*e*,) *The Pancreas* (sweetbread).

(*f*,) *The Liver.*

(*g*,) *The Kidneys* with their ducts, the ureters.

In addition to the above, the abdomen also contains:—

(i,) *The Aorta*– the main artery of the body—which passes down along the left side of the spine, and gives off numerous branches to supply the abdominal organs.

(ii,) *The inferior Vena Cava*, which is placed along the side of the aorta and carries back to the heart the impure blood from the lower extremities and the abdominal organs.

(iii,) *The Thoracic duct*, which passes up close to the aorta, and in front of the spine, and is the channel for the conveyance of the products of digestion (the chyle).

(iv,) Part of the *Sympathetic Nervous System.*

The Position of the Abdominal Organs:—

(i,) Under the *left arch* of the diaphragm is placed the stomach.

(ii,) Under the *right arch* of the diaphragm lies the liver, with the gall bladder just under its right edge.

(iii,) In the *centre* and *lower part* of the abdomen lie the coils of the small intestine.

(iv,) In the *right groin* lies the cæcum.

(v,) In the *right flank* is placed the ascending colon.

(vi,) Across the *front* of the abdomen is the transverse colon.

(vii,) In the *left flank* lies the descending colon.

(viii,) In the *left groin* lies the sigmoid flexure.

(ix,) Transversely across the *back* of the abdomen is placed the pancreas.

(x,) In the *left side* and touching the stomach is placed the spleen.

(xi,) In the *posterior wall* on each side of the spinal column are placed the kidneys, the right one being close under the liver, the left one close under the spleen.

II.—The Pelvis.—This is a basin-shaped cavity, bounded behind by the *sacrum* and *coccyx*, and at the front and sides by the *pelvic bones* (*see* chapter II.); it communicates above with the abdomen, and it is closed in below by a muscular floor termed

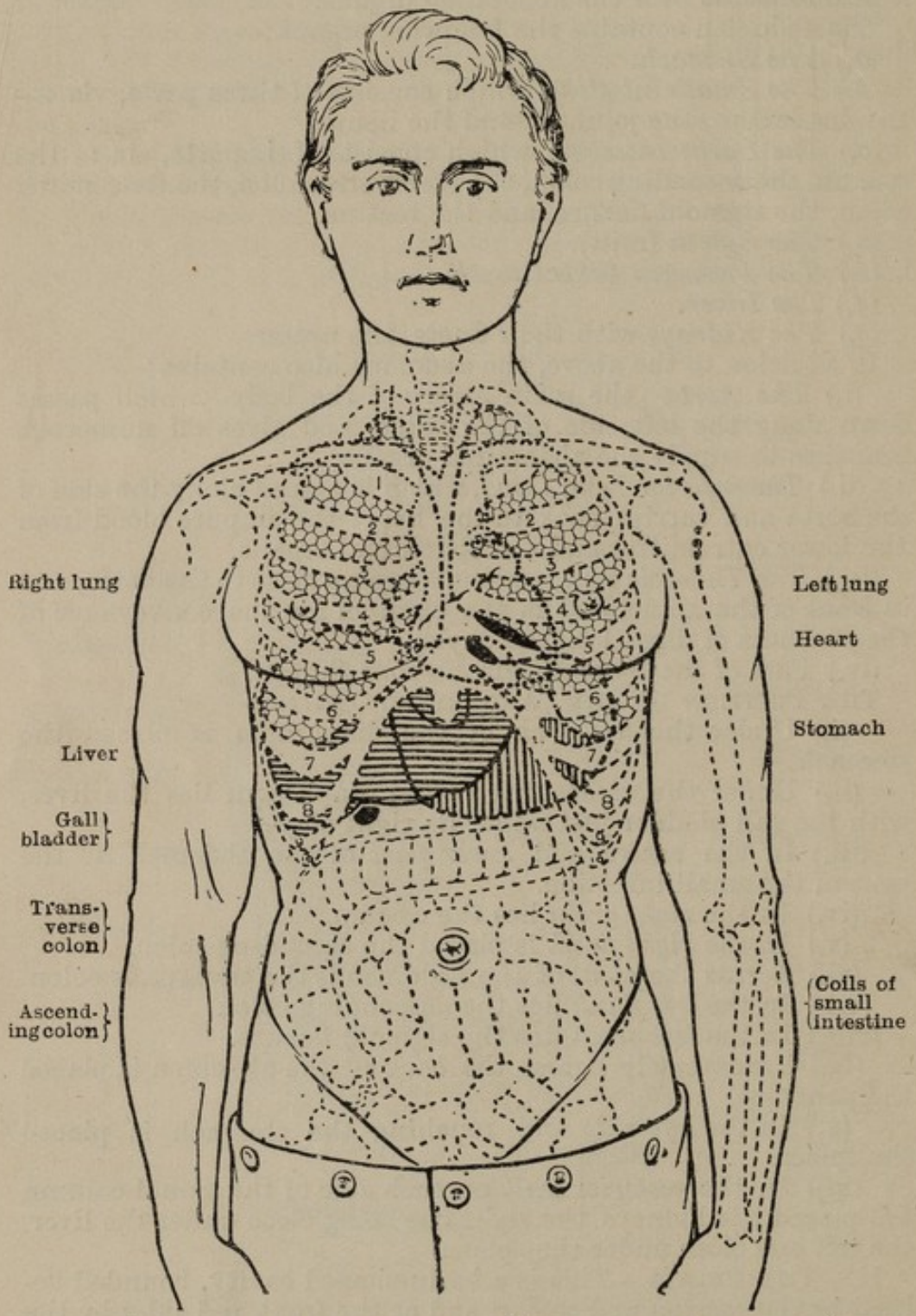


Fig. 16.—Showing the relation of the Thoracic and Abdominal Organs to the walls.—(*a*) Front view.
(The top middle trousers' button should be just about opposite the navel.)

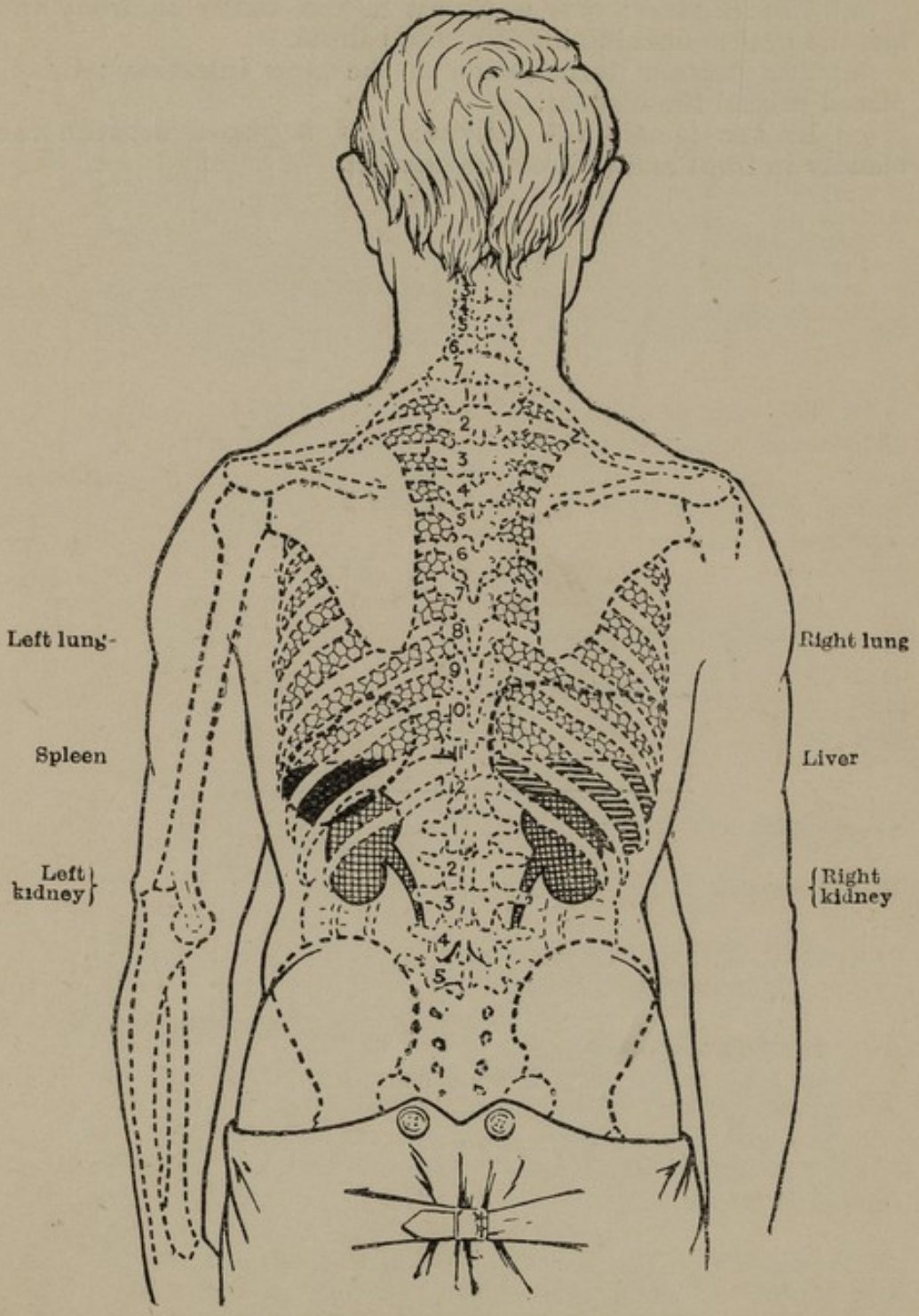


Fig. 17.—The Same.—(*b*) Back view.
(Trousers slipped down; the waist buckle should be opposite the waist.)

the *perineum*, in which is situated the opening of the rectum—the *anus*.

The *organs* contained in the pelvis are:—

(*a*,) *The Bladder*; this is placed in the centre in front and has the *ureters* opening into its base behind.

(*b*,) *The Rectum* (termination of the large intestine); this is placed behind the bladder.

(*c*,) In the female the *Uterus*; this is placed between the bladder in front and the rectum behind.

CHAPTER V.

THE BLOOD AND ITS CIRCULATION.

The Blood—Its Physical Characters—Its Structure and Quantity—The Coagulation of the Blood—The Functions of the Blood—The Kinds of Blood in the Body. The Heart—The Pericardium—The Situation and Position of the Heart—Its Structure—Its Action—Its Nervous Mechanism. The Arteries—their Structure—The Course of the Aorta and its Principal Branches. The Capillaries—their Structure and Distribution. The Veins—their Structure and Distribution. The Circulation of the Blood; through the Cavities of the Heart; through the Body (the Systemic circulation); through the Lungs (the Pulmonic circulation); through the Liver (the Portal circulation)—The Functions of the Circulation.

THE nourishing fluid of the body is the *blood*, and it is distributed to the various parts of the system by means of the *circulatory organs*, which comprise :—

A central force pump—the *Heart*, and a circuit of closed pipes—the *Blood-vessels.*

THE BLOOD.

This is contained within the heart and the blood-vessels.

Its Physical Characters.—In the living body blood is a red, apparently homogeneous, alkaline fluid having a faint odour, a saltish taste, a specific gravity of 1052 to 1058, and varying in colour from bright scarlet (arterial blood) to dark purple (venous blood).

Its Structure.—Blood consists of :—

(i,) A colourless transparent liquid, termed the *Plasma* or *liquor sanguinis*, in which float

(ii,) Minute solid particles, termed the *blood Corpuscles*, in enormous numbers.

Each cubic millimetre or $\frac{1}{16\,025}$ part of a cubic inch of human blood, contains over five millions of blood corpuscles.

These corpuscles are of two kinds, viz. :—

(*a*,) *The Red or Coloured Blood Corpuscles.*—These are soft, elastic, circular, bi-concave discs, each disc being $\frac{1}{3\,200}$ part of an inch in diameter, and of a pale yellow colour; when the discs are seen in numbers together, they appear red and give the blood its characteristic colour; after blood is drawn the red blood corpuscles adhere to each other by their broad surfaces, forming rolls (*rouleaux*) like so many coins.

(*b*,) *The White or Colourless Blood Corpuscles, or Leucocytes.*—These vary in shape and size, some are globular, others are irregular; they are also larger than the red corpuscles, being $\frac{1}{2\,500}$th part of an inch in diameter, and each contains one or

more *nuclei* in its centre; during life these corpuscles are *active*, they constantly change their shape (*amœboid* movements), and possess the power of absorbing foreign particles with which they come in contact. The white corpuscles exist in smaller numbers in the blood than the red, there being two or three white to one thousand red.

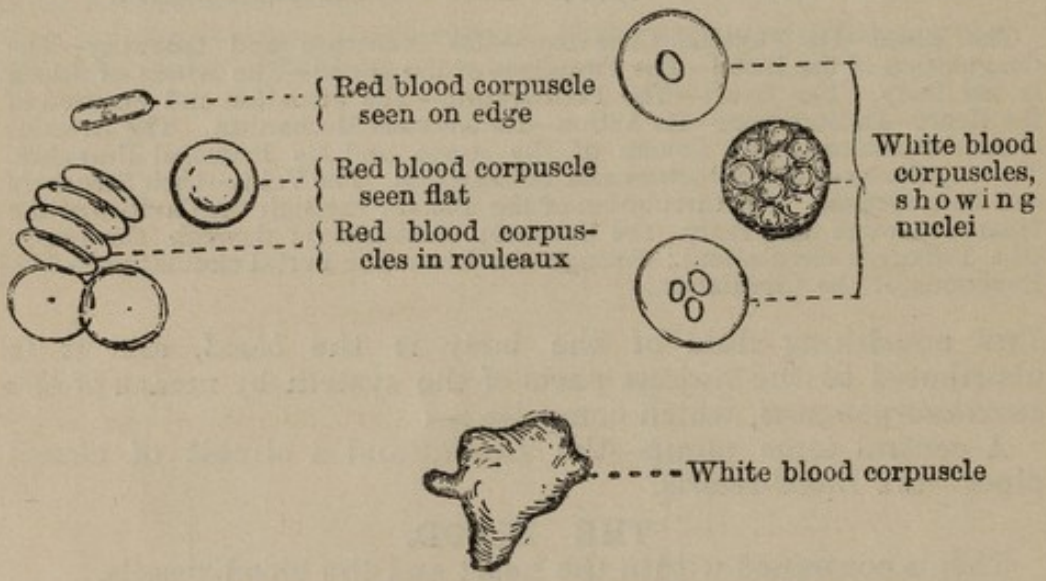


Fig. 18.—Blood Corpuscles (Magnified).

The Quantity of Blood in the Body.—This corresponds to about $\frac{1}{13}$th of the body weight, and it is distributed to the various parts as follows:—One quarter to each of the following, viz., (*a*,) the muscles; (*b*,) the liver; (*c*,) the heart, lungs, and the great blood-vessels; and (*d*,) the rest of the body.

The Coagulation of the Blood.—Blood possesses the property of *clotting* or *coagulating* on being shed; about four minutes after the blood leaves the blood-vessels it begins to clot, becoming first thick and viscid, and then forming a jelly, which in a short time becomes firmer and finally separates into two parts—a pale yellow alkaline fluid termed the *Serum*, and a solid red mass termed the *Clot*; this is composed of a network of fine fibres of a substance called *Fibrin*, and the red and white blood corpuscles which are held in its meshes. As long as blood remains in *healthy living blood-vessels* it keeps *fluid*, but if the vessels become *injured* or their *inner coats become diseased*, the blood begins to clot at the point of injury or disease; the *natural arrest* of hæmorrhage is due to this clotting of the blood at the mouths of open blood-vessels, and the measures which the surgeon adopts to arrest bleeding are practically those which favour the coagulation of the blood at the point of hæmorrhage.

The Functions of the Blood.—The purposes which the blood fulfils in the body are:—

(i,) *To absorb oxygen* from the air and carry it to the tissues. This is effected by the red blood corpuscles (*see* chapter VI, "Respiration").

(ii,) *To absorb the nourishment* derived from the products of digestion and convey it to the tissues.

(iii,) *To maintain and equalise the heat* of the body.

(iv,) *To provide the body with moisture.*

(v,) *To absorb refuse matter* from the tissues and convey it to the organs of excretion.

Arterial and Venous Blood:—

(i,) *Arterial Blood.*—This is found in the left side of the heart and in the arteries; it is pure, of a bright scarlet colour, and it contains a large quantity of oxygen united with it.

(ii,) *Venous Blood.*—This is found in the right side of the heart and in the veins; it is impure, of a dark purple colour, and it contains a large quantity of carbonic acid (carbonic oxide) united with it.

The Apparatus concerned in the Circulation of the Blood comprises:—

1. The Heart.
2. The Blood-vessels.

THE HEART.

This is a hollow muscular organ of a conical shape, 9 to 10 ounces in weight, about 5 inches long, 3½ inches broad, and 2½ inches deep. It is enclosed in a loose fibrous bag—

The Pericardium, which is conical in shape, having its base attached to the upper surface of the *diaphragm* (midriff), and its apex surrounding the great blood-vessels as they leave the heart; the pericardium consists of two layers—an outer, which is fibrous, and an inner, which is smooth and is reflected from the root of the large blood-vessels on to the external surface of the heart. It secretes a pale yellow fluid—the *pericardial* fluid.

The Situation and Position of the Heart.—The heart is suspended by the large blood-vessels (which spring from it), in the centre of the thorax; it is placed between the lungs, which partly cover it, and it lies in an *oblique* position behind the sternum and the costal cartilages, it projects more into the left than the right half cavity of the chest; and it rests by its posterior or under surface upon the *diaphragm.* The *base* of the heart is directed upwards, backwards, and to the right, and extends from the fifth to the eighth dorsal vertebræ; the *apex* of the heart points downwards, forwards, and to the left, and in the living subject its *impulse* (beat) against the chest wall can be felt in the *fifth intercostal space* (space between the fifth and sixth ribs), 1 inch below the left nipple and 3½ inches from the middle line of the sternum.

The Structure of the Heart.—The substance of the heart is composed of muscular fibres, which are arranged in three layers, viz.:—an inner layer of oblique fibres, a middle layer of circular fibres, and an outer layer of longitudinal fibres; the spaces between the muscular fibres are filled up with fat, which acts as a cushion. A *longitudinal muscular partition* divides the heart completely into two separate halves, a right and a left; each half is again divided by a *transverse constriction* into two compartments or chambers, which communicate one with the other by means of an opening—the *auriclo-ventricular orifice*, which is guarded by movable partitions or *valves*; the upper compartment acts as a receiving chamber for the blood, its walls are comparatively thin and it is termed an *auricle*; the lower compartment acts as a pumping chamber for the blood, its walls are thick and it is termed a *ventricle*. Each chamber of the heart is capable of containing about two ounces of blood.

The Chambers of the Heart.—

(*a*,) *The Right Auricle.*—This occupies the right and anterior portion of the base of the heart, it is quadrangular in shape, and it has projecting from its anterior and upper angle a tongue-shaped portion—the *auricular appendix*, which covers the root of the aorta; the inner surface of the wall of the auricle (except that of the appendix, which is more or less irregular) is smooth, at the *upper* and *lower posterior angles* there are *two openings*, viz., those for the *superior* and *inferior* vena cava respectively; these openings are not guarded by valves.

(*b*,) *The Right Ventricle.*—This occupies the anterior surface, the right border and a small part of the posterior surface of the heart, it extends nearly to the apex, and its upper left angle becomes continuous with the *pulmonary artery*; its muscular wall is thick at the base and thins off towards the apex. At the *base* of this ventricle are placed *two openings* which are protected by valves, viz.:—

(i,) *The auriculo-ventricular opening.* This is of an oval shape; it is situated towards the right and can easily admit three fingers.

(ii,) The opening for the *pulmonary artery.* This is smaller than the above and is placed more towards the left.

The valve protecting the auriculo-ventricular orifice is composed of *three segments or flaps*, and is termed the *Tricuspid Valve*; the flaps comprising this valve are made up of a thin transparent membrane, they are triangular and are attachedby their bases to the wall of the ventricle, and are here continuous with one another, their points or apices are free and meet in the middle line. The inner wall of the ventricle is very irregular, and has projecting from it small muscular pillars, termed the *Papillary muscles*; from the tips of these pillars pass thin white

cords, the *Chordæ tendineæ*, which attach themselves to the tips and under surface of the valves, and prevent these from being unduly forced back into the auricle. The valve protecting the orifice of the pulmonary artery is termed the *Semilunar valve.* This is composed of three half-moon-shaped flaps of transparent membrane, which are attached by their outer or convex borders to the inner surface of the artery; their inner borders are free, project into the vessel, and meet each other in the middle line. Each flap forms a pocket looking towards the artery; consequently the valve can permit the passage of the blood in one direction only, *i.e.*, from the ventricle into the artery.

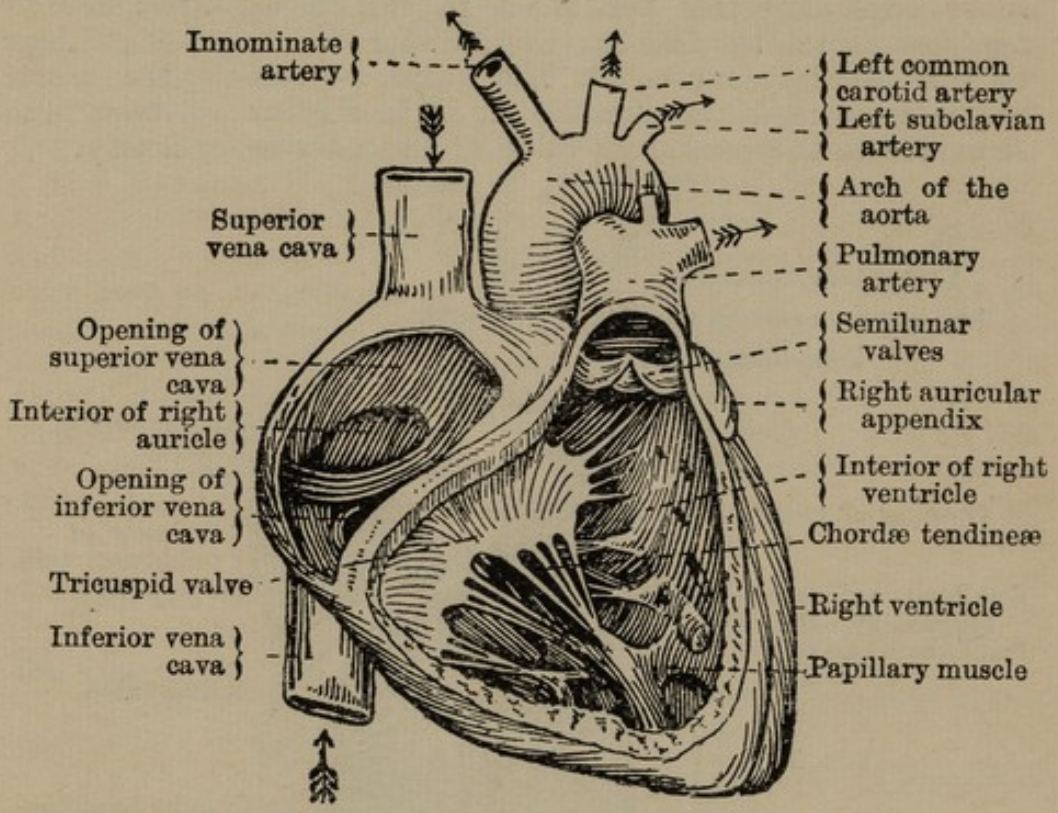


Fig. 19.—RIGHT SIDE OF THE HEART LAID OPEN.
(The arrows indicate the direction in which the blood flows.)

(*c*,) *The Left Auricle.*—This is situated along the left and posterior part of the base of the heart; it is quadrilateral in shape. A long tongue-shaped process, the *auricular appendix*, projects from the left side, curves towards the right and rests upon the pulmonary artery. There are *four openings* into this auricle, two on each side; these are the openings of the *pulmonary veins*; they have no valves.

(*d*,) *The Left Ventricle.*—This occupies the left border of the heart; in structure it is similar to the right ventricle but its

walls are three times as thick. At its base and placed close together there are *two orifices* guarded by valves, viz.:—

(i,) *The Auriculo-Ventricular Opening.*—This is placed at the left and posterior part of the base; it is oval in shape and smaller than the one in the right ventricle.

(ii,) *The Aortic.*—This is placed a little in front and to the right of the above; it is circular in shape.

The valve protecting the auriculo-ventricular orifice is termed the *bicuspid* or *mitral* valve, it is composed of two flaps of membrane, the outer edges of these flaps are attached to the wall of the ventricle and are continuous with one another, the inner edges are free and meet in the middle line; *chordæ tendineæ* attach the free edges and under surfaces of these flaps to the papillary muscles. The valve protecting the aortic orifice is termed the *semilunar*; it is similar in shape and structure to the semilunar valve of the pulmonary artery.

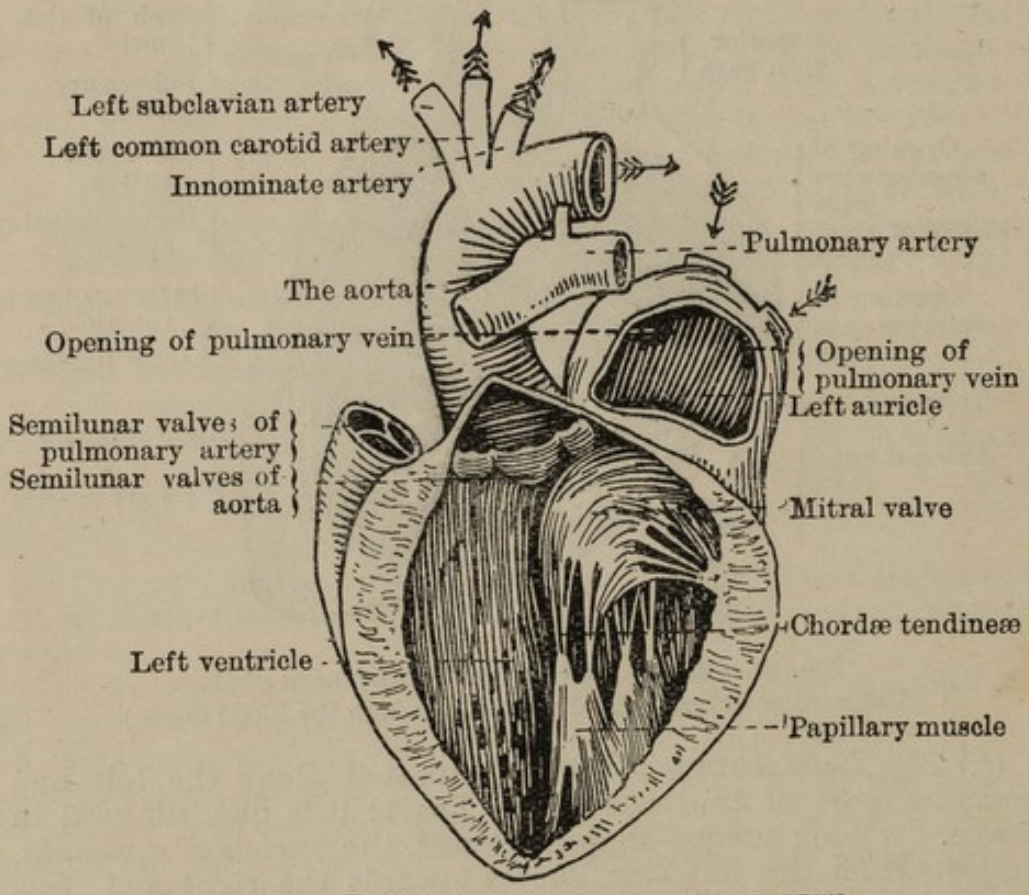


Fig. 20.—LEFT SIDE OF THE HEART LAID OPEN.
(The arrows indicate the direction in which the blood flows.)

The Action of the Heart.—The muscular fibres of the heart contract, by contracting they become shorter and thicker and obliterate the cavities of which they form the walls; consequently

the blood contained in the cavities is driven out. The two auricles of the heart contract *synchronously* (at the same time); this is immediately followed by the two ventricles contracting together, and this is followed by a pause or period of rest during which the heart relaxes and refills; the auricles then again contract, etc. The contraction of the auricles and ventricles is termed the *Systole* or "beat of the heart;" the period between two successive contractions is termed the *Diastole*. With each beat the apex of the heart strikes against the chest wall; this striking is termed the *Cardiac Impulse*. The heart beats in a healthy adult male about seventy-two times a minute. With each beat blood is forced into the aorta and the arteries, causing these vessels (which are elastic) to expand; so that a wave of distension, termed the *Pulse*, passes down the whole arterial system, and can be readily felt by the finger in any of the superficial arteries, *e.g.*, the radial artery at the wrist.

The Nervous Mechanism of the Heart.—The beat of the heart is *automatic*, and is due to the presence of *nerve cells* in its muscular substance. The *force* and *frequency* of the beat is regulated by *two sets of nerves*. The *vagus nerve* which has its origin in the *medulla oblongata*, besides supplying branches to the respiratory and digestive organs, also sends *branches to the heart*; these branches convey from the medulla impulses which *control* or *inhibit* the heart's action. The other set of nerves are supplied from the *sympathetic chain*, and convey impulses which *accelerate* the heart's action.

THE BLOOD-VESSELS.

These are:—

(i,) *The Arteries*, which convey the blood from the heart to the various parts of the body.

(ii,) *The Capillaries*, which distribute finally the blood to the organs and tissues.

(iii,) *The Veins*, which bring back the blood from the organs and tissues to the heart.

The Arteries.—These are fibro-muscular elastic tubes, which lead from the lower chambers (the ventricles) of the heart; they contain no valves within themselves (like the veins), except at their points of origin from the heart, viz., in the *aorta* and the *pulmonary artery*, and when empty their walls do not collapse. The main arteries usually occupy protected situations, *e.g.*, in the limbs they are found along the inner surfaces and in the folds of joints. The arteries by continually dividing break up at length into a number of branches of gradually diminishing size, which finally end in extremely small vessels of microscopic size—the *Capillaries*. In some parts of the body arteries run directly one into the other, forming what are termed

anastomoses, and thus should one channel be obstructed from any cause other channels are provided for the passage of blood to the tissues.

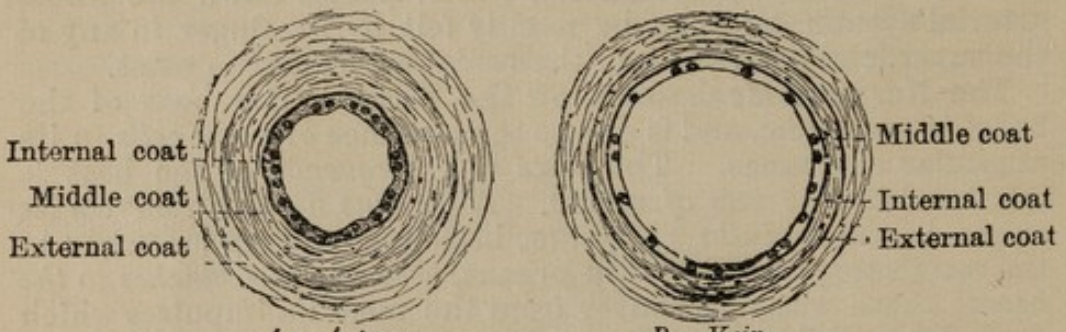
The Structure of an Artery.—A typical artery is composed of three coats :—

(*a*,) *An outer coat*, which consists chiefly of connective tissue.

(*b*,) *A middle coat*, which consists of muscular and elastic tissue.

(*c*,) *An inner coat*, which consists of a fine membrane of epithelial tissue, composed of thin flat cells united together by their edges.

The larger arteries contain more elastic tissue, the smaller ones contain more muscular tissue; the former are therefore more elastic, the latter more contractile.



A.—Artery. *B.—Vein.*

Fig. 21.—Transverse section of an Artery and a Vein of corresponding size (Magnified).

The course of the Aorta and its Principal Branches.

The Aorta.—The main artery of the body starts from the left ventricle, and at its point of origin gives off two branches—the *Coronary arteries*, which turn back over the surface of the heart to supply its muscular tissue with blood; it then passes upwards on the right side of the spine, and arches across the root of the left lung to the left side of the spine.

This arch is divided into three parts, viz.:—

(i,) The ascending aorta.

(ii,) The transverse aorta.

(iii,) The descending aorta.

From the *transverse arch of the aorta* three branches are given off, viz.:—

(i,) The *Innominate artery* from the right side of the arch. This is a short thick trunk about 1 inch long, which divides into two branches—

(*a*,) The *Right common Carotid*. This goes to the right side of the head and neck.

(*b*,) The *Right Subclavian*. This goes to the right upper limb.

(ii,) The *Left common Carotid*, the second branch. This goes to the left side of the head and neck.

(iii,) The *Left Subclavian*, the third branch. This goes to the left upper limb.

The *Common Carotid* artery runs up the side of the neck, and opposite the upper border of the *thyroid cartilage* (Adam's Apple) divides into two branches:—

(*a*,) The *Internal carotid.*—This buries itself deeply in the structures of the neck, passes upwards, and enters the skull through the *temporal bone* to supply the brain with blood.

(*b*,) The *External carotid.*—This runs upwards towards the lobe of the ear, and in its course gives off three large branches, viz.:—

(i,) The *Facial*, which courses over the lower jaw to supply the face.

(ii,) The *Temporal*, which courses upwards and in front of the ear towards the temple to supply the side of the head.

(iii,) The *Occipital*, which courses upwards behind the ear towards the occiput to supply the back of the head.

The *Subclavian artery* passes upwards in an arch behind the clavicle over the first rib to its lower edge, and is continued into the armpit as—

The *Axillary artery*, which extends across the axilla into the arm, where it is continued on as—

The *Brachial artery*, which passes downwards and forwards along the inner border of the *biceps* muscle to one inch below the bend of the elbow, where it divides into two branches.:—

(i,) The *Radial artery.*—This takes its course along the outer side of the forearm towards the thumb; here it dips deeply down and forms by union with the *ulnar* artery the *deep palmar arch*, from which branches are given off to the back part of the hand and the fingers.

(ii,) The *Ulnar artery.*—This courses along the inner side of the forearm to the wrist; here it forms by union with the *radial artery* the *superficial Palmar Arch*, from which branches are given off to the fingers and palm of hand.

The *Descending* aorta takes its course downwards through the thorax along the left side of the vertebral column, it is here termed the *Thoracic aorta*, and gives off branches to the *intercostal* muscles, the *lungs* and *other structures* in the thorax; it then pierces the *diaphragm* or *midriff*, enters the abdomen and is termed the *Abdominal aorta*, then it passes downwards in front of the vertebral column, and on reaching the level of the *fourth lumbar vertebra* it divides into two branches, the *Right* and *Left common iliac arteries.*

The chief branches given off from the *Abdominal aorta* from above downwards are:—

(i,) The *Cœliac Axis*, a short thick branch which divides into three, viz.:—

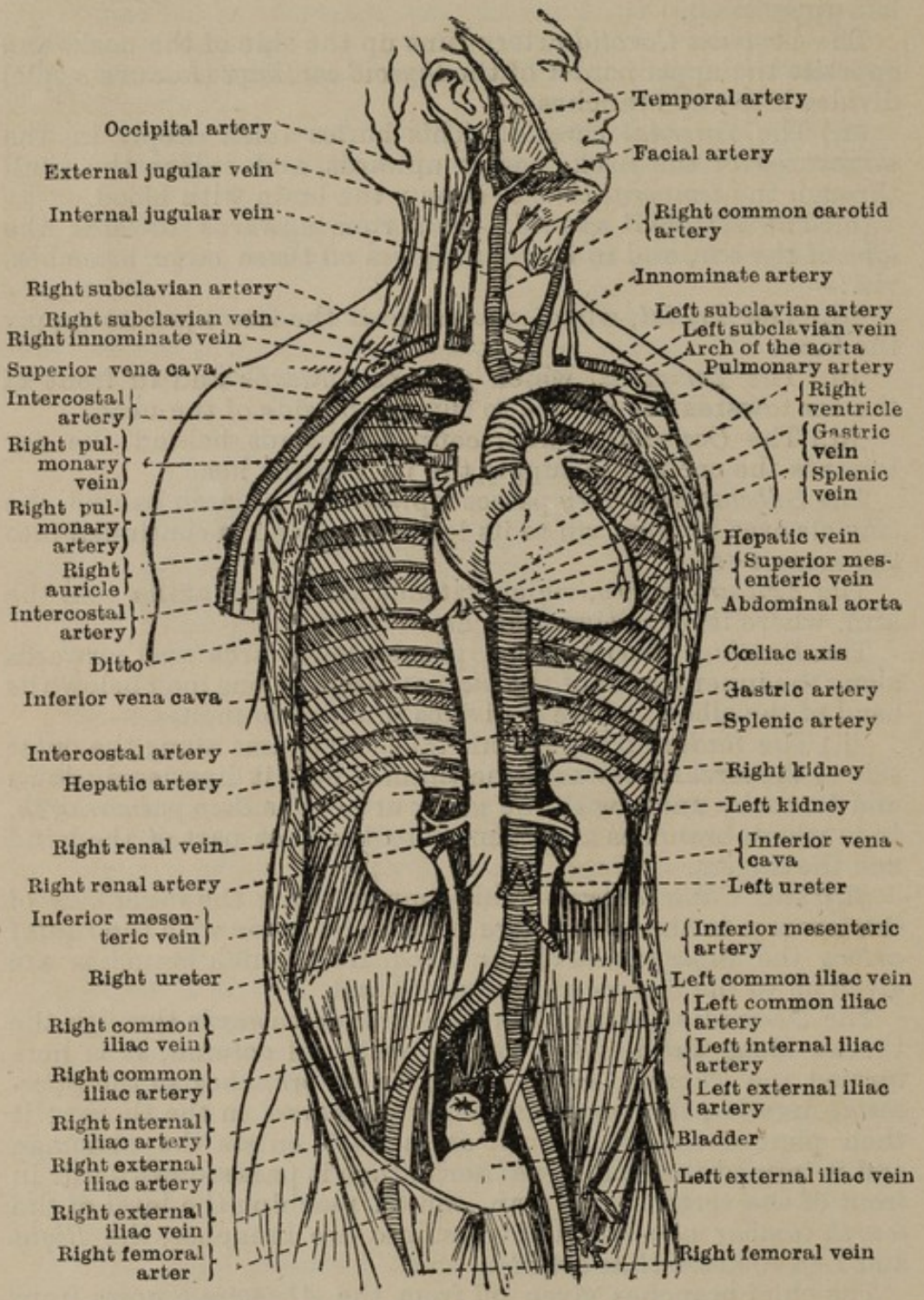


Fig. 22.—PRINCIPAL VESSELS OF THE HEAD, NECK, UPPER EXTREMITY AND TRUNK.

(*a*,) The *Gastric* artery to the stomach.
(*b*,) The *Splenic* artery to the spleen.
(*c*,) The *Hepatic* artery to the liver.
(ii,) The *Renal Arteries*, right and left to the kidneys.
(iii,) The *Mesenteric Arteries* to the mesentery and intestines.

The *Common Iliac Artery* is about 2½ inches long and divides into two branches:—

(i,) The *Internal iliac artery.*—This passes downwards and backwards into the pelvis, and supplies the structures contained in it.

(ii,) The *External iliac artery.*—This passes along the back of the pelvis to the middle of the fold of the groin; here it perforates the abdomen, enters the thigh and becomes—

The *Femoral Artery.*—This passes down the front of the thigh to the inner side of the knee, enters the ham and becomes—

The *Popliteal Artery*, which passes along the middle of the fold of the ham, and divides just above the bend of the knee into two, viz:—

(i,) *Anterior Tibial artery*, which pierces the structures between the two bones of the leg, passes down the front of the tibia to the ankle, and is continued on to the dorsum or upper surface of the foot as the *Dorsalis pedis artery*.

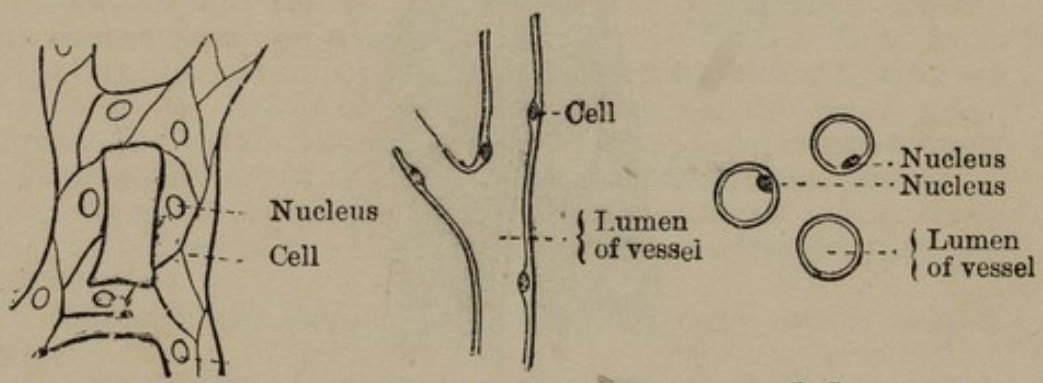
(ii,) The *Posterior Tibial artery.*—This passes down behind the tibia to the inner ankle and the sole of the foot, and gives off a branch:—

(*a*,) The *Peroneal* artery, which passes along on the outside of the back of the leg to the heel and outer ankle. At the inner ankle the posterior tibial artery divides into two branches, viz.:—

(*b*,) The *External Plantar* artery.
(*c*,) The *Internal Plantar* artery.

These supply the toes and sole of the foot.

The Capillaries.—These are extremely minute vessels, about $\frac{1}{3000}$ inch wide, which intervene between the smallest arteries and the commencement of the veins.



A, Surface view: *B, Cut longitudinally;* *C, Cut across.*

Fig. 23.—CAPILLARIES (Magnified).

Their Structure.—The walls of capillaries are very delicate, being made up of a single layer of flat cells, joined edge to edge to form a tube; these walls are permeable by the white blood corpuscles and permit the interchange of *nutritive material* from the blood to the tissues, and of *waste material* from the tissues to the blood.

The Veins.—These are thin-walled tubes which collapse when empty. Within the veins there are found valves, which are usually placed in pairs and look towards the heart; these valves are more numerous in the veins of the lower extremity and in the veins of muscular parts. Some veins, as the *superior* and *inferior venæ cavæ*, the *pulmonary veins* and the *portal vein*, contain no valves. The object of the valves is to prevent the backward flow of blood into the capillaries during muscular contraction.

The Structure of a vein.—A typical vein has three coats (*see* Fig. 21):—

(*a*,) An *Outer coat*, consisting of elastic tissue and muscular fibres.

(*b*,) A *Middle coat*, consisting of muscular and fibrous tissue, but much thinner than the middle coat of an artery.

(*c*,) An *Inner coat* of similar structure to the inner coat of an artery.

The Distribution of the Veins.—The veins are more numerous than the arteries, and are arranged into two principal sets; one, a *superficial set*, lies just below the skin; another, a *deep set*, accompanies the arteries. All the blood coming from the head,

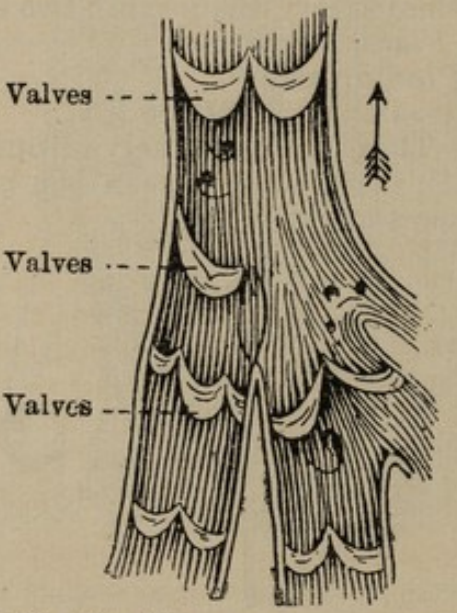


Fig. 24.—VEIN CUT LONGITUDINALLY.
(The arrow indicates the direction in which the blood flows.)

the neck and the upper extremities and the thorax is finally gathered up into one large vein, the *Superior vena cava.* All the blood coming from the lower extremities and the abdomen is finally gathered up into another large vein, the *Inferior vena cava.*

THE CIRCULATION OF THE BLOOD.

1. Through the Cavities of the Heart.—The *right auricle* receives its blood from the *Superior* and *Inferior Venæ Cavæ.* As soon as it is full it begins to contract from above downwards, *i.e.*, from just above the point where the two veins open into it, the blood unable to pass back into the veins flows downwards into the right ventricle, which as it becomes full also begins to contract; the first effect of this contraction is to force some of the blood behind the flaps of the *tricuspid* valve, these float up, meet together and shut off the ventricle from the auricle. As the contraction proceeds the *chordæ tendineæ* attached to the tricuspid valve tighten by the contraction of the *papillary* muscles, and prevent the valve from being forced back into the auricle; the pressure set up by the continued contraction of the *ventricle* finally forces open the *semilunar valve* of the *pulmonary artery*, the blood is driven along this vessel, distends it, and passes into the lungs. As soon as the right ventricle has emptied itself it begins to relax, the backward pressure in the over-distended pulmonary artery fills the pockets of the semilunar valve, brings them together and causes them to meet in the middle line; the blood is thus prevented from flowing back into the empty right ventricle.

The *four pulmonary veins* pour their blood into the *left auricle*; when this cavity is full it contracts in the same manner and at the same time as the right auricle, and the blood is driven into the *left ventricle*; when this is full it contracts in the same manner and at the same time as the right ventricle; as soon as its contraction begins some of the blood is forced back behind the flaps of the *mitral valve*, these meet and close the opening into the left auricle; as the contraction proceeds the *chordæ tendineæ* also tighten and prevent the flaps from being forced backwards. The continued contraction now forces the *semilunar valves* of the *aorta* and drives the blood along towards the body. When the left ventricle has emptied itself it relaxes, the pressure of blood in the overfull and distended aorta forces back the pockets of the semilunar valve; these meet and prevent the blood from flowing backwards into the left ventricle.

2. Through the Body.—Here the blood has a double course, viz.:—

(i,) *The Systemic Circulation.*—The pure arterial blood, which is bright red, is driven from the *left ventricle* into the *aorta*,

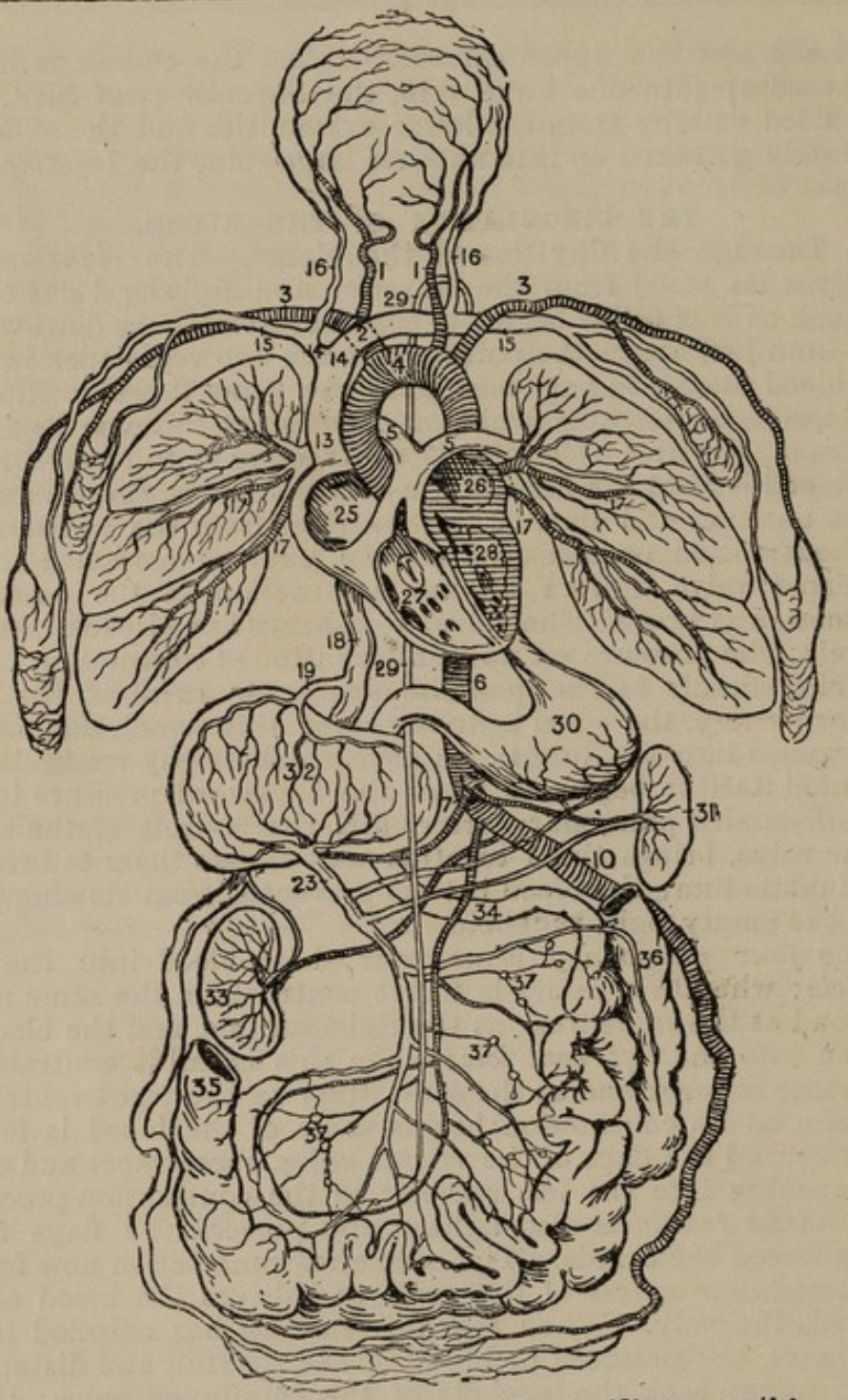


Fig. 25.—THE CIRCULATION OF THE BLOOD (diagrammatic).

1, The carotid arteries; 2, The innominate artery; 3, The subclavian artery; 4, The arch of the aorta; 5, The pulmonary arteries; 6, The thoracic aorta; 7 and 10, The abdominal aorta; 13, The superior vena cava; 14, The right innominate vein; 15, The subclavian veins; 16, The internal jugular veins; 17, The pulmonary veins; 18, The inferior vena cava; 19, The hepatic vein; 23, The portal vein; 25, The right auricle; 26, The left auricle; 27, The right ventricle; 28, The left ventricle; 29, The thoracic duct; 30, The stomach; 31, The spleen; 32, The liver; 33, The kidneys; 34, The duodenum; 35, The ascending colon; 36, The descending colon; 37, Abdominal lymphatic glands.

and is distributed by its numerous branches to the various parts and organs of the body; from the arteries it passes into the *capillaries*, here it gives up to the tissues its oxygen and the nourishment derived from the products of digestion, and takes up from them the carbonic acid and waste products, and passes into the *veins*, which convey it backwards towards the heart; all the venous blood, which is dark purple in colour, finally enters the *right auricle* by the *superior* and *inferior venæ cavæ*.

(ii,) *The Pulmonic Circulation.*—The venous blood is driven by the *right ventricle* into the *pulmonary artery*, which divides into two branches, the right and left, which go to the two lungs; in the lungs, these branches sub-divide into smaller and smaller vessels, and finally end on the walls of the air cells; circulating in this capillary network the venous blood meets with the pure inspired air; from this it absorbs the oxygen and gives up to it its carbonic acid, watery vapour and some volatile products; it changes its colour from dark purple to bright red, and is finally collected into four large vessels, two from each lung—the *pulmonary veins*, which bring it back to the *left auricle*.

The Portal Circulation.—The blood coming from the stomach, intestines, spleen and pancreas is first gathered up into one single trunk, the *portal vein*; this passes into the liver, and after branching and dividing in its substance breaks up into a number of capillaries, which finally end in the *hepatic vein* which passes from the liver into the *inferior vena cava* near its entrance into the right auricle.

The Functions of the Circulation.—The function of the *systemic circulation* is to convey oxygen gas (in the red blood corpuscles) and nutrient matter to the various organs and tissues, to distribute it to them by means of the capillaries, and to collect up also by means of the capillaries, substances which result from the wear and tear, and which are of no further use to the body and to convey them to the lungs and the other organs of excretion. The function of the *Pulmonic circulation* is the aëration of the blood (*see* chapter VI "Respiration"). The function of the *Portal circulation* is the elaboration of nutriment (*see* chapter VII "Digestion").

CHAPTER VI.

RESPIRATION.

The Purification of the Blood in the Body—The Respiratory Apparatus, *viz.*, the Upper Air Passages, the Larynx, Trachea, Bronchi and Lungs—Their structure—Respiration, how defined—The Respiratory Act—Inspiration and Expiration—Inspiration, how produced—Expiration, how produced—The Normal Rate of Respiration—The Quantity of Air respired—Asphyxia—The change of Venous to Arterial Blood.

The Blood is purified in three different ways, *viz.* :—

(i,) By passing through the blood-vessels of the *Lungs*, where it gets rid of its *Carbonic Acid Gas* (the result of oxidation of *Carbonaceous* or heat-producing substances) and excess of *Water* in the form of vapour.

(ii,) By passing through the blood-vessels surrounding the *Sweat Glands* under the surface of the skin (*see* chap. III, page 23), where it gets rid of excess of *Water* in the form of *Perspiration*, a small quantity of *Carbonic Acid Gas* and a little *Urea* (the result of destruction of *nitrogenous* or tissue-forming substances).

(iii,) By passing through the blood-vessels of the *Kidneys* (*see* chap. VIII, page 60), where it gives up excess of *Water* with a large proportion of *Urea* and a little *uric acid*, both held in solution (the latter also the result of the destruction of *nitrogenous* substances), in the form of *Urine*.

The *Purification* of the blood through the lungs is effected by the process of *Respiration*, or the *Act of Breathing*.

THE RESPIRATORY APPARATUS.

This comprises :—

1, *The Upper Air Passages, viz., the Mouth, Nose and Pharynx.*
2, *The Larynx.*
3, *The Trachea, or Wind Pipe*, and *Bronchi.*
4, *The Lungs.*

1, The Upper Air Passages (*see* chap. IX, *Fig.* 31).

The Mouth.—The cavity of the mouth is bounded on each side by the cheeks, the floor is formed by the tongue, and the roof by the palate. The front portion of the palate is hard, consisting of a bony plate, and is termed the *hard palate.* The back part is soft, consisting of a thin sheet of muscle, and is termed the *soft palate.*

The soft palate carries in its centre a prolongation termed the *Uvula.*

When the soft palate is fully depressed it separates the mouth from the pharynx. When it is drawn up over the posterior nares it shuts off the cavity of the nose from the pharynx.

The Nose.—This contains a cavity on each side separated by a central partition. Each cavity is partly divided into three chambers by three delicate scroll-like bones—the *Turbinated Bones.* The cavities open in front to the exterior by the nostrils or anterior nares and behind into the pharynx by the posterior nares.

The mouth and nose are lined by a highly vascular mucous membrane, so that the air in passing through them is both warmed and moistened before it enters the lungs.

The Pharynx.—This is a wide, funnel-shaped cavity, four inches long; its walls consist of sheets of muscular tissue lined by mucous membrane. At its lower end the pharynx opens behind into the *Œsophagus*, or gullet, and in front into the *Larynx.*

2, The Larynx contains the organ of voice. It is placed at the base of the tongue and forms the entrance to the *Trachea.* It has a funnel and ring-like appearance and is composed of nine cartilages connected by ligaments and moved by numerous muscles, and it is lined by mucous membrane. The opening into the larynx is chink-like and is termed the *Rima Glottidis.* This is guarded by a thin cartilaginous leaf-like structure termed the *Epiglottis* (*see* Fig. 25), which, in the act of swallowing, is drawn down over the glottis; food or other foreign matter is thus prevented from passing into the larynx. Situated in the interior of the larynx are the *Vocal Cords.* These are placed horizontally from before backwards, and are four in number. The two upper ones are termed the *False Vocal Cords.* They are merely folds of mucous membrane, and have nothing to do with voice production. The two lower ones are the *True Vocal Cords.* They are composed of fibrous tissue covered with mucous membrane. The height and depth of the tone depend upon the number of vibrations of the true vocal cords, the tension of the cords being produced by the small muscles surrounding the larynx.

3, The Trachea and Bronchi.—The trachea, or wind pipe, is a cartilaginous and membranous tube about 4½ inches long. It consists of from seventeen to twenty **C**-shaped cartilaginous rings placed one over the other and united by membrane. The posterior or back wall is formed of muscular tissue. Internally it is lined by *Ciliated Epithelium.*

At its lower part the trachea divides into two great branches termed the *Bronchi* (one for each lung). These consist of semi-circles of cartilage united together by connective tissue and

lined by mucous membrane. Each bronchus, after entering the lung, divides and subdivides into a large number of smaller tubes —the *Bronchial Tubes*—until finally each minute bronchial

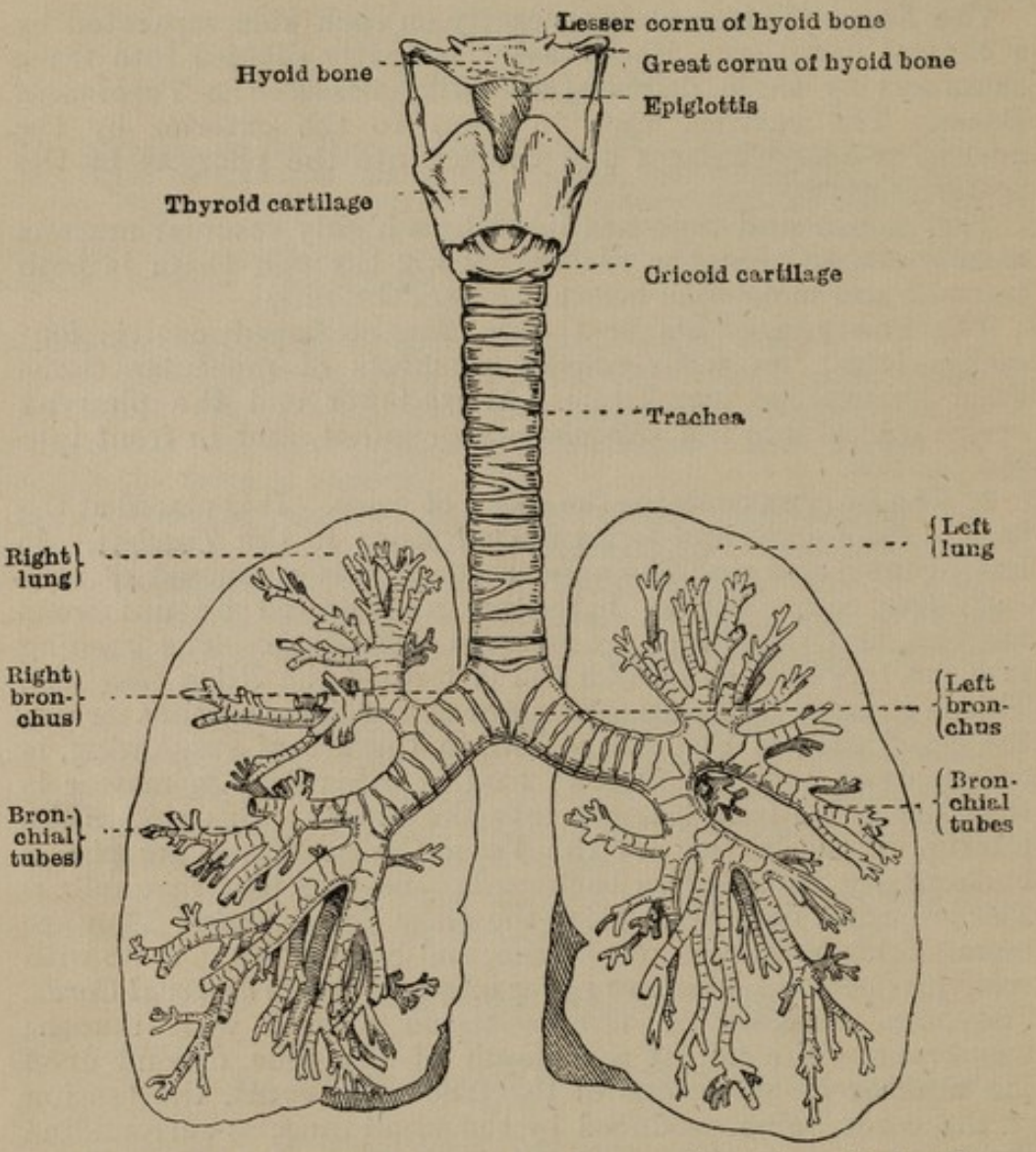


Fig. 26.—The Larynx, Trachea and Bronchi (seen from the front).

tube divides into a cluster of short, blunt and somewhat dilated branches. These dilatations are termed *Infundibula*. The wall of each infundibulum is folded inwards, partly dividing it into a number of chambers. Each of these chambers is termed an *Alveolus* or air cell.

4, The Lungs are two large conical spongy masses which fill up the cavities of the thorax (*see* chap. IV, *Fig.* 15) on each side of the heart.

They are surrounded by the ribs, the costal cartilages and the sternum at their tops, backs, fronts and outer sides; their

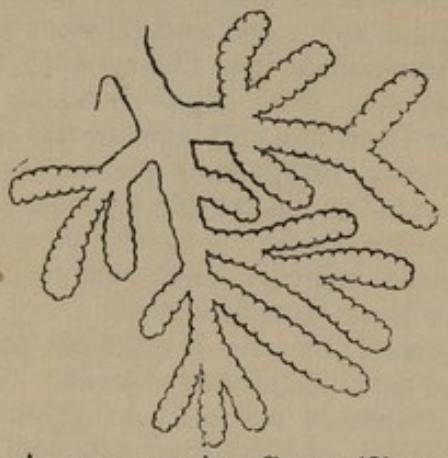


Fig. 27.—Alveoli or Air Cells (diagrammatic).

inner sides incline towards the pericardium, and by their bases they rest on the diaphragm.

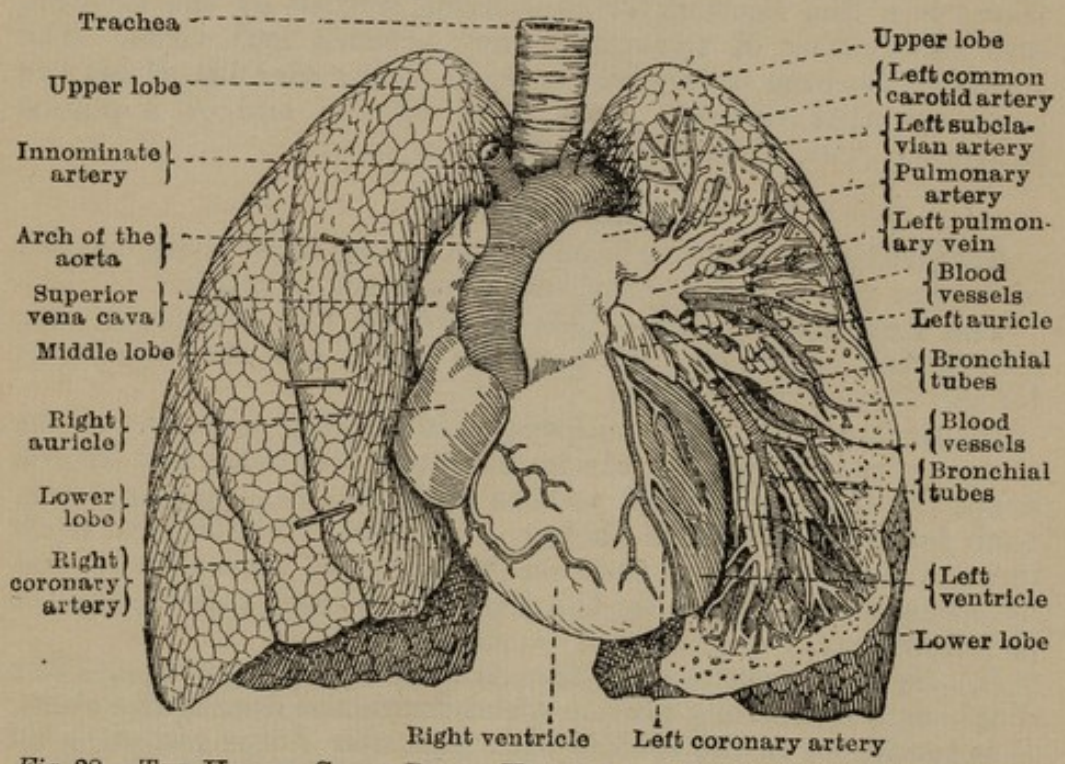


Fig. 28.—The Heart, Chief Blood Vessels and Lungs (seen from in front). The front portion of the left lung is cut away to show the branching of the bronchial tubes and the blood vessels.

They are covered by a delicate serous membrane, the *Pleura*, which is also reflected over the inner surface of the thorax. The pleura secretes a thin fluid, the *Serous* fluid, which enables

the lungs to work smoothly against the walls of the thorax during the movements of respiration.

Each lung is conical in shape with its base below, resting upon the arch of the diaphragm, and its apex above. This forms a blunted point and reaches into the root of the neck above the margin of the first rib. The right lung is divided into *three lobes*; it is broader than the left (owing to the position of the heart) and also shorter, but it is of greater capacity.

The left lung is smaller, narrower and longer than the right, and is divided into *two lobes*. A little above the middle of the inner border of each lung is the *root* by which the lung is connected with the heart and trachea.

The *Root* is formed by the bronchus, pulmonary arteries, nerves, lymphatics and pulmonary veins. The lung substance is made up of a number of air cells or alveoli which are really the closed dilated ends of the fine bronchial tubes (see above).

The walls of the alveoli consist of fine elastic connective tissue lined internally by a layer of flattened cells joined edge to edge. Situated just beneath the cells and in the connective tissue is a fine network of capillaries formed by the dividing and subdividing of the pulmonary arteries and veins. The tissue of the lung is very *elastic* (so that the amount of air the lung contains varies); it is light, spongy and of a porous character, and, when healthy, floats in water.

RESPIRATION.

Respiration may be defined as the *taking in* by living matter of oxygen gas, and the *giving out* of carbonic acid gas.

The Respiratory Act.—This is divided into two parts, *viz.*, *Inspiration*, or drawing air into the lungs, and *Expiration*, or forcing air out of the lungs.

Inspiration.—In the unopened thorax the pressure of the atmosphere through the air in the bronchial tubes and alveoli keeps the lungs distended so that each lung fills up completely each lateral half of the thorax. In order, therefore, to draw more air into the lungs the thorax has to be increased in size by some force exerted by the living body, and this is effected as follows, *viz.*:—

(i,) *By the flattening of the Arch of the Diaphragm.*—The diaphragm is a strong muscle which forms the floor of the chest. It is tendinous in the middle with muscular fibres radiating all round. These are inserted into the lumbar vertebræ, into the cartilages of the lower six ribs and into the lower end of the breast bone. It is arched above so that it is *convex* to the thorax. When the diaphragm contracts, the muscular portion pulls on the central tendinous part, draws it down and causes the arch to become less convex. This flattening of the

diaphragm increases the cavity of the thorax from above downwards (*see* Fig. 29).

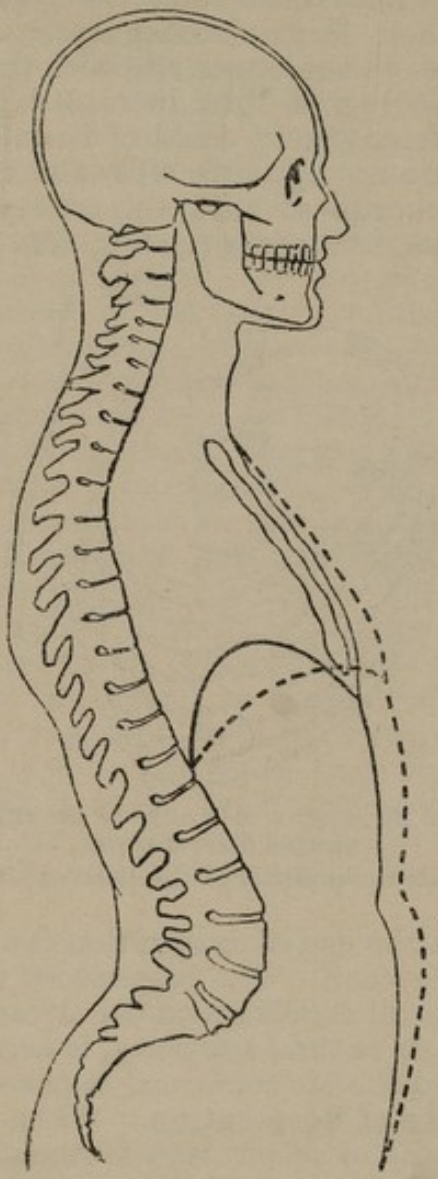


Fig. 29.—Diagram to show the Changes in the position of the Diaphragm during Respiration.

The dotted lines indicate the position occupied by the sternum, diaphragm and abdominal walls at inspiration.

(ii,) *By the Elevation of the Ribs and Sternum.*—The ribs in passing round from the vertebral column behind to the sternum in front do not pass horizontally round the wall of the chest, but *obliquely* downwards. The arches of the ribs also increase in size from above downwards. The joint also between each rib and the vertebral column allows of a certain amount of up

and down movement of the front end of the rib. The spaces between the ribs are filled by the *Intercostal Muscles*, so that when these muscles contract the ribs are raised The lower ribs with their larger arches come into the position previously occupied by the upper ribs with their smaller arches. The size of the thorax is thus increased from side to side. Again, as the anterior (front) ends of the ribs move upwards, they carry the sternum upwards with them, and at the same time thrust it forwards so that the cavity of the thorax is increased from behind forwards (*see* Fig. 30).

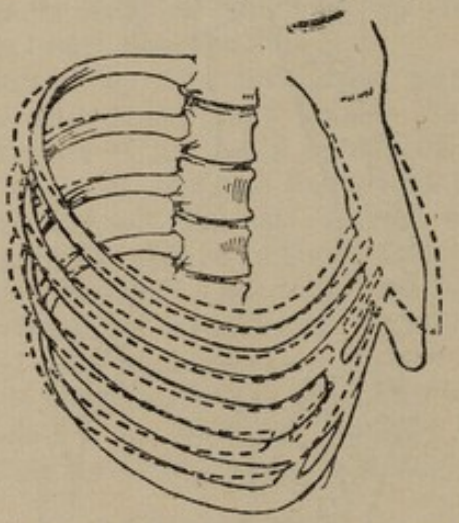


Fig. 30.—Diagram to show the Movements of the Ribs and Sternum during Respiration.

The dotted lines indicate the position of the Ribs and Sternum at inspiration.

Expiration.—At the end of inspiration the diaphragm relaxes and becomes more arched. The respiratory muscles which put the sternum and costal cartilages on the stretch also relax. The thoracic cavity, by its natural elasticity, is accordingly reduced to its original size, and the air contained in the lungs is driven out.

The Normal Rate of Respiration.—When a person is at rest and is quiet the rate of respiration is about *seventeen times a minute*. This number is increased during exertion.

As the movements of respiration have to be imitated in artificial respiration, it is important to bear the normal rate in mind.

Quantity of Air Respired.—The full capacity of the lungs in an adult is about 330 cubic inches; in an ordinary respiration about 20 to 30 cubic inches of air enter the lungs. This is called *Tidal Air*. After each ordinary expiration about 200 cubic inches of air remain in the lungs; this is called *Stationary Air*. By a deep expiration about 100 more cubic inches can be expelled; this is termed *Supplemental Air*. The remaining

100 cubic inches is called *Residual Air* and cannot be expelled. By taking a deep inspiration 100 cubic inches extra can be drawn into the lungs (making up the full capacity of 330 cubic inches); this is called *Complemental Air.*

Asphyxia.—If air from any cause is hindered in passing into the lungs, the blood in the body becomes more venous. In order to remove the obstruction coughing is produced. If the obstruction is not removed, this venous change is increased. The venous blood acting upon the brain causes the respiration to become quicker and more powerful, and a condition termed *Dyspnœa* is produced. As the dyspnœa increases in violence all the muscles of the body are thrown into spasmodic contraction, producing *Convulsions.* If the obstruction still continues, the convulsions cease, the beats of the heart become weaker, and the circulation becomes feeble. After a few respiratory efforts the breathing stops. The heart, then also, after a few flickering beats, stops. In warm-blooded animals death from asphyxia occurs in from three to five minutes.

The Change of Venous to Arterial Blood.—This takes place as the blood passes along the capillaries of the lungs. Through the delicate walls of the air-cells gases can readily pass. The venous blood brought to the lungs is heavily laden with *carbonic acid.* The pure air (the result of respiration) contained in the air-cells is rich in *oxygen.* An interchange of gases therefore takes place. The oxygen gas passes from the inspired air into the capillaries, and is taken up by the red blood corpuscles. The carbonic acid gas passes from the blood into the air contained in the air-cells and is given out in the expired air.

CHAPTER VII.

DIGESTION.

Classes of Food Stuffs—The Object of Digestion—The Alimentary Tract, its Structure, and the Changes the Food undergoes in its passage through it.

The **Food Stuffs** required for the nutrition of the body are divided into the following classes, *viz.*:—

(i,) *Nitrogenous Food* or *Proteids*—such as lean meat, fish, white of egg, etc. These are required for the growth and nutrition of the tissues, they also provide a certain amount of heat and force.

(ii,) *Carbohydrates*—such as starches, sugar, etc. These produce heat and force, and are required for the formation of fat.

(iii,) *Fats*—such as butter, cream, animal and vegetable fats, and oils. These produce heat and force.

(iv,) *Salts*—chiefly the chlorides, phosphates and carbonates of sodium and potassium, and salts of iron.

(v,) *Water*.—This is present in all food.

Before food stuffs can be absorbed into the circulation they must be rendered *diffusible*.

The object of Digestion, therefore, is to render food capable of passing through the alimentary tract into the circulation, in order that it may mix with the blood and make up for the wear and tear of the body.

THE ALIMENTARY TRACT.

This begins at the mouth and ends at the anus; it is a musculo-membranous tube, and comprises:—

1, *The Mouth.*
2, *The Pharynx.*
3, *The Œsophagus.*
4, *The Stomach.*
5, *The Small Intestine.*
6, *The Large Intestine.*

The following are **the changes** the food undergoes in its passage through the alimentary tract:—It is first of all taken into

1, The Mouth (*see* chap. VI, page 48), through the lips; it is here subjected to a process of grinding by the teeth, and becomes mixed with *Saliva*, which is a clear fluid secreted by the *Salivary glands*, which are situated under the tongue at the sides and lower part of the mouth. This process is termed *Mastication*, or *Chewing*.

The saliva moistens the food, and aids swallowing; it dissolves some of the minerals and salts, and it acts upon the *starchy part* of the food and converts it into *grape sugar*, which is diffusible, and can enter into the blood vessels of the stomach.

The food, after being finally divided, passes by the act of *swallowing* from the back of the mouth through

2, The Pharynx (*see* chap. VI, page 49) into

3, The Œsophagus, or Gullet.—This is a muscular tube about nine inches long, lined with mucous membrane; it commences at the bottom of the pharynx, passes down in front of the spinal column behind the trachea, through the thorax, pierces the diaphragm, enters the abdomen and ends at the *cardiac*, or large end of the stomach.

From the œsophagus the food passes into

4, The Stomach (*see* chap. IV, Fig. 15).—This is a hollow, pear-shaped muscular bag, concave at the top and convex below; it has a capacity of about two quarts; it is suspended at the top of the abdomen, directly under the diaphragm, with its larger or *cardiac* end to the left side, and its smaller or *pyloric* end to the right side under the liver.

The walls of the stomach are composed of different layers: the outside one is a *serous* covering—the *peritoneal* coat; then comes a *muscular* coat in which the muscular fibres run in three different directions; after this a *sub-mucous* coat of areolar tissue containing blood vessels, nerves, and lymphatics, and finally the internal lining of *mucous* membrane, which is honeycomb in appearance and is composed of *alveoli* or shallow pits with minute tubes—the *gastric follicles*—opening into their bases; these are modified at different parts of the organ to form the *peptic* and *mucous* glands, which secrete the *gastric juice*. From ten to twenty pints of gastric juice are secreted into the stomach in twenty-four hours; this is a clear fluid, slightly saltish in taste and acid in reaction, its active principle is *pepsine*, it has the property of dissolving proteid substances, such as meat, cheese, etc., it is also antiseptic. The grumous acid fluid resulting from the digestion of the food in the stomach is called *Chyme*, this leaves the stomach by the *pylorus* (a circular valve at its narrow end), and enters the *duodenum* or first part of the small intestines.

The intestines are divided into two parts, the *Small* and the *Large*.

5, The Small Intestine (*see* chap. IV, Fig. 15), is formed by a continuous tube which commences at the pylorus at the upper part of the right side of the abdomen, passes into the centre of the abdomen in a succession of coils, and finally unites with the large intestine at the *ileo-cæcal* valve just above the centre of the groin at the right side; it is about twenty-one

feet in length and one inch in diameter; the first part which is continuous with the stomach, is about ten inches in length, and is called the *Duodenum;* into it open the *common bile duct*, which is formed by the junction of the gall duct from the liver and the duct from the gall bladder, and the *pancreatic duct* which carries the pancreatic juice from the pancreas.

The general structure of the walls of the small intestine somewhat resembles that of the stomach, except that they contain different kinds of glands, *viz.*, tubular, globular or ovoid (as *Peyer's glands*), and lobular (as *Brunner's glands*).

The second part of the small intestine is termed the *Jejunum*, it is about eight feet in length. The last part of the intestine is termed the *Ileum*, it is about twelve feet long.

The partially-digested food in passing along the intestine becomes mixed with the bile and the pancreatic juice, which enter it through a common orifice.

The Bile, which is secreted by the liver, is a greenish yellow fluid, slightly alkaline, it has the property of *emulsifying* the fats and moistening the mucous membrane; it is also slightly purgative and antiseptic in its action; about one-and-a-half to two pints are secreted in twenty-four hours.

Pancreatic juice, which is secreted by the pancreas, or sweetbread, is a clear fluid slightly alkaline and viscid; it converts *starches* into *sugar*, dissolves albuminous and gelatinous foods, and emulsifies fats; from half to three-quarters of a pint is secreted daily. Besides these, a considerable quantity of intestinal juice is secreted in the intestines, this has the properties of all the other digestive juices combined, so as to act on the remaining undigested food, and render it ready for absorption.

After the food has been digested in the small intestine it passes downwards, being forced on by the peculiar worm-like contractions of the small intestine (termed *peristaltic action*), and it is here that the absorption into the system takes place. The peptones, the sugar, most of the salts, and a great deal of water pass through the mucous membrane into the blood capillaries; the peptones and sugar after absorption being carried straight to the liver. The finely divided fats are first saponified and emulsified by the action of the bile and the pancreatic juice, and then pass in the form of a creamy looking fluid, termed *Chyle*—into the *lacteals* of the intestines which are situated in the *villi* of the mucous membrane. These lacteals collect the soluble nourishment *Chyle*, and carry it on to the *Receptaculum Chyli*, which is situated in front of the spine in the abdomen; from here it is taken by the *Thoracic Duct* (*see* chap. V, Fig. 25), which passes up the front of the spine into the thorax, and is discharged into one of the large *veins* at the root of the neck, and thus becomes mixed with the blood.

The remaining undigested food passes through the ileo-cæcal valve and enters the ascending or first part of the *large* intestine.

6, The Large Intestine is a convoluted tube continuous with the small intestine, it is about six feet in length, and from one-and-a-half to two inches in diameter. It is divided into three parts—(1,) the *Cæcum*, which is a pouch just above the junction of the large with the small intestine at the right side of the lower part of the abdomen; (2,) the *Colon*, which is sub-divided into three parts—the *Ascending Colon*, which commences at the ileo-cæcal valve, passes up the right side of the abdomen, crosses the front of the top of the abdomen, when it becomes the *Transverse Colon* (*see* Fig. 15, page 28), and comes down the left side as the *Descending Colon*, and finally joins (3,) the *Rectum* at the lower part of the abdomen on the left side.

The *Rectum* forms a double curve called the *Sigmoid Flexure*, it passes down the back of the pelvis, and ends at the *Anus*, which is guarded at its orifice by a circular muscle.

The remaining nourishment from the food is taken up by the vessels of the large intestine, the indigestible residue which is left becomes more and more solid, and is at last evacuated in the form of *fæces*. Under ordinary circumstances the food takes about twelve hours in passing through the small intestine, and from twenty-four to thirty-six hours in passing through the large intestine.

CHAPTER VIII.

EXCRETION.

The Organs of Excretion, *viz.*, the Lungs, the Skin, and the Kidneys—The Kidneys, their Structure and Functions.

THE tissues of the body are constantly undergoing *oxidation*, which is a process of waste; these waste products, the chief of which are carbonic acid, water, and urea, must be got rid of from the body, and this is effected by the

Organs of Excretion, which comprise—

1, *The Lungs.* (*See* chap. VI).

2, *The Skin.* (*See* chap. IV).

3, *The Kidneys.*—These discharge the urea, most of the mineral matter, and a large quantity of water in the form of *Urine.* They are placed on the loins, one on each side of the vertebral column (*see* chap. IV, Fig. 17). Each kidney is about four inches long, two to two-and-a-half inches wide, and one inch thick, and weighs about four ounces. The surface of the kidney is smooth, its outer border is convex, its inner border is concave, and here the renal arteries, veins and ureter enter it.

The substance of the kidney is richly supplied with blood-vessels; it is made up of a number of coiled tubes—the *urinary tubes*—which terminate towards the surface, in dilatations termed the *Malpighian capsules.* Into each capsule enters a small renal artery, which breaks up into a bunch of capillary vessels, called a *glomerulus*; a small vein carries the blood from the glomerulus into other veins, these finally unite and empty themselves into the inferior vena cava. It is during the circulation through the glomeruli that the blood gets rid of

(i,) *The Water*, and (ii,) *the Urea*, which pass into the tubules, and from them into the ureters, in which the tubules end. The *ureters* open below into a muscular bag, the *bladder*, which is situated in the pelvis; and from the bladder the urine is expelled externally.

About two to three pints of water are discharged daily by the kidneys.

CHAPTER IX.

THE NERVOUS SYSTEM.

The duties of the Nervous System—Its divisions—The Brain, its structure and functions—The Cranial Nerves, their distribution and functions—The Spinal Cord, its structure—The Spinal Nerves, their structure and functions—Reflex action—The Sympathetic System, its structure, distribution and functions.

THE *duties* of the Nervous System are to control and regulate all the functions of the body.

The Nervous System is divided into:—

I.—*The Cerebro-Spinal System*, consisting of the brain, spinal cord and the cerebro-spinal nerves.

II.—*The Sympathetic System*, consisting of the sympathetic ganglia and nerves.

I.—THE CEREBRO-SPINAL SYSTEM.

The Brain.—This fills the whole of the cavity of the cranium and weighs in an adult male about 3 lbs. It is enclosed in three membranes, *viz.*:—(*a*,) An external one—the *Dura Mater*—which is tough and fibrous, rough on its outer side where it is united to the skull, and smooth on its inside where it comes in contact with (*b*,) The middle membrane—the *Arachnoid*—which is a delicate, transparent, serous structure; (*c*,) An inner membrane—the *Pia Mater*. This is very delicate in structure and covers the immediate surface of the brain. It contains the blood vessels which supply the surface of the brain with blood.

The Brain is divided into four parts, *viz.*:—

(i,) *The Cerebrum*, or *Large Brain.*—This fills the entire cavity of the upper part of the skull and comprises nearly seven-eighths of the whole of the brain. It is divided into two lateral halves, the right and left *Hemispheres*. Each of the hemispheres again is divided from the front backwards into three lobes, *viz.*, the *Anterior*, *Middle* and *Posterior* lobes. The surface of the brain is much increased in area by being thrown into folds or *convolutions*.

The substance of the cerebrum is made up of a thick layer of *grey matter* surrounding the *white* fibrous nerve tissue.

The cerebrum is the chief seat of sensation, intelligence, the will and the emotions.

(ii,) *The Cerebellum*, or *Small Brain* is placed at the lower part of the back of the skull, immediately under and covered by

the back of the cerebrum. It is also divided into two *Hemispheres.* It is composed of *grey matter* which surrounds the fibrous *white matter.* Its surface is *convoluted,* and on section it presents a beautiful figure like the branches of a tree, termed the *arbor vitæ* (tree of life).

The chief function of the cerebellum is to regulate or co-ordinate muscular movements as seen in running, walking, etc.

(iii,) *The Medulla Oblongata.*—This is placed under the middle of the cerebrum and just in front of the cerebellum. It is about 1 inch long, broad above where it is continuous with the cerebrum, and narrow below where it passes into the spinal cord. It consists of *white* matter outside and *grey* matter inside.

The *function* of the medulla is to govern various involuntary movements, as the acts of breathing, swallowing, etc.

(iv,) *The Pons Varolii.*—This is a broad band of nerve matter passing round in front of the medulla oblongata. It connects the two hemispheres of the cerebellum.

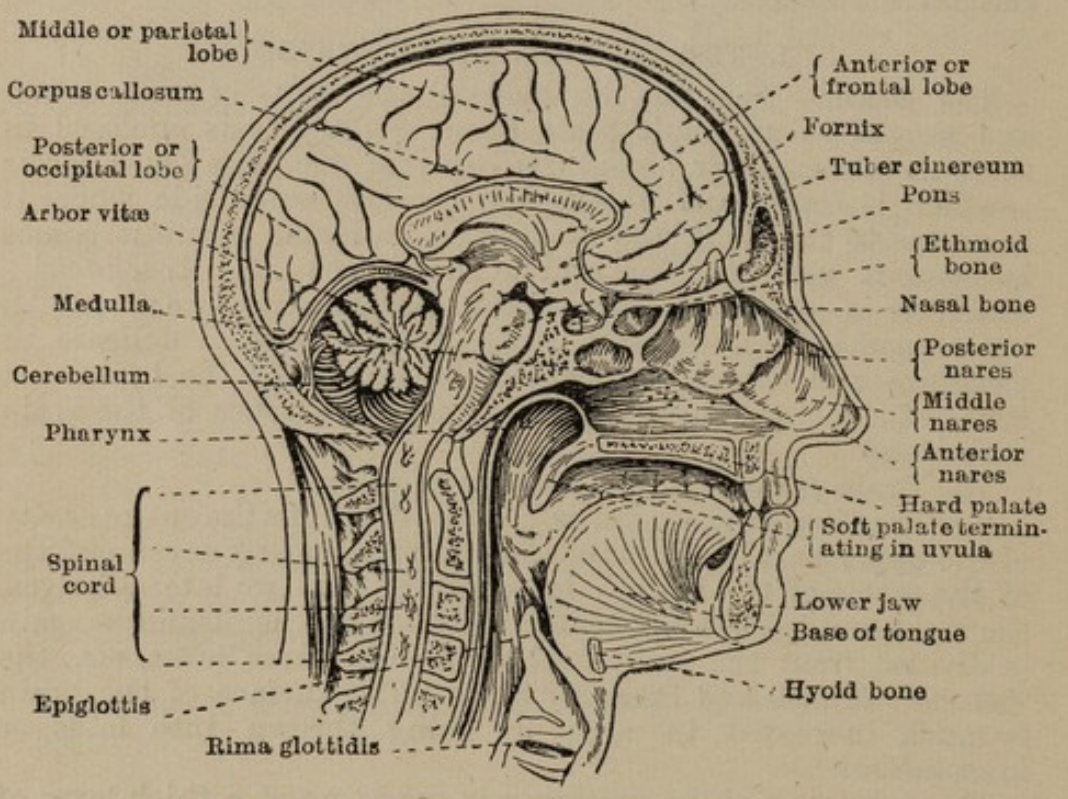


Fig. 31.—Longitudinal Section through the Head.

The Cranial Nerves are of two kinds, *viz.* :—

(i,) *Sensory Nerves.*—These convey sensation—either *special,* such as light, sound, smell; or *general,* such as a feeling of pain, resistance, etc.—from the exterior to the brain.

(ii,) *Motor Nerves.*—These convey impulses from the central nervous system to the muscles, causing the latter to contract and produce movement.

The cranial nerves are arranged in twelve pairs and are given off from the lower and front part of the brain. They are numbered as follows from before backwards:—

1*st Pair.*—The *Olfactory Nerves*, or nerves of smell, which send fibres to the mucous membrane of the nose and convey the various sensations of scent to the brain.

2*nd Pair.*—The *Optic Nerves*, or nerves of sight, which go to the eyes.

3*rd Pair.*—The *Motor Oculi*, which move the eyes.

4*th Pair.*—*Motor Nerves*, to one of the external muscles of the eyes.

5*th Pair.*—*The Trigeminal;* large nerves, both motor and sensory, each dividing into three branches, hence called *Trigeminal*; to supply the skin of the face, the muscles of the lower jaw and the tongue.

6*th Pair.*—*Motor Nerves*, to the external muscles of the eye.

7*th Pair.*—The *Facial Nerves*, to the muscles of the face.

8*th Pair.*—The *Auditory Nerves*, or nerves of hearing, to the internal ear.

9*th Pair.*—The *Glosso-pharyngeal Nerves*, both sensory and motor. Sensory fibres go to the tongue and produce the sense of taste, and motor fibres to the muscles of the pharynx.

10*th Pair.*—The *Pneumogastric Nerves*, both sensory and motor, to the larynx, lungs, heart, stomach and liver.

11*th Pair.*—*Motor Nerves*, to special muscles of the neck.

12*th Pair.*—*Lingual Nerves*, to the muscles of the tongue.

The Spinal Cord (*see* chap. IV, Fig. 14).—This is continuous with the lower end of the medulla oblongata. It commences at the level of the upper border of the atlas, or first vertebra, and passes along the whole length of the spinal canal to the first lumbar vertebra. It is about eighteen inches in length and one-third to half-an-inch in diameter, cylindrical in form, and somewhat flattened in front. It is surrounded by the same three membranes as the brain, which are continuous with those of that organ.

Spinal Nerves.—During its passage along the spinal canal the spinal cord gives off thirty-one pairs of nerves, called the spinal nerves (*see* Fig. 14, p. 27). These emerge from each side of the spinal cord by two roots, an anterior or *motor* root and a posterior or *sensory* root (*see* Fig. 32). These roots almost immediately unite, forming nerve trunks of mixed character, which pass out of the spinal canal at its side between the vertebræ to all the different parts of the body. At the lower end of the spinal cord the nerves come off in a thick brush termed the *Cauda Equina*, or horse's tail.

Reflex Action.—The sensory fibres of a mixed spinal nerve convey *sensory impulses* to the grey matter in the posterior horn. Here these impulses so act upon the grey matter that

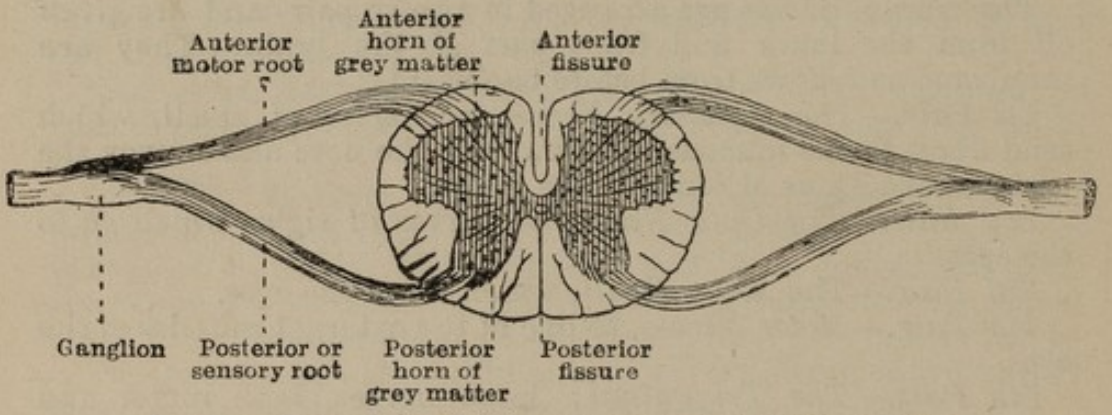


Fig. 32.—Transverse Section through the Spinal Cord.

they cause new impulses to arise—*motor impulses*. These pass from the grey matter of the anterior horn to the muscles, causing them to contract. This movement takes place without the action of the will or brain, and is termed *reflex action*.

II.—THE SYMPATHETIC SYSTEM.

The sympathetic system consists of a row of *Ganglia* or nerve centres passing down each side of the front of the spine. These give off nerves to all the internal organs—the heart, lungs, stomach, intestines, etc., and also to the coats of the blood-vessels; they are connected with the cranial and spinal nerves by small branches. The sympathetic nerves are not under control, and work independently of the will; they regulate the functions of life—circulation, respiration, secretion and excretion—even when the brain is at rest or paralysed, as during sleep, insensibility from apoplexy, injury to the brain, alcoholic poisoning, influence of chloroform, nitrous oxide gas, etc., in this way keeping the functions of the body going while the brain is recovering itself. They also regulate the contractions of the blood-vessels and the consequent supply of blood to the different parts of the body.

PART II.

CHAPTER X.

THE APPLICATION OF BANDAGES.

Uses of Bandages—Kinds of Bandages—The Triangular Bandage; how to make it, how to fold it for storage, its advantages, ways in which it may be used, manner of folding it broad or narrow, the "reef" and "granny" knots, methods of applying the narrow, broad, and large arm slings—The Triangular Bandage for wounds of the scalp, forehead, back of head, temple, chin, ears, side of face, eye, neck, shoulder, chest, back, ribs (also for fracture of), abdomen, upper arm, elbow, forearm, wrist, hand, hip, thigh, knee, leg, foot, lower part of abdomen or perinæum, groin—The Triangular Bandage for the stump of a limb, for fracture of the lower jaw, for securing splints, for arresting hæmorrhage—The Roller Bandage; its divisions, its sizes, how to roll it, its named parts, points to be remembered in its application, the manner in which it may be applied—The Circular Bandage—The Spiral Bandage—The Reverse Spiral Bandage—The Oblique Bandage—The Figure of 8 Bandage—The Spica Bandage—The Spica for the groin, the shoulder, the female breast, the thumb, the great toe, the heel, the elbow, the knee—To apply the roller bandage to the upper extremity, to the finger, to the lower extremity—The Head Bandages, viz. capeline and twisted—Bandage for the chest and the abdomen—Bandages of special form, viz.—The Square Bandage—The Four-tailed Bandage for the jaw, head, and knee—The Many-tailed Bandage and the T Bandage.

BANDAGES ARE EMPLOYED FOR THE FOLLOWING PURPOSES:—

(i,) To give support to injured parts.
(ii,) To keep dressings in place.
(iii,) To fix splints and other apparatus.
(iv,) To overcome excessive muscular action.
(v,) To stop bleeding by means of pressure.
(vi,) To protect wounded parts from exposure.

THE KINDS OF BANDAGES IN GENERAL USE ARE:—

(I,) The Triangular Bandage.
(II,) The Roller Bandage.
(III,) Bandages of special form.

I.—THE TRIANGULAR BANDAGE AND ITS APPLICATION.

To make the Triangular Bandage.—Take a piece of linen or unbleached calico not less than 38 inches square, fold it diagonally and cut it along the fold. Each of the triangular pieces will then form one bandage. The named parts of the Triangular bandage are: The base of the triangle—this is termed the *Lower Border*; the two sides of the triangle—the *Side Borders*; the

apex of the triangle—the *Point*; the remaining corners of the triangle—the two *ends*. (Fig. 33.)

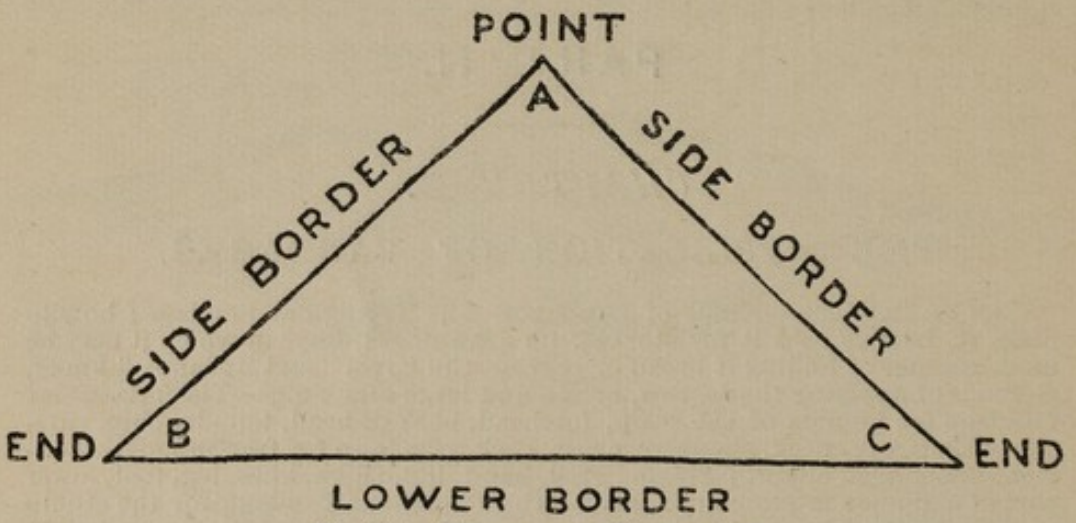


Fig. 33.—Triangular Bandage.

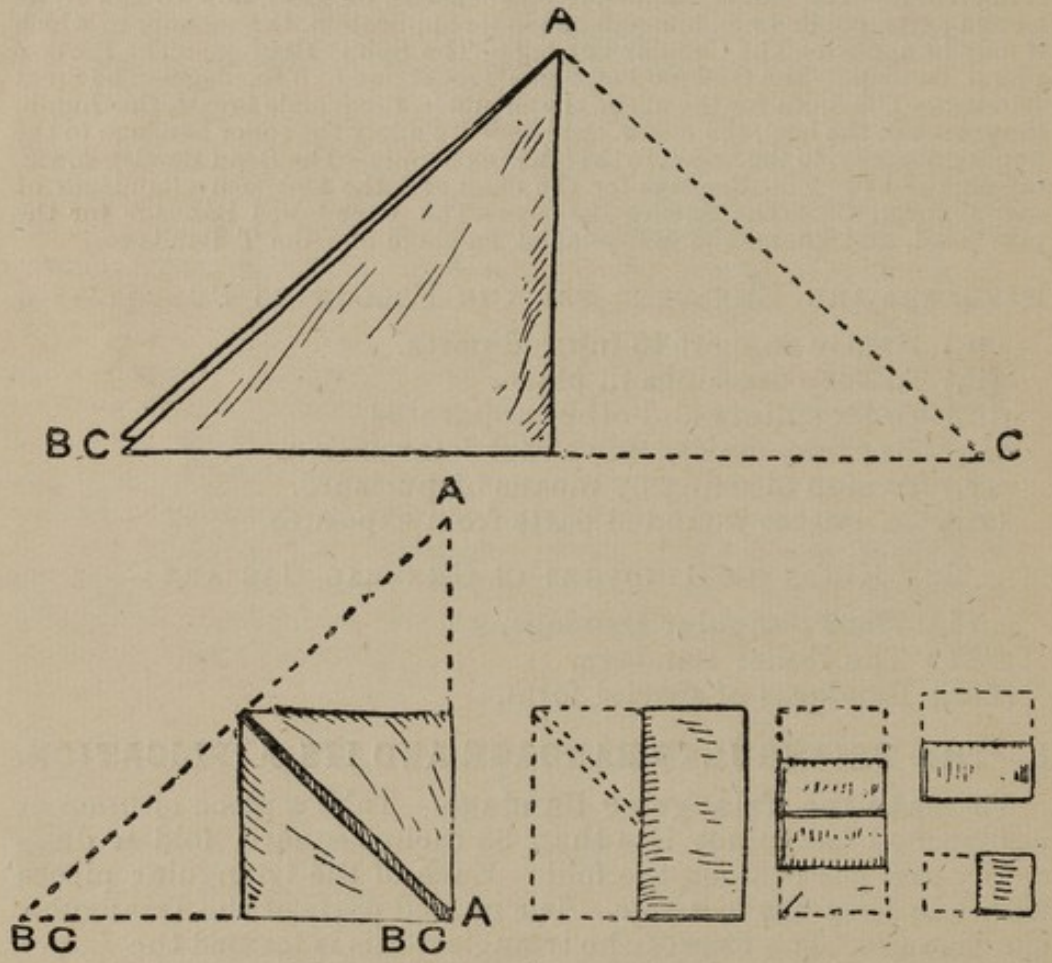


Fig. 34.—Method of folding triangular bandage for storage.

To fold the Bandage for Storage.—First, spread the bandage out flat, then fold it perpendicularly down the centre, placing the right end on the left. Now bring the ends thus folded and the point to the centre of the lower border, forming a square; then fold the square in half from right to left, next fold the two ends over or *vice versa*, making them meet in the centre; now double again in half (this will give a packet 7″ × 3½″) and secure with a pin. If folded over once more it forms a neat pad. (Fig. 34.)

The Triangular Bandage has the following advantages:—It can be easily made from a handkerchief, and is therefore well suited as an emergency bandage; its application can be easily acquired; temporary dressings may be fixed better with it than with the Roller bandage, and it can be used for almost every purpose for which a bandage is required.

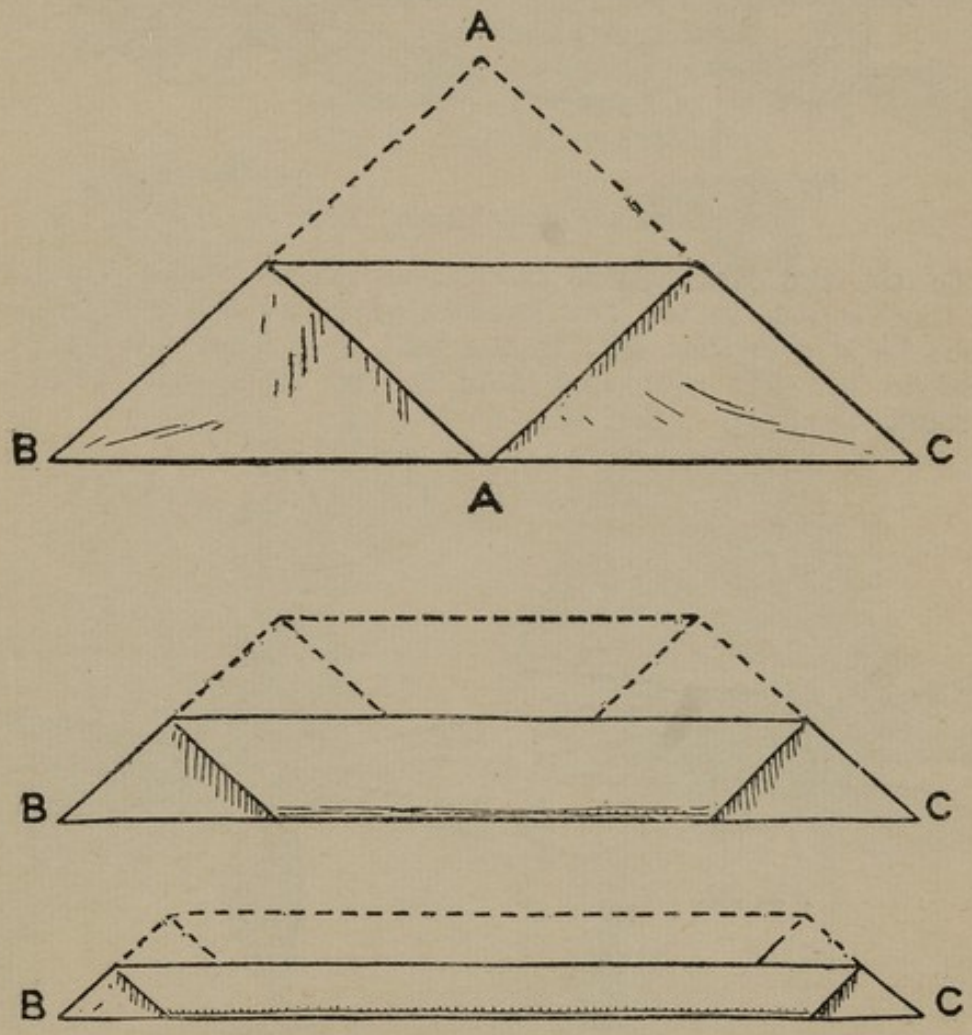


Fig. 35.—Method of folding triangular bandage broad and narrow for use.

The Triangular Bandage may be applied:—

(i,) Unfolded (called a "whole cloth").
(ii,) Folded broad.
(iii,) Folded narrow.

To Fold the Bandage Broad or Narrow.—Spread the bandage out and carry the point down to the lower border. If required *broad*, fold it lengthways upon itself once. If required *narrow*, fold it lengthways upon itself twice. (Fig. 35.)

To fasten the Bandage after applying it, either pin it with a safety pin or tie a *reef* or *sailor's knot;* never tie a "granny" knot

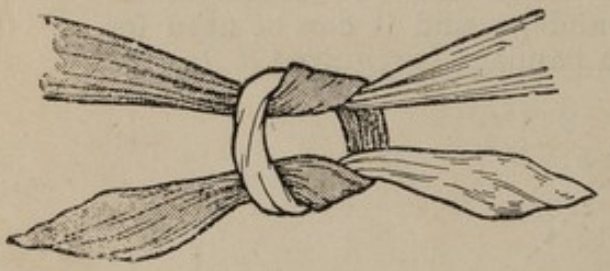


Fig 36

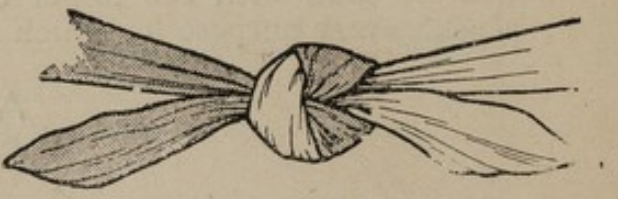


Fig. 36*a*.

Figs. 36, 36*a* — "Reef" Knot.

To tie the Reef Knot proceed as follows: hold the ends of the bandage in the two hands; wind the end held in the right hand over that held in the left; then wind the end now held in the left over that held in the right, and bring it through the loop. (Fig. 36.)

Fig. 36*b*.

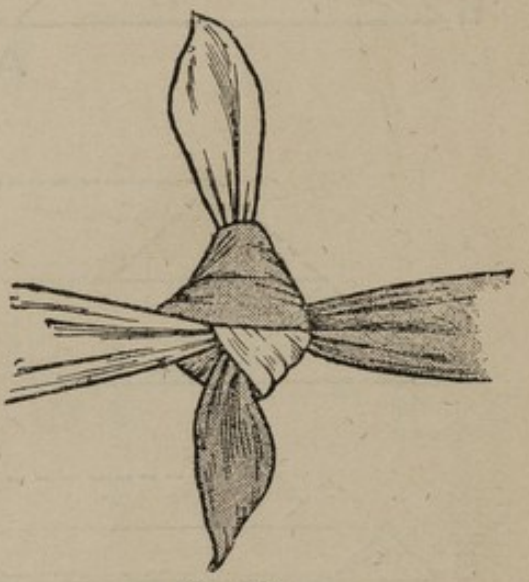


Fig. 36*c*.

Figs. 36*b*, 36*c*.—"Granny" Knot.

The reef knot, if properly tied, should have its free ends lying in the same line as the bandage (Fig. 36*a*). In the "granny" knot the ends lie at right angles to the bandage (Fig. 36*c*). The advantages of the reef knot over the "granny" are, that it is firmer, is less liable to slip, and it is easily untied.

The use of the Triangular Bandage as a Sling for the Forearm.

The following slings may be applied with the Triangular bandage:—

1.—The Narrow Arm Sling.—This is applied by first folding the bandage *narrow*, then placing one end over the shoulder of the uninjured side, and allowing the other end to hang down in front; the forearm is now bent to the required height, the hanging end is drawn up in front of it and over the shoulder of the injured side and the two ends are then tied behind the neck.

2.—The Broad Arm Sling.—This is made by folding the bandage *broad*, *i.e.*, once on itself, and is applied in precisely the same way as the narrow arm sling.

Fig. 37.

Fig. 37*a*.

Figs. 37, 37*a*.—The Large Arm Sling applied as a support for the Forearm.

3.—The Large Arm Sling is applied in two ways:—

(i,) *As a Support for the Forearm,* thus:—Place the apex of the bandage below and well beyond the elbow of the forearm on the injured side, and the upper end across the top of the opposite shoulder (Fig. 37); then carry the forearm across the chest to the desired level, now bring the lower end upwards across the forearm, pass it over the shoulder of the injured side, and tie the two ends behind the neck; then draw the apex forward over the point of the elbow and pin it to the bandage in front. (Fig. 37*a*.)

Fig. 38.

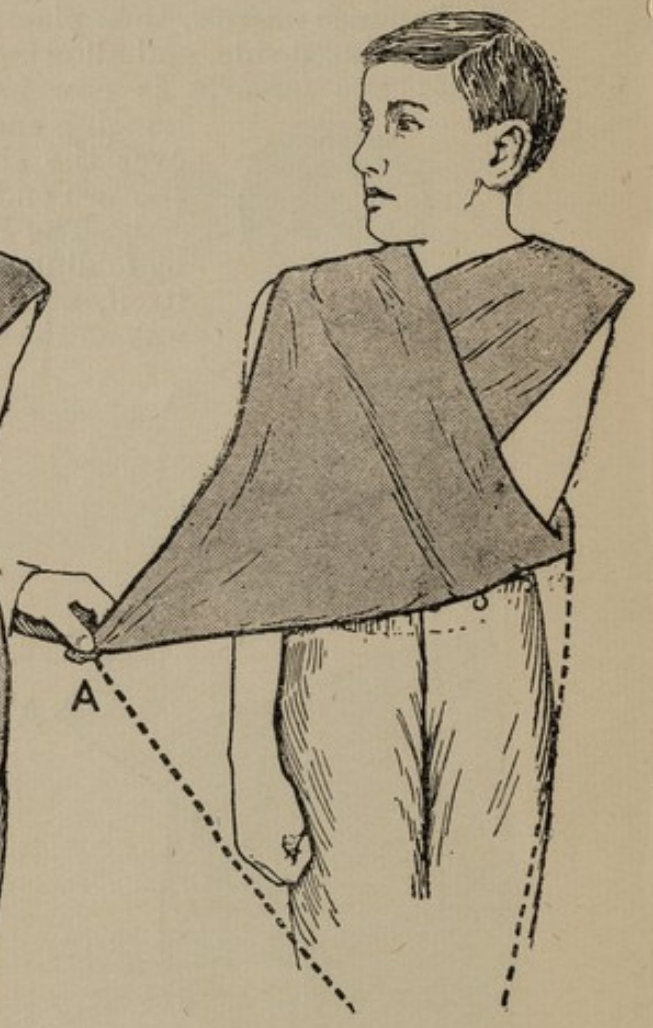


Fig. 38*a*.

(ii,) *As a Support for the Elbow,* thus:—Place the bandage with one end on the shoulder of the injured side and the apex pointing in the opposite direction to the elbow; then flex the forearm on the injured side, and place it across the front of the chest with the fingers touching the opposite shoulder (Fig. 38);

now draw the lower end over the elbow and across the front of the chest to the top of the shoulder on the uninjured side, and tie it to the upper end (Fig. 38*a*; then take the apex, fold it well over the forearm and pin it to the bandage above on the injured side. (Fig. 38*b*.)

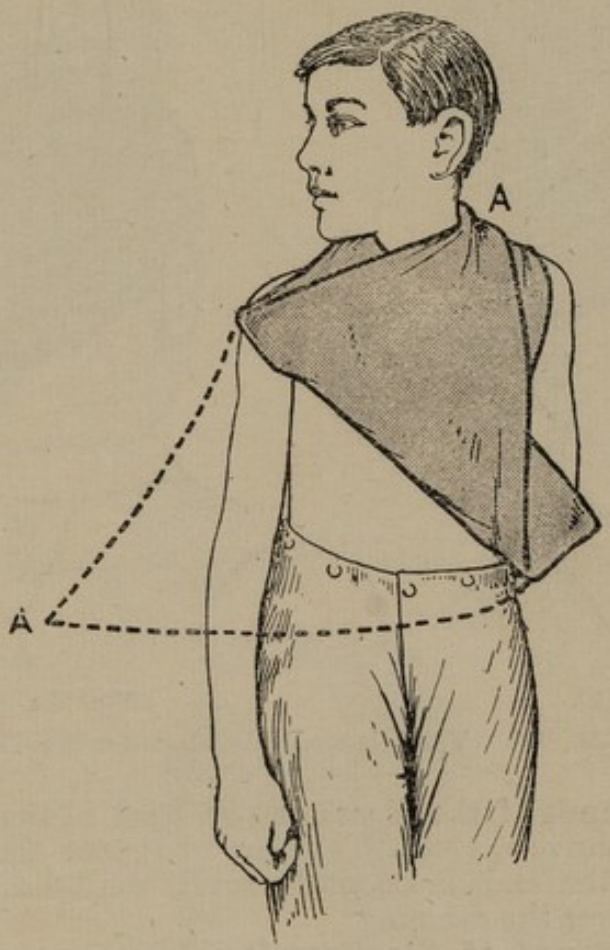


Fig. 38*b*.

Figs. 38, 38*a*, 38*b*.—The Large Arm Sling applied as a support for the Elbow

The Triangular Bandage for Wounds.

Here before applying the triangular bandage, it is important in all cases to first apply to the wound clean (antiseptic) dressing, in the form of a pad.

1.—**For a wound of the Scalp,** first fold the lower border of the bandage lengthways to form a *hem* 1½ *inches wide*, then place it with the middle of the hem over the centre of the forehead just above the root of the nose, and the point hanging over the back of the head to the neck; now carry the two ends backward above the ears (which are left out), cross the ends behind at the nape of the neck over the point and below the occiput (the

prominence at the back of the head); this is important, otherwise the bandage will not remain tight, bring the ends forward and tie them in front on the forehead, Fig. 39. Next pull the point down, to make the bandage fit well over the head, then turn it over on to the top of the head and pin it. (Fig. 39*a*.)

Fig. 39.

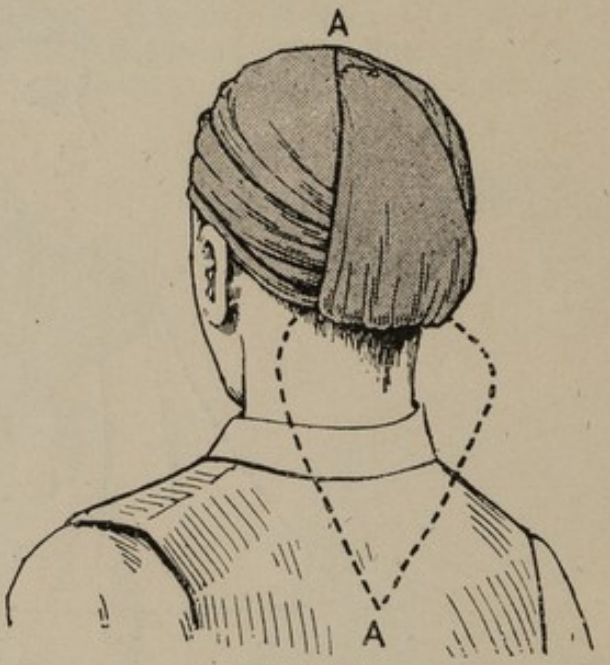


Fig. 39*a*.

Figs. 39, 39*a*.—**The triangular bandage for the Head.**

2.—For wounds of the Forehead or Back of the Head, fold the bandage *narrow*, place the centre of it over the pad on the wound, carry the ends horizontally round the head, cross them, and knot off over the dressing.

3.—For a wound of the Temple, place the centre of the bandage folded *narrow* on the opposite temple to the one wounded, bring the ends forward, cross them over the pad placed on the wound (Fig. 40), then carry them respectively over the top of the head and below the jaw, and tie on the sound temple exactly opposite the crossed ends. (Fig. 40*a*.)

4.—For wounds of the Chin, Ears, or Side of the Face, place the centre of the bandage folded *narrow* under the chin, carry the ends upwards and tie on the top of the head.

5.—For wounds of both Eyes, place the centre of the bandage folded *narrow* on the bridge of the nose, carry the ends backwards, cross them, bring them forward and tie in front.

6.—For a wound of one Eye, place the centre of the bandage folded *narrow* over the injured eye, pass the ends obliquely, one upwards over the forehead and the other downwards over

the ear, cross them behind, and below the occiput, then bring them forward and tie over the pad on the wound. (Fig. 41.)

Fig 40.

Fig. 40*a*.

Figs 40, 40*a*.—The triangular bandage for the Temple.

Fig. 41 —The triangular bandage for the Eye.

7.—For a wound of the Neck, place the centre of the bandage folded *broad* or *narrow* (according to the size of the wound), on the pad, carry the ends round the neck, cross them, bring them back and tie over the pad.

8.—For a wound of the Shoulder, place the centre of the bandage *unfolded* on the point of the shoulder, with the point of the bandage well up to the angle of the jaw, and the lower

border across the middle of the upper arm, then carry the ends round the arm, cross them on the inner side, bring them forward and tie on the outside; now place the forearm on the injured side in a *narrow arm sling*, then pass the point of the bandage under the sling, double it back on itself, and pin it to the bandage on the top of the shoulder. (Fig. 42.)

Note.—Should the shoulder be injured so as not to be able to bear the weight of the forearm in a sling, after applying the first bandage to the wound, take a second bandage folded *narrow*, place the centre of it over the point of the first bandage, carry the ends obliquely downwards and tie them under the armpit on

Fig. 42.—The triangular bandage for the Shoulder.

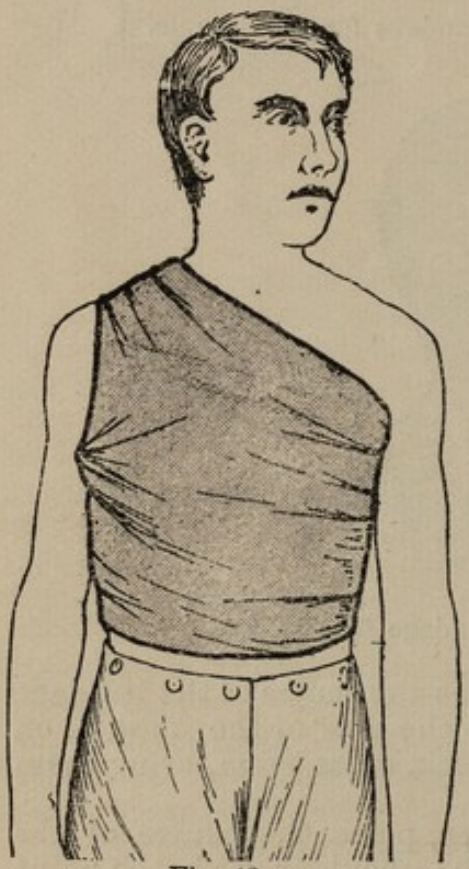


Fig. 43.

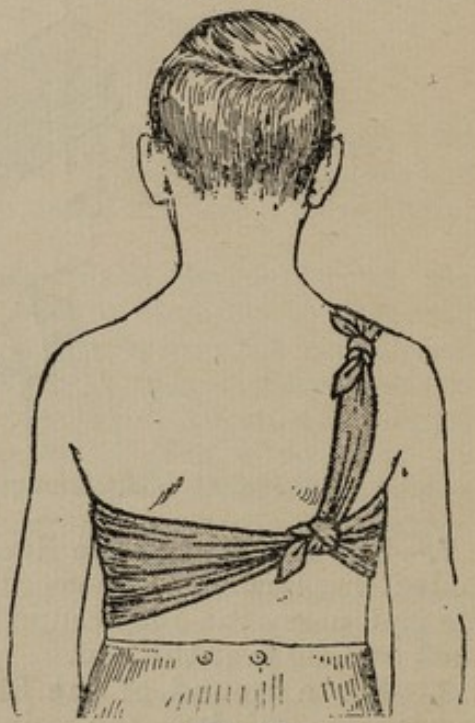


Fig. 43*a*.

Figs. 43, 43*a*.—The triangular bandage for the Chest.

the sound side, then double the point back on itself and pin it to the bandage on the top of the shoulder.

9.—For wounds of the Front of Chest, apply the bandage *unfolded*, with its centre across the front of the chest and its point over the shoulder on the injured side (Fig. 43); carry the two ends round the chest and tie them at the back, leaving one end longer than the other; now draw the point well over the shoulder and tie it to the longer end behind. (Fig. 43*a*.)

10.—For wounds of the Back, apply the bandage in a reverse way to the above. (Figs. 44, 44*a*.)

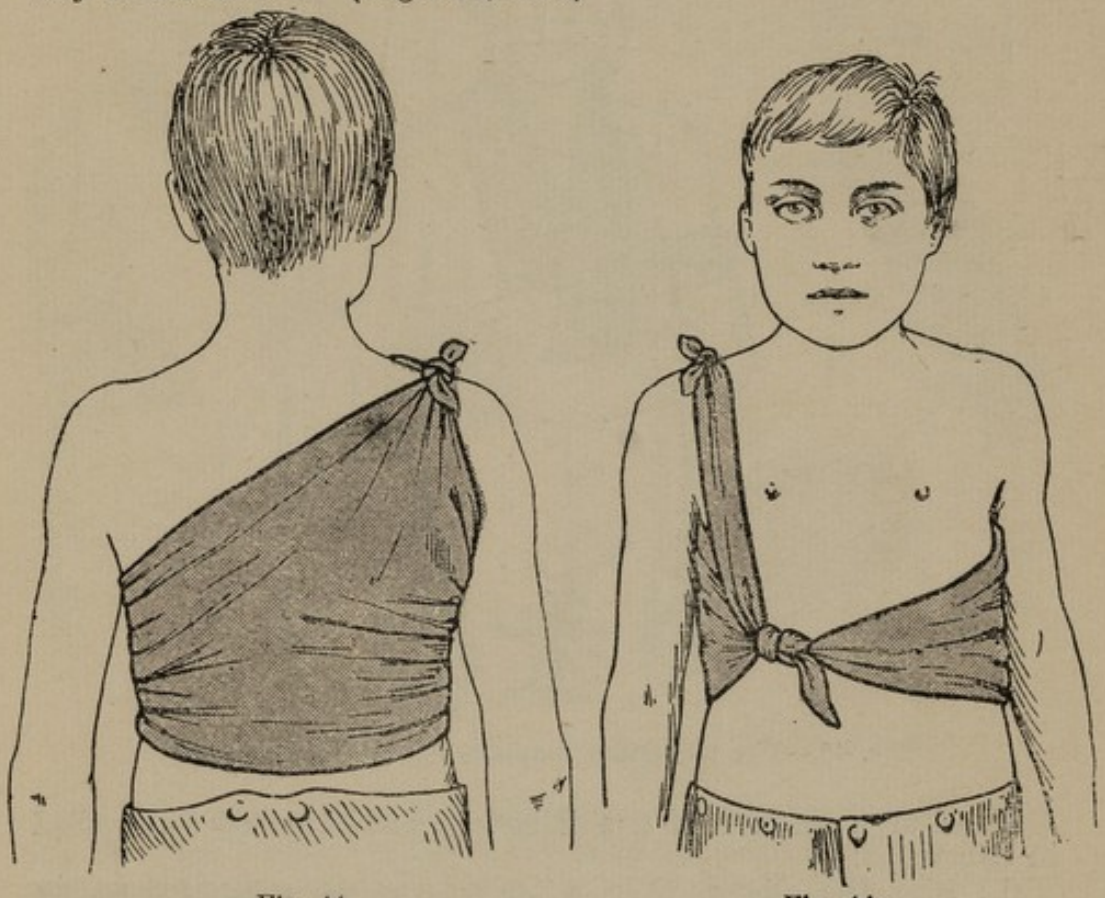


Fig. 44. *Fig.* 44*a*.

Figs. 44, 44*a*.—The triangular bandage for the Back.

11.—For a wound of the Side of the Chest, take a bandage folded *broad*, apply the centre of it over the pad on the wound, carry the ends round the chest and tie on the opposite side. *Note.*—In applying this bandage it should be tied just tight enough to retain the pad in position, but it should not compress the chest wall unduly.

12.—For a wound of the Abdomen, apply the centre of the bandage folded *broad* over the pad on the wound, and tie the ends at the side.

13.—For a wound of the Upper Arm, apply the middle of the bandage folded *narrow* over the pad on the wound, carry the ends backwards, cross them behind, bring them forward and tie in front; then place the forearm on the injured side in a *narrow arm sling.* (Fig. 45.)

Fig. 45.—The triangular bandage for the Upper Arm.

14.—For a wound of the Elbow, a bandage may be applied in two ways:—

(i,) Flex the elbow; then, after turning in a broad hem on the *lower border* of the bandage, place the centre of it over the point of the elbow with the point of the bandage upwards, pass the ends round the forearm, cross them in front, carry them round the arm again, cross them behind above the joint, bring them forward and tie in front (Fig. 46); then draw the point well down and pin it to the bandage below (Fig. 46*a*). Now place the arm in a narrow arm sling.

(ii,) Flex the elbow, then place the centre of the bandage folded *broad* over the point of the elbow, bring the ends forward, cross them in front, carry them backwards round the upper part of the forearm, cross them behind and *below* the point of the elbow

securing the lower edge of the broad bandage, then bring them forward, again cross them in front, now carry them backwards round the lower part of the upper arm, securing the upper edge of the broad bandage, and tie behind just *above* the point of the elbow (Fig. 46*b*). Then place the forearm in a narrow arm sling.

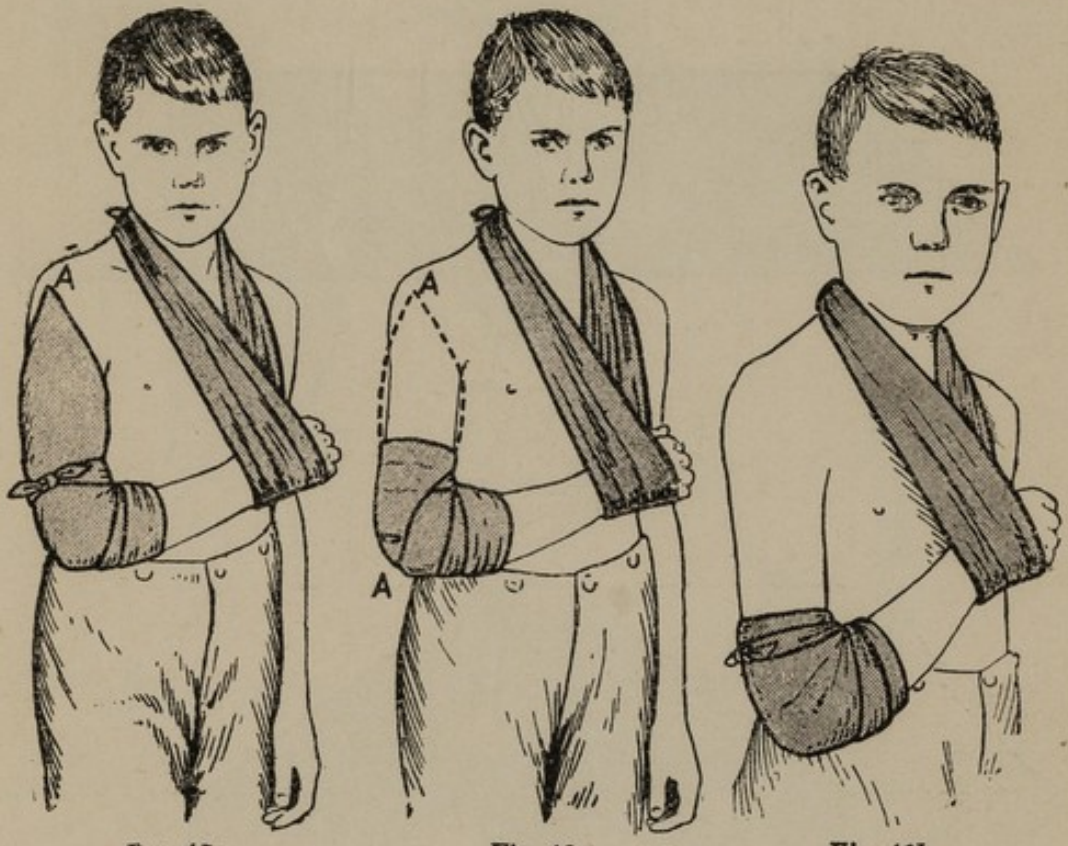


Fig. 46. *Fig.* 46*a*. *Fig.* 46*b*.

Figs. 46, 46*a*, 46*b*.—The triangular bandage for the Elbow.

15.—For wounds of the Forearm, or of the Wrist, apply the bandage folded *narrow* in the same manner as for the upper arm, and then place the forearm in a *large arm sling.*

16.—For a wound of the Hand.

(i,) *To cover the Open Hand.*—Spread out a bandage *unfolded*, place the hand upon it with the wrist on the centre of the lower border—palm downwards and the fingers towards the point (Fig. 47)—turn the point over the fingers and carry it across to the back of the wrist, then draw the bandage downwards on each side of the hand (Fig. 47*a*), and pass the ends upwards round the back of the wrist, cross them over the point (Fig. 47*b*); then carry them in front of the wrist, bring them back again and tie them over the point (Fig. 47*c*); now draw the point over the knot and pin it to the bandage below.

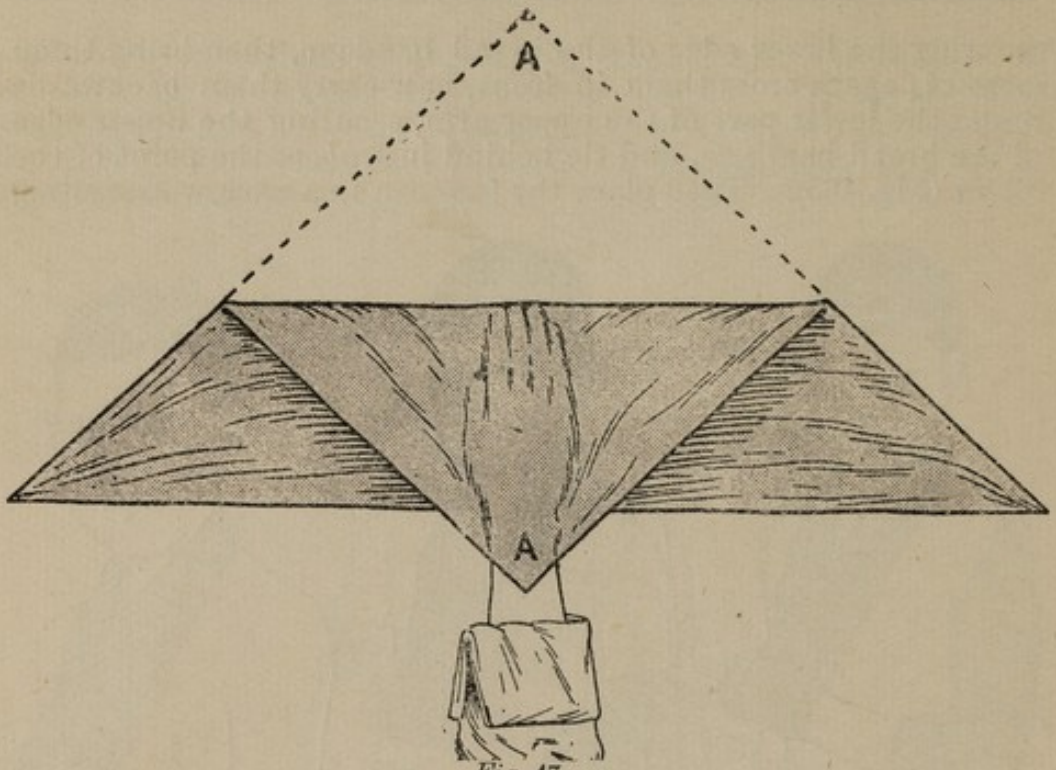


Fig. 47.

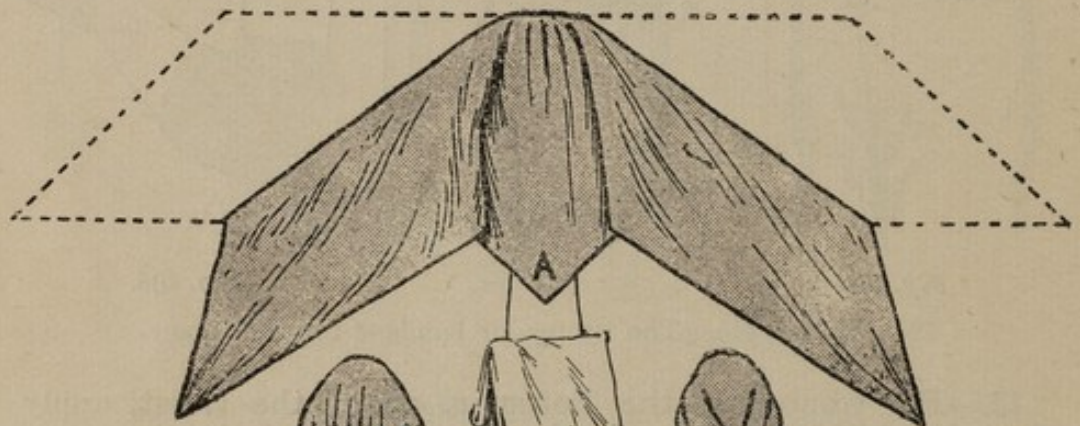


Fig. 47*a*.

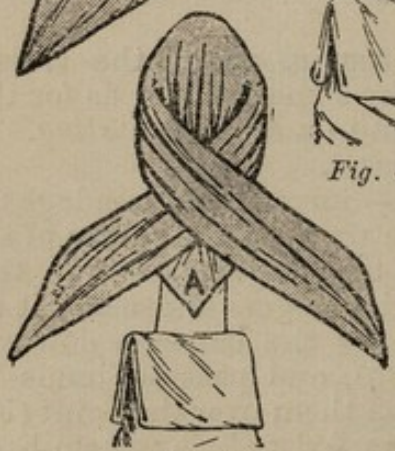


Fig. 47*b*.

Fig. 47*c*.

***Figs.* 47, 47*a*, 47*b*, 47*c*.—The triangular bandage for the Open Hand.**

(ii,) *To cover the Palm or the Back of the Hand.*

For the Palm.—Place the centre of the bandage folded *narrow* over the pad on the wound, bring the ends round the hand, cross them on the back obliquely; then bring them over the wrist forwards, cross them in front, carry them back again over the wrist, and tie. (Fig. 48.)

For the Back.—Reverse the process.

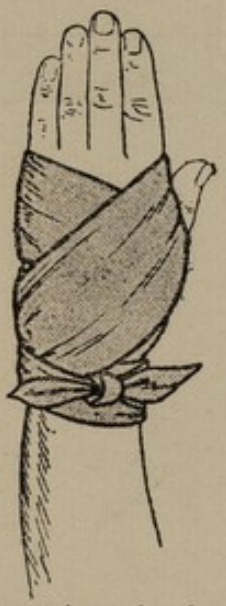


Fig. 48—The triangular bandage for the Palm of the Hand.

Fig. 49.—The triangular bandage for the Fist.

(iii,) *For a wound in the Palm of the Hand*, either of the following methods my be used:—

(*a*,) Place a firm pad in the palm to well fill it, and bend the fingers over the pad, now apply the centre of the bandage folded *broad* longitudinally across the bent fingers, carry the ends up towards the wrist, cross them just below the root of the thumb, then take them round the wrist and cross them on the opposite side, bring the lower end forward and carry it over the first knuckle of the index finger to the back of the wrist, now carry the upper end from within outwards once or twice round the wrist and then tie the two ends together. (Fig. 49.)

(*b*,) *Squire's Method.*—After placing a firm pad in the palm of the hand and bending the fingers over it, apply the centre of the bandage folded broad across the back of the wrist (Fig. 50); now carry the thumb end of the bandage diagonally across the front of the hand over the knuckles, and across the back of the hand to the thumb side of the wrist again (Fig. 50*a*); then carry the other end diagonally across in the opposite direction (Fig. 50*b*); now bring both ends round to the front of the wrist, cross them, pull tight, carry them round to the back of the wrist, and tie (Fig. 50*c*).

(c,) Spread out a bandage unfolded, turn up a fairly broad hem on the lower border, then place the closed fist with a firm pad in it on the centre of the bandage—back of the hand downwards—bring the point over the fist to half-way up the forearm, carry the ends forward, cross them in front on the wrist, then carry

Fig. 50.

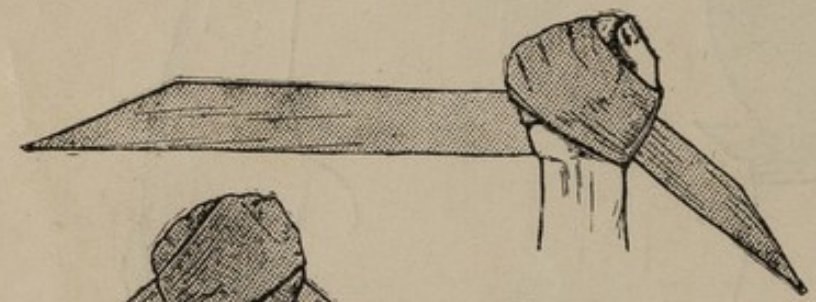


Fig. 50*c*.

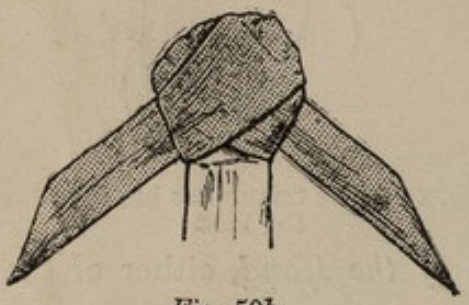


Fig. 50*b*.

Fig. 50*c*.

Figs. 50, 50*a*, 50*b*, 50*c*.—The triangular bandage for a Wound in the Palm of the Hand (Squire's Method).

them backwards and cross them on the back of the wrist, again bring them forward and tie in front, now draw the point firmly down over the knot and pin it to the bandage below.

After the hand has been bandaged by any of the above methods, the elbow should be supported in the *large arm sling*.

17.—For a wound of the Hip, first tie one bandage folded *narrow*, like a waist belt, round the body just above the hips; then apply the centre of a second bandage *unfolded* on the wounded hip, with the lower border well down on the thigh, carry the ends backwards round the thigh, cross them behind, bring them forward, and tie them on the outside; now pass the point under the narrow bandage, bring it down and pin it to the bandage below. (Fig. 51.)

18.—For a wound of the Thigh, Knee, or Leg, apply the bandage folded *broad*, in the same manner as for the upper arm.

In applying the bandage to the knee, the leg should be kept straight and the knot should be tied below the knee-cap.

19.—For a wound of the Foot, spread out a bandage *unfolded*, place the foot on the centre of it with the toes towards the point, draw the point upwards over the instep; take one of the ends in each hand close up to the foot, bring them forward round the ankle to the front and over the point, cross them on the instep, carry the ends back round the ankle, cross them behind, catching the lower border of the bandage, bring them forward again and tie in front on the ankle; now draw the point well over the knot and pin it to the bandage below. (Fig. 52.)

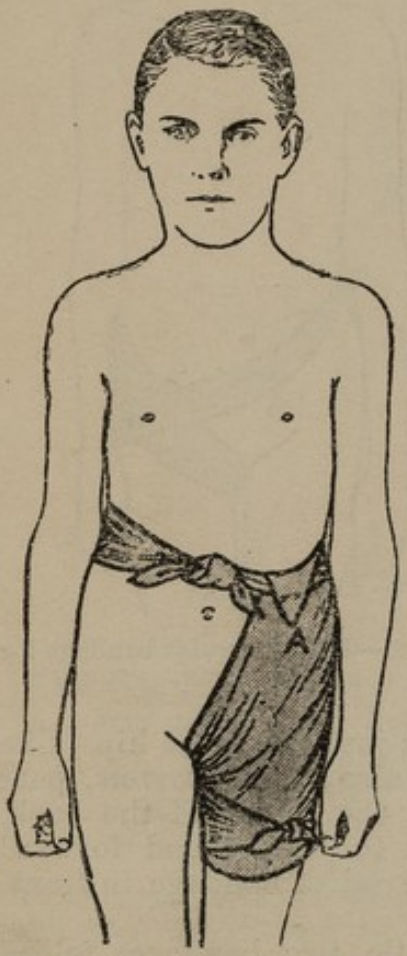


Fig. 51.—The triangular bandage for the Hip.

Fig. 52.—The triangular bandage for the Foot.

20.—For a wound of the Lower Part of the Abdomen or of the Perinæum, the bandage may be applied in two ways:—

(i,) Apply the bandage *unfolded* with its lower border uppermost and the centre of the bandage well over the front of the lower part of the abdomen; pass the two ends backwards and

tie them behind; draw the point down to tighten the bandage; then carry it between the legs, draw it up well behind and tie it to the ends. (Fig 53.)

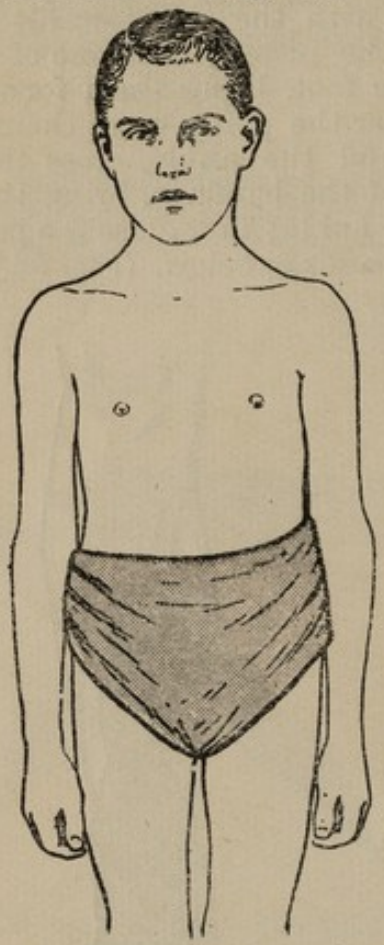


Fig. 53.—The triangular bandage for the lower part of the Abdomen.

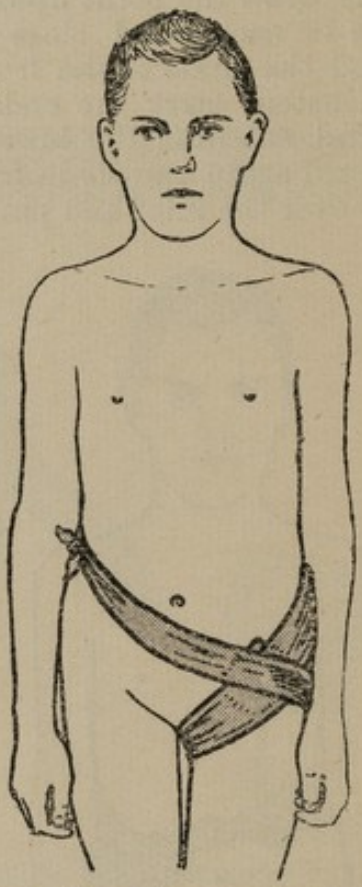


Fig. 54.—The triangular bandage for the Groin.

(ii,) Tie one bandage folded *narrow* just above the hips, like a waist belt; take another bandage also folded *narrow*, pass one end beneath the waist bandage at the centre of the back, fold it over and pin it, then bring the other end forward between the thighs, pass it under the waist bandage in front, fold it over and pin it.

21.—For a wound in the Groin, tie two bandages folded *narrow* end to end; apply the centre of this double bandage to the back of the thigh, just below the buttock, bring the ends forward, cross them over the pad on the wound in the groin, carry them back above the hips, and tie in front. (Fig. 54.)

22.—For the Stump of a Limb, lay the bandage *unfolded* below the stump with the lower border upwards, draw the point well over the stump; bring the ends forward, cross them over the

point, carry them back, again cross them, bring them forward and tie in front; now draw the point forward well over the knot and pin it to the bandage below. (Fig. 55.)

Fig. 55.—The triangular bandage for a Stump.

THE TRIANGULAR BANDAGE FOR FRACTURES.

The Triangular bandage may be used.

1.—For putting up the following Fractures:—

(i,) Fracture of the Jaw.
(ii,) Fracture of the Ribs.
(iii,) Fracture of the Clavicle.
(iv,) Fracture of the Pelvis.

(*See* Chapter XIII, Fractures.)

2.—For fixing Splints to Limbs.—If it is required to secure splints to the arm, forearm, wrist, leg or ankle, the bandage should be used folded *narrow*; if splints are to be tied to the thigh or knee, the bandage should be folded *broad*. Either of the following methods may be adopted:—

(i,) First adjust the splints to the limb, now raise and steady the limb; then place the centre of the bandage folded either *narrow* or *broad*, as the case may be, over the outer splint at the spot where it is to be tied, pass the two ends round the limb,

cross them on the inside, bring them forward and tie on the outside over the centre of the splint.

(ii,) By the *Looped Triangular bandage*, which is applied as follows: Take a triangular bandage folded *narrow* or *broad*, double it lengthways upon itself; then, after adjusting the splints to the limb, raise and steady it, and place the loop from above upon the outer splint at the spot where the splints are to be tied, carry the ends round the limb from without inwards, then pass both ends through the loop, one from right to left and the other in the opposite direction; now tighten the bandage by steadily drawing on the two ends, and then tie over the centre of the splint (Fig. 56). The advantage of this method is that splints can be easily fixed without unduly disturbing the parts. *Note.*—Always fix splints to the limb first *above* the seat of fracture.

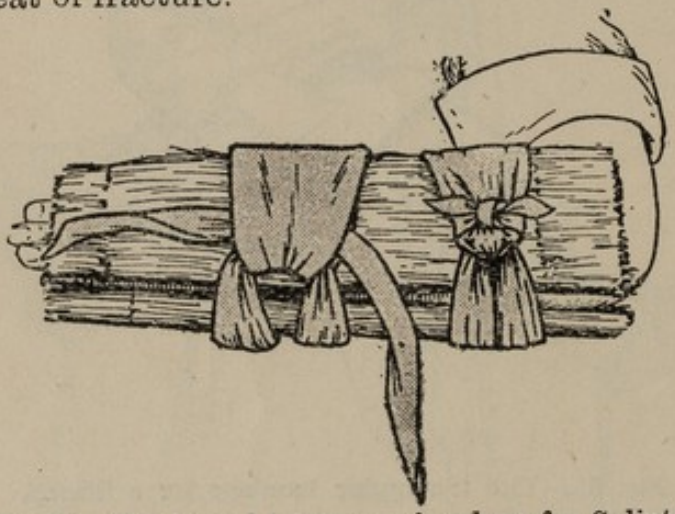


Fig. 56.—The looped triangular bandage for Splints.

THE TRIANGULAR BANDAGE TO ARREST HÆMORRHAGE.

Here the Triangular bandage may be used:—

1.—To Improvise a Tourniquet.

2.—To Bandage the Limbs to each other in the Method of Forced Flexion. (For these, *see* chapter XI, Hæmorrhage.)

3.—As a Knotted or Twisted Bandage. This method of application is described above (*see* Wound of Temple, page 72).

4.—For Venous Hæmorrhage. To tie round a limb.

Caution.—After bandaging for hæmorrhage, do not in the absence of the surgeon leave a tight bandage on for more than three hours.

II.—THE ROLLER BANDAGE AND ITS APPLICATION.

The Roller Bandage is essentially the bandage for use in all cases where it is required to maintain firm pressure, *e.g.*, to control bleeding, to fix dressings after operations, etc. For

emergency cases in non-professional hands the Roller is not so well adapted as the Triangular, as it requires for its proper application considerable skill and experience.

ROLLER BANDAGES MAY BE DIVIDED INTO—

1.—Elastic Bandages.—These are of several kinds, woven, india rubber, etc.; they are used to check the flow of blood when drawn tightly round a part and to give support, as in varicose veins.

2.—Semi-elastic Bandages.—These are made out of flannel, domette, silk, cotton, net, etc. As they lie more smoothly, they are easy to apply and do not want reversing.

3.—Non-elastic Bandages.—These are made out of grey sheeting, unbleached or bleached calico, linen, etc., and are the roller bandages in general use.

THE SIZES OF THE ROLLER BANDAGE FOR ADULTS ARE AS FOLLOWS:—

Part.	*Breadth.*	*Length.*
For the Head	2 to 2½ ins.	5 to 7 yards.
,, Finger	¾ in.	1 to 2 ,,
,, Hand	1 in.	4 to 5 ,,
,, Arm	1½ to 2½ ins.	8 to 12 ,,
,, Shoulder	2½ to 3 ins.	8 to 12 ,,
,, Chest or Abdomen	3 to 4 ins.	6 to 8 ,,
,, Leg or Thigh	2½ to 3 ins.	10 to 12 ,,
,, Foot	2½ ins.	4 ,,

To Roll the Bandage.—Turn in enough of one end to start the roll, place the bandage upon the thigh with the part rolled near the groin, and roll the cylinder with the palm of the

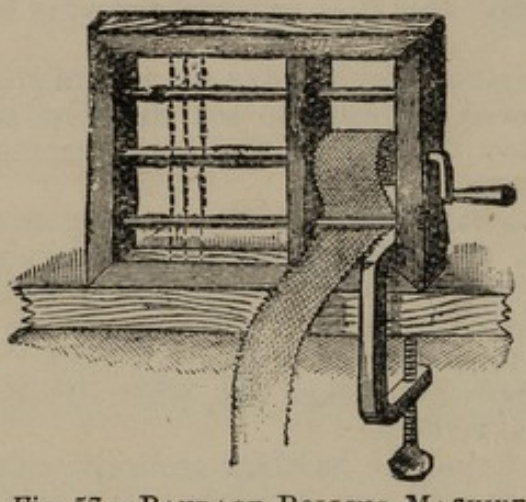


Fig. 57.—BANDAGE ROLLING MACHINE

hand upon it from above downwards. When the roll is completed insert a couple of pins in it. Bandages are rolled more efficiently on a *Bandage Rolling Machine.* (Fig. 57.)

The Named Parts of the Bandage are :—The initial or *free end*; the rolled up or *terminal end*; and the *body*. When a bandage is rolled up from one end only it is termed a *single-roller*, when rolled up from both ends a *double roller*.

Points to be observed in the Application of the Roller Bandage.

(i,) Before applying the bandage see that it is *tightly* rolled.

(ii,) Stand in front of the limb to be bandaged, and place it in the exact position in which it is to be kept, if it is the upper limb bend the elbow, and place the hand with the thumb pointing upwards.

(iii,) Commence by applying the outside of the bandage to the inside of the limb and then taking a couple of turns round the limb to fix the bandage.

(iv,) Always bandage from below upwards, except when otherwise indicated.

(v,) Always bandage from within outwards, over the front of a limb.

(vi,) While bandaging, never unroll more than two or three inches of the bandage at a time.

(vii,) Let each succeeding turn of the bandage overlap two thirds of the preceding turn.

(viii,) Bandage the part firmly but never too tightly, or too loosely; if the edges turn up on running the hand down a bandage after it has been applied, it shows that the bandage is too loose.

(ix,) Use firm, equable pressure throughout the bandage; if when the bandage is removed red lines are seen on the surface of the skin, it indicates that unequal pressure has been exerted by the bandage.

(x,) In bandaging a limb, leave the tips of the fingers and of the toes uncovered, in order to see that the bandage has not been applied too tightly; if the tips become blue and cold loosen the bandage.

(xi,) Apply the bandage smoothly, leaving no wrinkles.

(xii,) Keep all the margins parallel, and keep the crossings and reverses in one line, and towards the outer side of the limb.

(xiii,) Never reverse the bandage over a sharp bone.

(xiv,) Always form a figure of 8 over a joint.

(xv,) Never apply a bandage wet, when dry it will shrink and bind the limb too tightly.

(xvi,) End by fixing the bandage securely with a safety pin.

(xvii,) Never re-apply a bandage without first completely winding it up.

(xviii,) In taking off a bandage gather the slack into a loose bundle, and pass it round and round the part from which it is being remove.

THE ROLLER BANDAGE MAY BE APPLIED IN THE FOLLOWING WAYS:

(i,) As a Circular bandage.
(ii,) As a Simple Spiral bandage.
(iii,) As a Reversed Spiral bandage.
(iv,) As an Oblique bandage.
(v,) As a Figure of 8 bandage and its modification the Spica.

1.—The Circular Bandage consists of a series of turns made round a part, each turn exactly overlapping the one preceding it.

2.—The Simple Spiral Bandage consists of a series of spiral turns, each turn overlapping the preceding one by about two-thirds. It can only be applied to those parts which vary but slightly in their circumference, such as the forearm just above the wrist, and the fingers. (Fig. 58.)

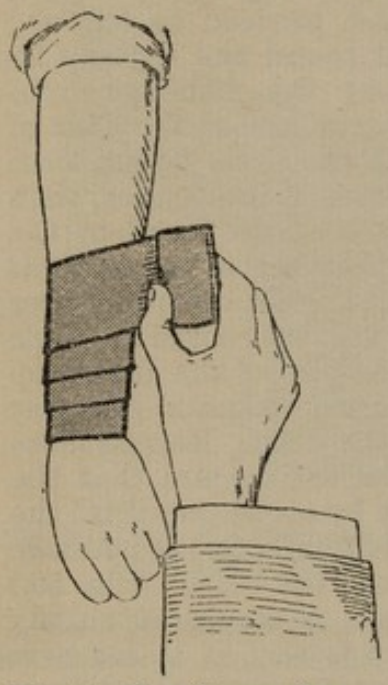


Fig. 58.—THE SIMPLE SPIRAL.

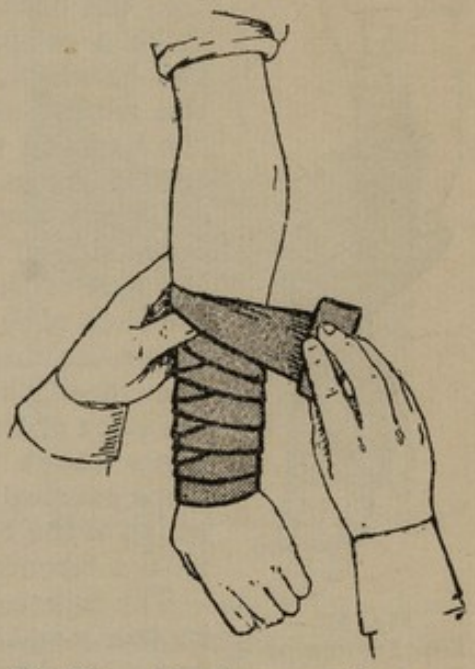


Fig. 58*a*.—THE REVERSE SPIRAL.

3.—The Reverse Spiral Bandage consists of a series of spiral turns in which the bandage is reversed upon itself while it is being applied, the object of reversing being to make the bandage lie smoothly and firmly over parts which vary considerably in diameter—such as the upper part of the forearm, the calf, etc.

To Reverse proceed as follows: First take a couple of spiral turns round the limb, then holding the *head* of the bandage lightly in one hand, place the thumb of the disengaged hand over the lower border of the bandage, on the outer side of the limb; now slacken about three inches of the bandage, turn

it over, reverse it downwards, pass it under the limb to the opposite side, keeping its lower edge parallel with that of the turn below; when the outer side of the limb is reached make the reverse again, and so on. (Fig. 58*a*).

This bandage is *firmer* than the simple spiral and is to be preferred for *fixing splints* to a limb. Its disadvantages are that it is somewhat liable *to slip*, and it is *not elastic*.

4.—The Oblique Bandage consists of a series of rapidly ascending spirals which pass up the limb without their edges overlapping. It is used only for *holding dressings* loosely in place.

5.—The Figure of 8 Bandage consists of a series of loops, each loop forming a figure of 8, and overlapping the one below by about two-thirds the width of the bandage.

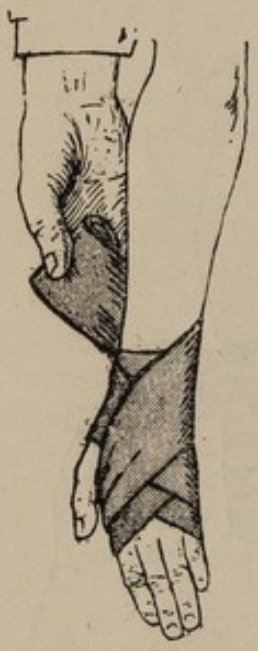


Fig. 59.—The Figure of 8.

To Apply the figure of 8 *Bandage* to a part, *e.g.*, the back of the hand, proceed as follows: Take a couple of turns round the wrist to fix the bandage, then carry the bandage from the thumb side of the wrist across the back of the hand to the base of the little finger, then across the palm at the root of the fingers, then obliquely across the back of the hand to the outer side of the wrist, then across the palm at the root of the fingers and again obliquely over the back of the hand towards the root of the little finger, leaving about one-third of the first loop uncovered, then again across the palm and over the back of the hand to the wrist. Repeat these turns about three times, taking care that the loops overlap each other by about one-third the width of the bandage, and finally fix the bandage with a circular turn round the wrist. (Fig. 59.)

The figure of 8 bandage is employed chiefly in the *neighbourhood of joints*; it is *less firm* but *more elastic* than the reverse spiral bandage.

The Spica Bandage.—This is a modification of the Figure of 8 bandage, having one loop much larger than the other. It is used to *retain dressings*, and to keep up *pressure* on a joint.

There are two methods of applying the Spica, viz.:—

(i,) *The Ordinary Spica* which is used at the junction of a limb.

(ii,) *The Divergent Spica*, which is used to cover in large prominences, such as the heel, the bend of the knee, and the elbow.

The Spica Bandage for the Groin may be employed either from below upwards as an "ascending spica," or from above downwards as a "descending spica."

(i,) *The Ascending Spica.*—Begin by first slightly flexing the

hip on the side of the affected groin, then with a bandage 2½ to 3 ins. wide and 10 to 12 yards long, take a couple of *spiral* turns round the upper fourth of the thigh, now make *reverses* up the thigh till the groin is reached; then carry the bandage across the front of the groin outwards and upwards to a little above the hip joint, then across the small of the back, and over the hip on the opposite side to the front of the abdomen, and across the pubes back again to the affected groin, then to the outside of the thigh round the back of it to the inside, and over the groin; again across the body, and so on, making each turn go about half-an-inch higher than the lower edge of the preceding turn, and finally fix with a safety pin. (Fig. 60.)

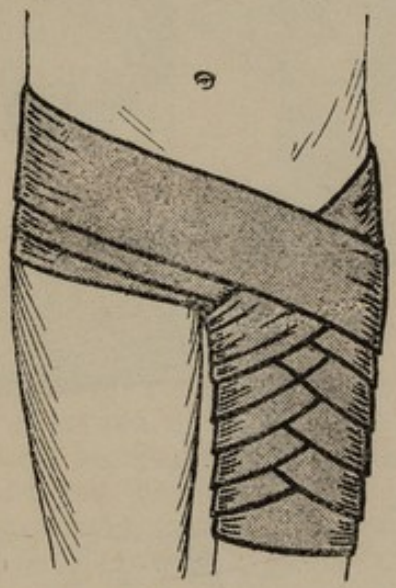


Fig. 60.—The "Ascending Spica" for the Groin.

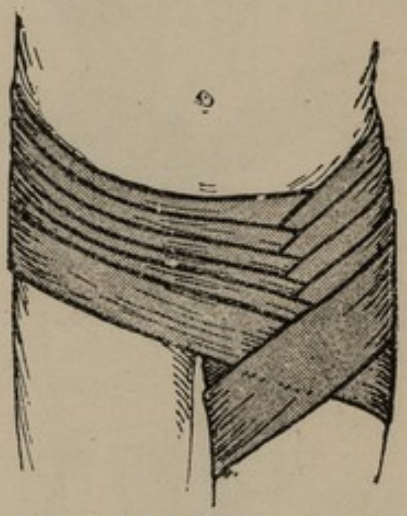


Fig. 61.—The "Descending Spica" for the Groin.

(ii,) *The Descending Spica.*—Flex the thigh as before, then lay the free end of the bandage over the affected groin; now carry the bandage from within outwards across the hip on the same side, taking care that it lies as high as possible (*i.e.*, just below the brim of the pelvis); then pass it horizontally across the loins and round the hip on the sound side, then bring it obliquely across the front of the abdomen below the navel, over and round the thigh, and then again across the affected groin back to the first turn, and so on, causing each turn to lie on a *lower level* than the preceding turn and to over lap it by about two-thirds the width of the bandage. (Fig. 61.)

The Spica for the Shoulder may also be applied in two ways:—

(i,) *From below Upwards*, as an "ascending spica," thus: Take a bandage 2½ to 3 ins. wide and 8 to 12 yards long, make a couple of *spiral turns* from within outwards round the upper

third of the arm on the affected side, now make *reverses* up the arm till the shoulder is reached; then (after first placing a little cotton wool in both armpits), carry the bandage behind the shoulder across the back to the opposite side and under the armpit on that side, then across the front of the chest well up towards the top of the breast bone, then across the shoulder in a line with the reverses upon the bandage, then round the arm below the shoulder from behind forwards to the front, and then across the back, and so on. (Fig. 62.)

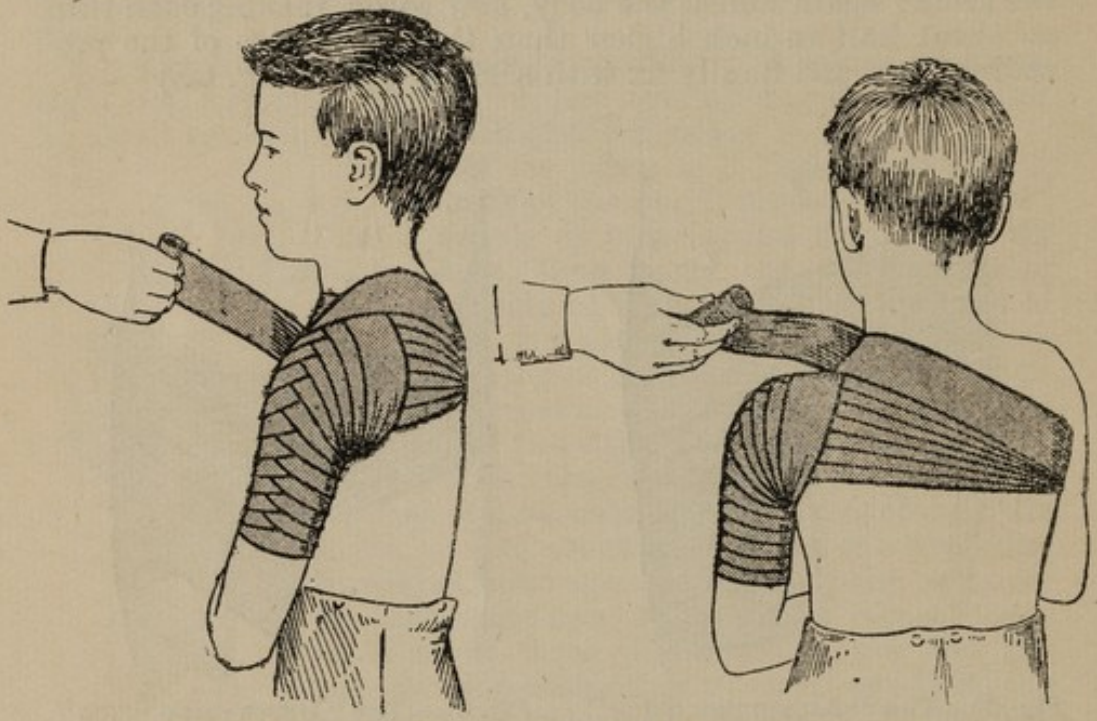


Fig. 62.—The "Ascending Spica" for the Shoulder.

(ii,) *From above Downwards*, as a "descending spica," thus: After bringing up the bandage by means of *reverses* to the armpit, carry it over the front of the shoulder and as high up the neck as possible, then round the back to the opposite side; now under the arm on that side and across the front of the chest and the front of the arm on the affected side; then under the armpit and over the shoulder again to the back, but this time on a lower level than the preceding turn, and so on. (Fig. 63.)

Spica for the Female Breast.—Take a bandage 3 to 4 ins. wide and 6 to 8 yards long, lay the free end of it about four inches below the affected breast, then make two horizontal turns round the body to fix the bandage; now carry the bandage under the affected breast and over the opposite shoulder, then down the back and again to the front on a slightly higher level than the preceding turn; then horizontally across the body, and so on,

till the whole breast is covered, the horizontal and oblique turns being each time on a little higher level.

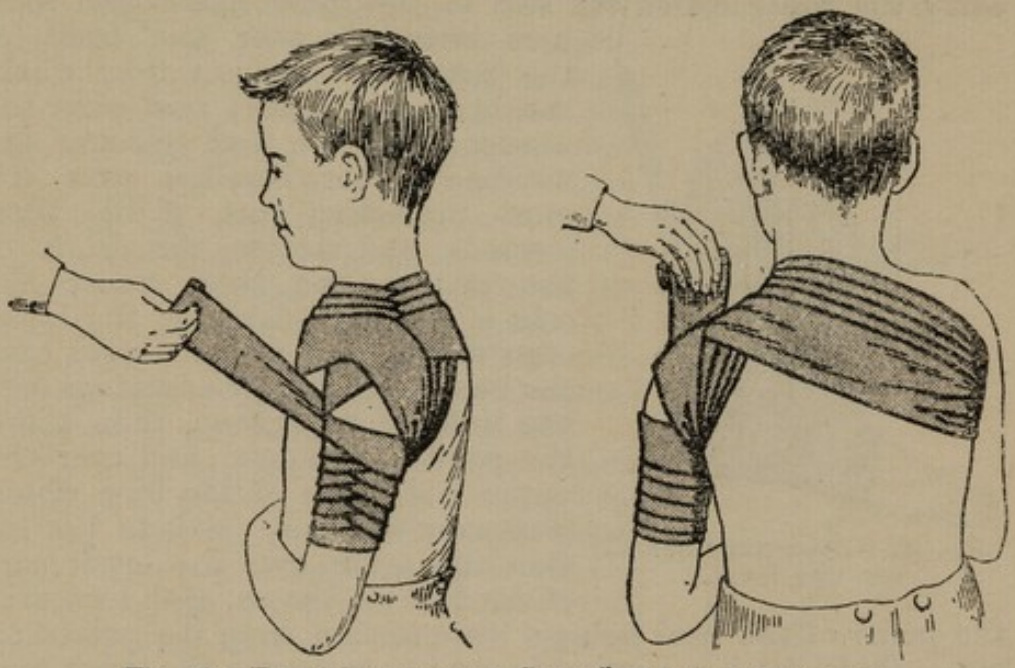


Fig. 63.—The "Descending Spica" for the Shoulder.

Spica for the back of the Thumb.—This is the regular bandage for a *sprain* of the thumb and for *hæmorrhage* from the part. Take a bandage not more than ¾ inch wide and 1 to 2 yards long, place the hand with the palm downwards, lay the free end of the bandage below the root of the thumb and carry the bandage across to the back of, and round the wrist twice to fix it; now carry it upwards from the root of the thumb to between the thumb and forefinger, then round the thumb as high as it will lie, then across the back of the hand, and round the wrist, back again to the root of the thumb; then again round the thumb, covering two-thirds of the former loop, then across the back of the hand, and so on; bring the loops round the thumb a little nearer the wrist each time; finally fix the bandage round the wrist either with a safety pin, or by splitting the end and tying. (Fig. 64.)

Fig. 64.—The Spica for the Back of the Thumb.

Spica for the Great Toe.—This is applied in precisely the same way as the above, the ankle taking the place of the wrist.

Divergent Spica for the Heel.—Take a bandage 2½ ins. wide and 4 yards long, place the free end of it across the outer ankle; carry the roller under the sole to the inner ankle, and from here outwards over the front of the instep to the point from where the bandage started; now carry the bandage over the heel (placing the middle of the bandage over the most projecting part of it), then inwards and across the front of the instep, and then under the sole of the foot, catching the lower edge of the loop which passes over the heel; now take the bandage over the front of the instep, then above the point of the heel, and over the upper loose edge of the loop which goes over the heel, back to the instep and again over the lower part of the heel, and so on, each loop over the point of the heel being a little further from the preceding one. Finish with a couple of spiral turns round the lower part of the leg. (Fig. 65.)

Fig. 65.—Divergent Spica for the Heel.

Divergent Spica for the Elbow.—Take a bandage 1½ to 2½ ins. wide and 4 yards long, first flex the elbow, then carry the roller up the forearm by means of reverses till the elbow is reached, now place the middle of the bandage well over the point of the elbow, then carry it from within outwards and catch the lower loose edge of the loop which encircles the point of the

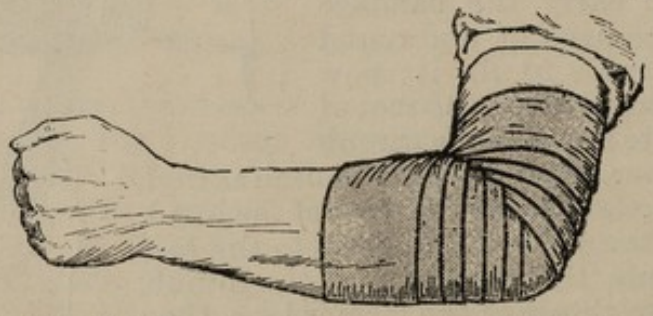


Fig. 66.—Divergent Spica for the Elbow.

elbow, then take the bandage across to the inner side of the elbow, bring it from within outwards again, and catch the upper loose edge of the loop; continue these figures of 8 from within outwards alternately, making each overlap two-thirds of the preceding one. This bandage is employed when it is required to keep the forearm in a *bent position*, as after fractures and injuries about the elbow joint. (Fig. 66.)

Divergent Spica for the Knee.—First slightly flex the knee, then lay the free end of a bandage 2½ to 3 ins. wide and about 4 yards long, against the inner side of the knee and carry the roller over the front of the knee-cap to the outer side of the knee and then back to the starting point; then across the front of the knee, catching the lower loose margin of the turn above, then back to the starting point, and again across the front of the knee, this time catching the upper loose margin of the first turn; continue these figures of 8 above and below alternately. This bandage is used to give *support* to the knee joint when it is inflamed. (Fig. 67.)

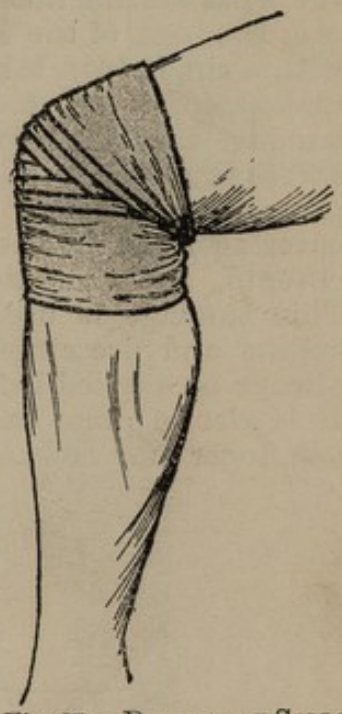


Fig. 67.—Divergent Spica for the Knee.

To Bandage the Upper Extremities proceed as follows: Take a bandage 2½-inches wide and 10 to 12 yards long, make a couple of spiral turns round the wrist, beginning at the root of the thumb and passing outwards over the back of the wrist; then carry the bandage downwards over the back of the hand to the root of the little finger; now take one turn round the fingers, leaving the tips free, then make a *figure of* 8 *round the back of the hand*, and repeat it three or four times; then carry the bandage by spiral turns upwards till the thick part of the forearm is reached, then apply the *reverse spiral* till the bulging of the forearm begins to diminish, now flex the elbow, make a *figure of 8 round it*, leaving the point free, unless it is injured, in which case cover it, then make a few *spiral turns* round the lower part of the upper arm, then carry the bandage up by *reverse spirals* to the armpit, and secure the end with a safety pin. (Fig. 68.)

Note.—Never bandage the forearm and arm in a straight position and then flex the elbow afterwards, as this will produce compression of the veins and lead to swelling of the hand and forearm, and subsequent mortification.

Fig. 68.—The Upper Extremity bandaged.

Finger Bandage:—

The Continuous Finger Bandage.—Take a bandage ¾-inch, or, still better, ⅔-inch wide, and 4 yards long. Make a turn round the wrist leaving about 6 ins. of the end free, carry the bandage over the back of the hand to the outer side of the little finger, with a single turn take it well up to the level of the nail, then make *spiral turns* round the finger to the root, then carry the bandage across the back of the hand round the wrist, and again across the back of the hand to the root of the ring finger, now proceed successively with this and each of the other fingers, covering them in the same way as the little finger till all are covered, and then tie the bandage with the loose end (Fig. 69). This bandage is used to prevent swelling of the hand when splints and dressings are applied to the forearm. It should always be applied before other bandages are put on higher up. It is also of great use for burns and scalds of the fingers. Any one finger may be bandaged in a similar manner to the above.

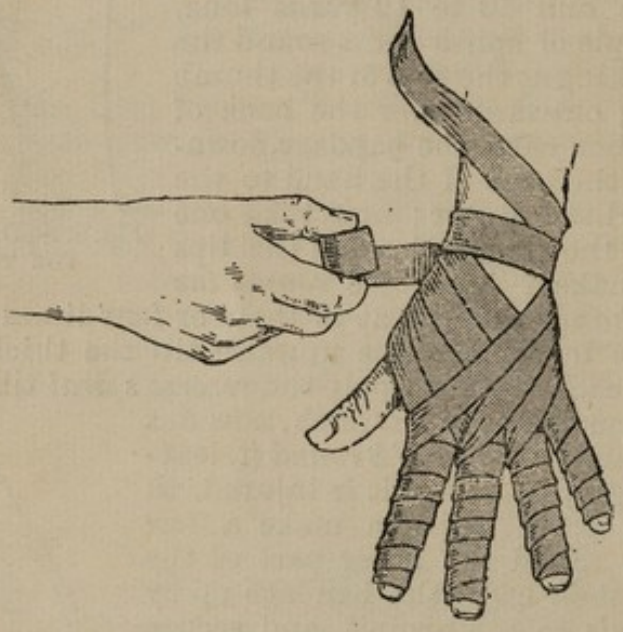


Fig. 69.—The Continuous Finger Bandage.

To Bandage the Lower Extremity proceed as follows: Take a 2½-inch bandage, 10 to 12 yards long. Extend the leg and place the foot at right angles to it; lay the free end of the bandage over the inner ankle, now carry the roller over the instep to the root of the little toe, then across the sole of the foot to the ball of the great toe, then over the instep and the outer ankle, round the back of the heel, across the inner ankle and over the front of the instep to the root of the little toe, then across the sole of the foot to the ball of the great toe, and then

across the top of foot at the base of the toes round the sole of the foot and back again to the ball of the great toe; now make *two reverses* round the lower part of the foot, these reverses being opposite the middle of the top of the foot, then make *two figure of 8 turns* round the ankle and heel, then make *three spiral turns* round the lower part of the leg and ankle, then carry the bandage upwards by *reverse spirals* till the knee is reached, now make *figure of 8 turns* round the knee joint, either covering it in or leaving it free, then carry the bandage up the thigh by *reverse spirals*, finish and secure the end with a safety pin. (Fig. 70.)

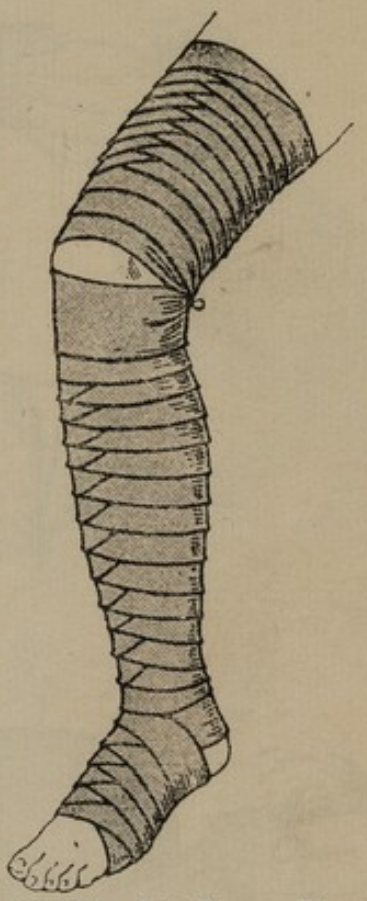


Fig. 70.—The Lower Limb Bandaged.

Bandages for the Head.

(i,) *The Capeline Bandage.*—Take two roller bandages, one 2 ins. wide and 6 yds. long, the other 1½ ins. wide and 5 yds. long. Sew the free ends together, this will form a double-headed roller. Make the patient sit on a low chair, stand behind him holding the wide roller in the right hand and the narrow roller in the left hand; now place the middle of the double-headed roller against the centre of the forehead, and carry the rollers backwards one on each side above the ears, and below and behind the occiput, cross hands passing the narrow roller over the wide one, now change rollers taking the wide roller in the left hand and the narrow roller in the right hand; draw the bandage tight, carry the wide roller upwards along the top of the middle of the head to the root of the nose, and bring the narrow roller horizontally forward above the right ear, and across the wide roller at the root of the nose; now carry the wide roller back across the top of the head a little to the left of the middle line (Fig. 71), fix it behind as in front by the narrow roller, then bring it over to the front across the head a little to the right of the middle line (Fig. 71*a*), again fix it by the narrow roller, and continue these operations backward and forward, each time making the bandage which is covering the top of the head diverge a little from the middle line till the ears are reached; now cut off the vertical bandage in front, and fix by taking two extra turns with the horizontal bandage round the head and pinning on one side. (Fig. 71*b*.)

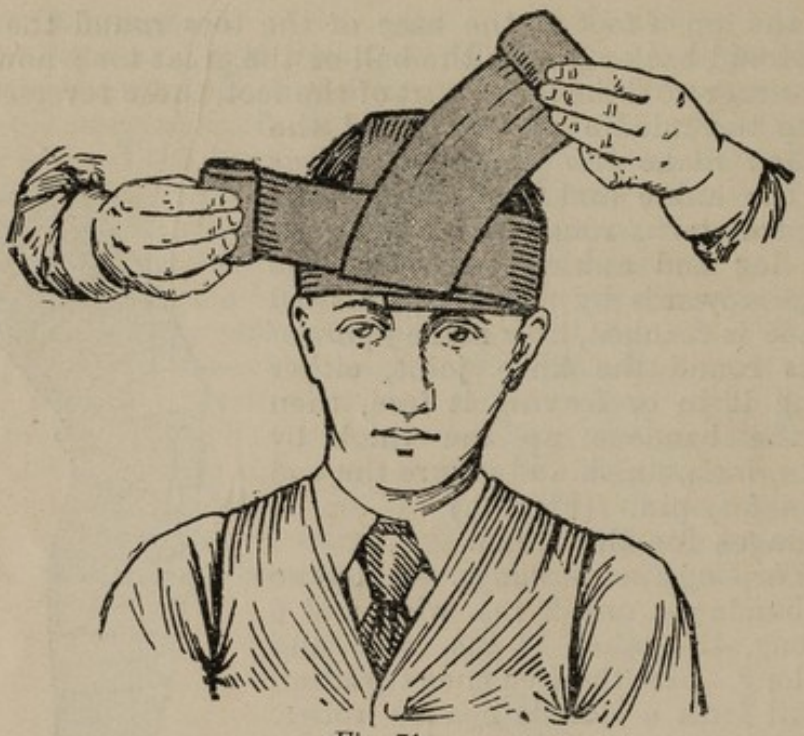


Fig. 71.

Fig. 71*a*. *Fig* 71*b*.

Figs. 71, 71*a*, 71*b*.—The Capeline Bandage.

This bandage is used for fixing dressings on the head. Its disadvantages are: that it is troublesome to apply; it is hot, and if put on too tightly it becomes painful.

(ii,) *The Twisted or Knotted Bandage.*—Take a bandage 2½ ins. wide and 8 yards long, unroll it for about 1 foot, hold the free end in the left hand; place the bandage against the left temple, carry the roller round the forehead, across the opposite temple, then

Fig. 72. *Fig.* 72*a*. *Fig.* 72*b*.

Figs. 72, 72*a*, 72*b*.—The Twisted or Knotted Bandage.

below the occiput, and bring it back to the unrolled end, now twist it round this end sharply, and carry it vertically upwards round the vertex (Fig. 72) down the side of the face under and over the jaw till the unrolled end is reached; now twist it round this again, and carry it obliquely midway between the two preceding turns (Fig. 72*a*), round the head to the starting point; then make another twist and take it vertically round the head. Repeat these oblique and vertical turns alternately till sufficient pressure is obtained, and fix the bandage by knotting the two ends together. (Fig. 72*b*.)

This bandage is used to exert pressure on a graduated compress placed over a bleeding wound of the temple, and for retaining dressings on the front of the head.

To Bandage the Chest.—A bandage applied to the chest has a tendency to slip down; to avoid this a brace is used and the bandage is applied from *below upwards*. Therefore proceed as follows: Take a roller 6 ins. wide and 6 to 8 yards long, slit the free end down the centre to about 2½ feet, place the bandage with the roller touching the back and the slit ends lying well

over the shoulders and in front of the chest, now turn the bandage at right angles at the lower part of the back, and make spiral turns over the free ends and round the chest from behind forward, and from below upwards, each spiral over-lapping the one below

Fig. 73. *Fig.* 73*a*.

Figs. 73, 73*a*.—The Chest Bandage.

it by about one half its breadth (Fig. 73); when the desired level is reached secure the last spiral with a safety pin in front and behind; now double the free ends over the applied bandage and pin each end to the corresponding bandage on the shoulder. (Fig. 73*a*.)

To Bandage the Abdomen, proceed in the same way as for the chest, but bandage from *above downwards*. This bandage is best made of flannel.

Table showing the kinds of Roller Bandage to be applied to different parts.

Part to be Bandaged.	Kind of Bandage to use.	Object of the Bandage applied.
1. The Head -	The Capeline -	To retain dressings
	The Twisted or Knotted	To exert pressure on a graduated compress or pad placed over a bleeding wound and to retain dressings.
2. The Chest -	The Spiral- -	To give support, exert pressure or retain dressings
3. The Breast -	The Spica - -	To give support

Part to be Bandaged.	Kind of Bandage to use.	Object of the Bandage applied.
4. The Abdomen	The Spiral- -	To give support, exert pressure or retain dressings
5. The Thumb -	The Spica - -	For sprain of the thumb, or to arrest hæmorrhage from the part
6. The Fingers -	The Spiral, known as the Continuous Finger bandage	To retain dressings, especially in case of burns or scalds, or to prevent the fingers from swelling when splints or dressings are applied to the forearm
7. The Hand -	The Figure of 8 -	To retain dressings, fix splints, etc.
8. The Wrist -	The Spiral- -	Ditto
9. The Forearm -	The Reverse Spiral	Ditto
10. The Elbow		
(*a*) To cover the point	The Divergent Spica	To keep the forearm in a bent position, as in fractures, or in injuries about the elbow joint.
(*b*) To leave the point uncovered	The Figure of 8 -	To retain dressings or exert pressure
11. The Upper Arm		
(*a*) For the lower part	The Spiral- -	To retain dressings, fix splints, etc.
(*b*) For the upper part	The Reverse Spiral	Ditto
12. The Shoulder	The Spica - -	To retain dressings, or to exert pressure
13. The Great Toe	The Figure of 8 -	For sprains, or hæmorrhage from the part
14. The Foot -	The Figure of 8 followed by the Spiral and the Reverse Spiral	To retain dressings, or exert pressure, or fix splints.
15. The Heel		
(*a*) To cover the point	The Divergent Spica	Ditto
(*b*) To leave the point uncovered	The Figure of 8 -	Ditto
16. The Ankle -	The Spiral - -	Ditto, or to fix splints
17. The Leg -	The Reverse Spiral	Ditto
18. The Knee		
(*a*) To cover it in	The Divergent Spica	To give support to the joint when it is inflamed
(*b*) To leave it uncovered	The Figure of 8 -	To retain dressings
19. The Thigh -	The Reverse Spiral	To retain dressings, or to fix splints
20. The Groin -	The Spica - -	To retain dressings, or to exert pressure

BANDAGES OF SPECIAL FORM AND THEIR APPLICATION.

1.—The Square Bandage.—This is used as a protection for the entire head and neck. Take a handkerchief a yard square, and fold in two so as to allow the under layer to project about 4 ins. beyond the upper; lay the middle of the bandage upon the

Fig. 74.

Fig. 74*a*.

Fig. 74*b*

Figs. 74, 74*a*, 74*b*.—The Square Bandage.

top of the head, with the larger flap covering the eyes, the margin of the upper flap in a line with the eyebrows, and the short borders hanging upon the shoulders (Fig. 74); now take the two outer corners, pass them below the inner ends and tie them in a reef knot firmly under the chin (Fig. 74*a*), turn the border of the under layer over the forehead, take its two corners, carry them backwards and tie in a reef knot behind the head. (Fig. 74*b*.)

2.—The Four-Tailed Bandage.—This is used to keep a dressing on the chin, the top, back, or front of the head, and on the knee; it is also used for a broken jaw.

(i,) *The Four-Tailed Bandage for the Jaw.*—Take 1½ yds. of a 3-in. roller, make a longitudinal slit in the centre of it about 3 ins. long and then slit down the ends to within 6 ins. of the centre. Place the chin in the centre slit, then carry the two lower ends to the top of the head and tie them; carry the two upper ends behind the neck and tie them (Fig. 75); now tie the ends to each other behind the head. (Fig. 75*a*.)

Fig. 75.

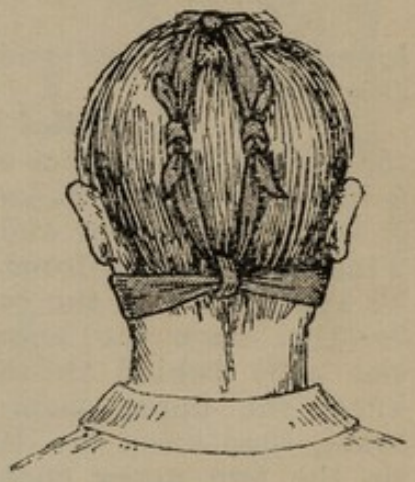


Fig. 75*a*.

Figs. 75, 75*a*.—The Four-tailed Bandage for the Jaw.

(ii,) *The Four-Tailed Bandage for the Head*, the "four-tailed cap." Take a piece of calico 6 to 8 ins. wide and 3 feet long, and slit up the ends to within 2 inches of the centre.

(*a*) To apply it to the *front* of the head: Place the centre of the bandage upon the top of the head, carry the two anterior ends backwards over the ears and tie them below the occiput, then carry the two posterior ends forwards and tie them under the chin. (Fig. 76.)

(*b*) To apply it to the *back* of the head: Place the centre of the

bandage upon the back of the head, carry the two upper ends downwards and tie them under the chin, then carry the two

Fig. 76.

Fig. 76*a*.

Figs. 76, 76*a*.—The Four-tailed Bandage for the Head.

lower ends forwards and tie them in front on the forehead. (Fig. 76*a*.)

(iii,) *The Four-Tailed Bandage for the Knee.*—Take a piece of calico 6 to 8 ins. wide and 3 ft. long, and slit it down the narrow ends to within 2 ins. on each side from the centre. To apply it: Lay the centre of the bandage upon the knee-cap, cross the ends behind the bend of the knee, the upper ends below the lower, then bring the ends forward, tie the two upper ones above the knee-cap and the two lower ones below it. (Fig. 77.)

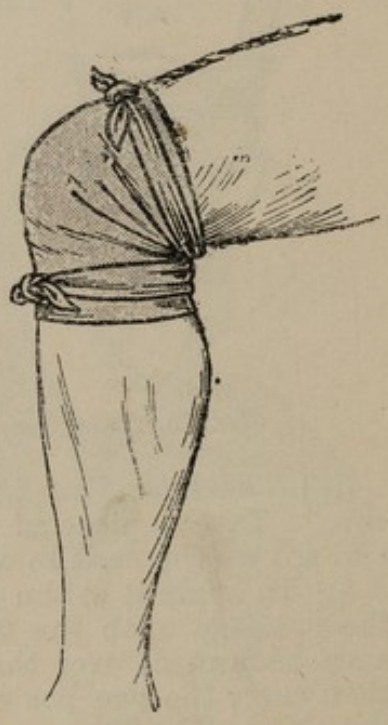


Fig. 77.—The Four-tailed Bandage for the Knee.

3.—The Many-Tailed Bandage (Bandage of Scultetus).—This is employed in cases where it is advisable not to disturb a limb more than is necessary. For the bandage the widths required are—2¼ ins. for the arm, and 3½ ins. for the leg. To make the bandage: Take a strip as long again as the part it is required to cover, spread it out, now lay

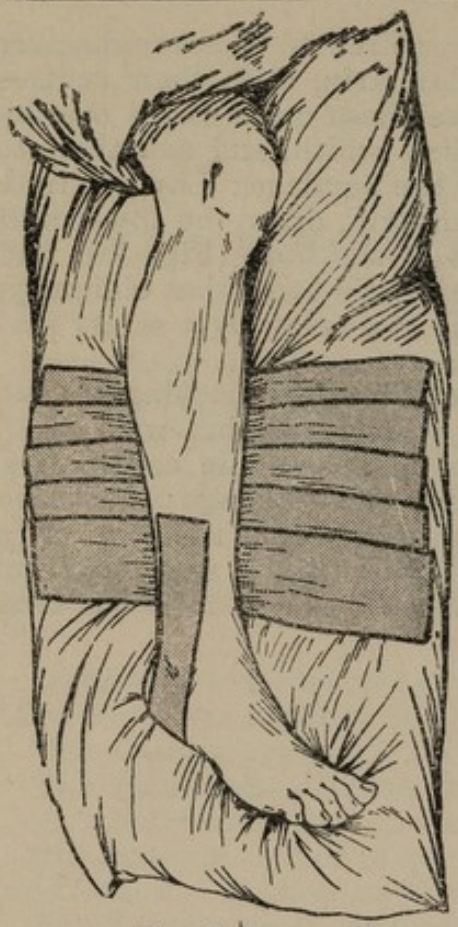


Fig. 78.

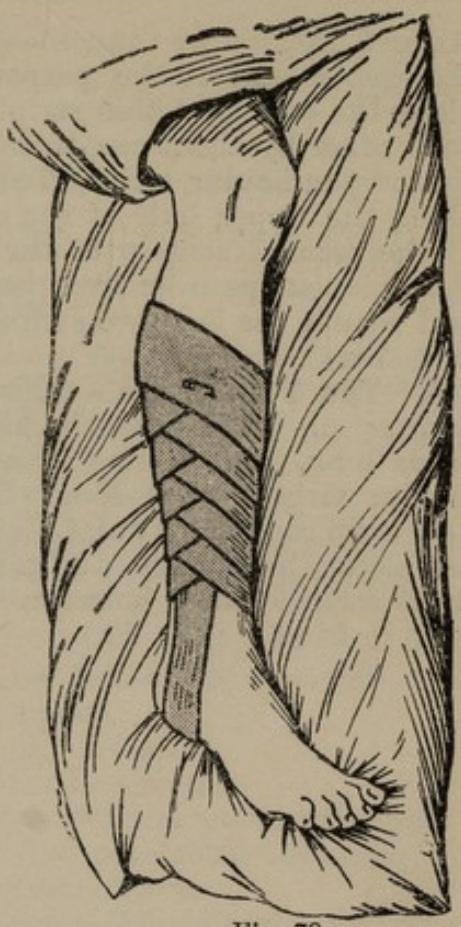


Fig. 78a.

Figs. 78, 78*a*.—The Many-tailed Bandage.

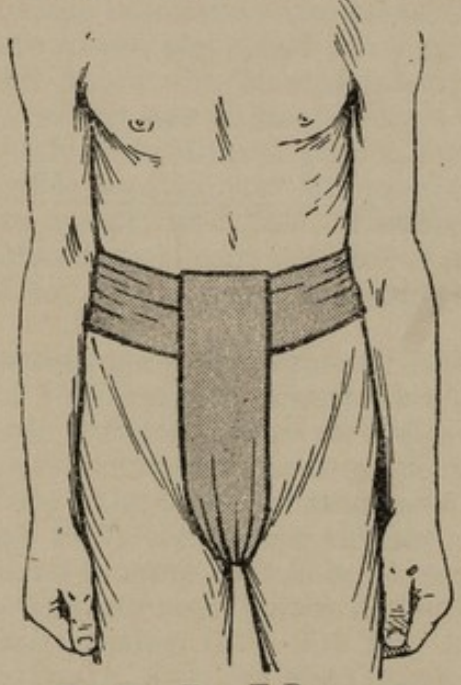


Fig. 79.—The T Bandage.

strips 6 ins. longer than the part required to be covered across the upper half of the perpendicular strip, with their centres along the centre of this strip; make these cross strips overlap each other by about one-third of their width, and sew them to the perpendicular strip. To apply the bandage: Lay the limb along the upper half of the central strip, draw the lower half of the central strip over the front of the limb (Fig. 78), fold the cross strips over from below upwards somewhat obliquely, and secure the last two strips to the two below by a safety pin. (Fig. 78*a*).

4.—The T Bandage.—This is used to retain dressings on the perinæum. It is made by taking a bandage 3 ins. wide by 1½ yards long, and sewing it at right angles to the centre of a similar strip 1 yard long. To apply the bandage: Pass the long strip round the waist above the hips, so that the short strip lies along the sacrum, and pin the ends in front; now bring the short strip forward between the thighs and pin it to the long strip in front. (Fig. 79.)

CHAPTER XI.

HÆMORRHAGE AND ITS IMMEDIATE TREATMENT.

Hæmorrhage—Definition, Causes, Situation, Symptoms, and Varieties of—The Treatment of Capillary Hæmorrhage—The Treatment of Venous Hæmorrhage—The Treatment of a Burst Varicose Vein—The General "First Aid" Treatment of Arterial Hæmorrhage—First Aid Methods of Controlling Arterial Hæmorrhage—Digital Compression, the points where the chief vessels may be digitally compressed—Forced Flexion of a Limb, Esmarch's Band, Tourniquets (Improvised, Völker's, Screw and Field)—The Treatment of Constitutional Symptoms—The Immediate Treatment of External Hæmorrhage—Internal Hæmorrhage, its Causes, and the Means to be adopted for its Treatment—Blood Spitting, Blood Vomiting, and Nose Bleeding, their Causes and Treatment.

Definition.—Hæmorrhage may be defined as the escape of blood from the heart or the blood-vessels.

The Causes are:—(i,) *Injury;* (ii,) *Disease.*

The Situation.—Hæmorrhage may be either:—

(i,) *External.*—This is most frequently the result of injury.

(ii,) *Internal.*—This is generally due to disease affecting the blood-vessels, or their neighbouring structures.

The Symptoms of Hæmorrhage are:—The actual appearance of blood (which is always seen in external hæmorrhage, while in internal hæmorrhage blood may also reveal its presence—*e.g.*, in bleeding from the lungs, etc.), and the constitutional effects, more or less, which follow the loss of blood, *i.e.*, the signs of *syncope* or *fainting*, which are indicated by a cold and clammy skin, a pallid and livid face, dilated pupils, feeble and irregular breathing, an irregular and almost imperceptible pulse, dizziness, inclination to vomit, and loss of consciousness. These constitutional effects are in direct proportion to the suddenness of the loss of blood, *i.e.*, the quicker the loss the more profound the syncope.

Varieties of Hæmorrhage.—The severity of the bleeding varies with the portion of the vascular circuit which is wounded, and hæmorrhage presents different characteristics according to its origin from capillaries, veins or arteries respectively:—

1. *Capillary.*—This is the least dangerous form; it is indicated by a general oozing from the whole surface of a wound, and the colour of the blood is more or less brick red.

2. *Venous.*—This is indicated by the blood flowing in a continuous stream, and issuing from the cut end of the vessel furthest from the heart, *i.e.*, in the limbs from below the

wound, the colour of the blood being a dark purple. Venous hæmorrhage comes next in seriousness to arterial.

3. *Arterial.*—This is the most serious form of bleeding; it is indicated by the blood flowing in a forcible pulsatile stream (which rises with each beat of the heart and falls in the interval), and issuing from the cut end of the vessel nearest the heart, *i.e.*, in the limbs from above the wound, the colour of the blood being a bright scarlet.

EXTERNAL HÆMORRHAGE.

1. The Treatment of Capillary Hæmorrhage.—Expose the part to the air and apply pressure to the wound to close the vessels, and prevent further escape of blood. This may be done by means of a perfectly clean finger, or a clean bit of sponge or lint. If the above means are not sufficient, encourage coagulation of blood, so that the clot may seal the cut vessels; this may be done by the application of clean cold water, or hot water at a temperature of 100° to 120° F., or by first drying the part and then applying a *styptic*, such as common salt, burnt or dried alum, tincture of steel, turpentine, tannic or gallic acid, Friar's balsam, tincture of eucalyptus, etc.

Note.—Styptics are not to be applied too strong, otherwise they destroy the vitality of the tissues.

2. The Treatment of Venous Hæmorrhage.—In treating bleeding from veins, adopt the following measures, viz.:—

(i,) Remove all constrictions which impede the backward flow of blood to the heart, *i.e.*, all tight clothing about the chest and neck must be loosened, garters undone, etc.

(ii,) Elevate the bleeding part if possible above the level of the heart, *i.e.*, if the bleeding is from a limb, raise it.

(iii,) Apply first digital pressure (pressure with perfectly clean fingers), *directly* to the surface of the wound, and then place a clean pad on the wound and keep it in position by a bandage.

(iv,) Keep the wounded part in an elevated position (if possible) for some hours after the bleeding has stopped.

The Immediate Treatment of a Burst Varicose Vein.—The superficial veins of the lower extremity are liable to become dilated or *varicose*, from the incompetency of their valves and the consequent undue pressure of the column of blood upon their walls; these dilated veins may burst, producing serious or even fatal hæmorrhage if not promptly attended to; the measures therefore to be adopted in dealing with a condition of this description are as follows:—

(i,) Place the patient at once on his back.

(ii,) Remove all constrictions round the limb on the heart side.

(iii,) Raise the wounded leg.

(iv,) Expose the bleeding surface, place a clean pad directly on the wound and fix it, by means of a triangular bandage.

(v,) If the patient has to be removed, carry him on a stretcher, lying on his back with his foot raised.

(vi,) Keep the patient in a recumbent position with the foot raised for some hours after the accident.

(vii,) If the bleeding has been at all excessive keep the patient warm, in order to counteract any sudden failure of the heart's action.

3. Treatment of Arterial Hæmorrhage.—In arterial bleeding the force of the heart's beat pumping the blood through the cut vessel prevents any chance of clotting, therefore the two main factors in stopping bleeding are:—

(i,) To place the bleeding part, if possible, in a *proper position*, *i.e.*, above the level of the heart, at the same time expose the wound to the air, and remove all constrictions which impede the return of venous blood.

(ii,) To apply *pressure* to the wound itself or to the main artery supplying the part. Pressure should always first be applied with the thumb and finger (*digital* pressure), so that no time is lost in getting appliances.

To aid the above means, the patient should be kept *absolutely quiet* and in a *recumbent position.*

Should there be any constitutional symptoms (*syncope*), these must be treated (*see* page 119).

"First Aid" Methods of Controlling Arterial Hæmorrhage.—The measures to be adopted will depend upon the severity of the bleeding.

1. If the Bleeding is not Excessive, *i.e.*, in all superficial hæmorrhages apply:—

(i,) Firm *pressure* directly to the bleeding point by means of absolutely clean fingers, and when the bleeding has quite stopped, place

(ii,) A clean *pad* over the wound and keep it in position either by means of a folded triangular bandage, or by a roller bandage.

In some situations, *e.g.*, the palm of the hand, a *graduated compress* (made by superimposing several layers of clean lint upon each other, the smallest piece being about the size of a sixpence and the largest that of a shilling) is more effective than a simple pad.

2. If the Bleeding is Excessive, apply if possible:—

(i,) *Digital Compression* (compression by means of the fingers) to the main artery supplying the part with blood. This pressure is applied to the artery between the wound and the heart, and at a point where some hard basis of support is furnished, against which the artery can be pressed, *e.g.*, where the vessel passes over or along a bone.

The great value of digital compression is that it can be applied immediately. In digital compression the following points are to be remembered:—

(*a*,) To use the thumb to make the pressure.

(*b*,) Having ascertained the position of the artery by its *pulsation*, get it fairly against the bone, and press directly upon it, using sufficient force just to stop the bleeding but not to cause the patient any pain.

(*c*,) Compress if possible the *artery only*, avoiding all adjacent structures such as veins and nerves. Digital compression is only applicable in certain parts of the body, *viz.*, the limbs, the neck, and some parts of the head and face, and it cannot be effectively maintained by one person for more than about fifteen consecutive minutes at a time.

(ii,) *Replace Digital Compression* by applying a hard pad upon the artery, and keeping it in position by a bandage.

The following vessels may be digitally compressed, viz.:—

1. The Temporal Artery.—This passes over the zygoma, and may be best compressed at a point one finger's breadth in front of the opening of the ear, pressure being applied directly against the bone. (Fig. 80.)

Fig. 80.—Compression of the Temporal Artery.

Fig. 81.—Compression of the Occipital Artery.

2. The Occipital Artery.—This passes over the mastoid process, and can be best compressed at a point two fingers' breadth from the centre of the back of the ear, pressure being applied directly backwards. (Fig. 81.)

3. The Facial Artery.—This passes over the lower jaw, and can be best compressed at a point one inch in front of the angle of the jaw, pressure being applied directly backwards. (Fig. 82.)

4. The Common Carotid Artery.—This passes along the side of the neck, from a point midway between the angle of the jaw and the mastoid process to the sternal end of the clavicle; it can be best compressed at a spot one and a half inches above the joint between the sternum and the clavicle, pressure being applied inwards and backwards. (Fig. 83.)

Fig. 82.—Compression of the Facial Artery.

Fig. 83.—Compression of the Common Carotid Artery.

5. The Subclavian Artery.—This passes across the upper surface of the first rib; it can be best compressed at a point behind the middle of the clavicle, pressure being applied

Fig. 84.—Compression of Subclavian with the Thumb.

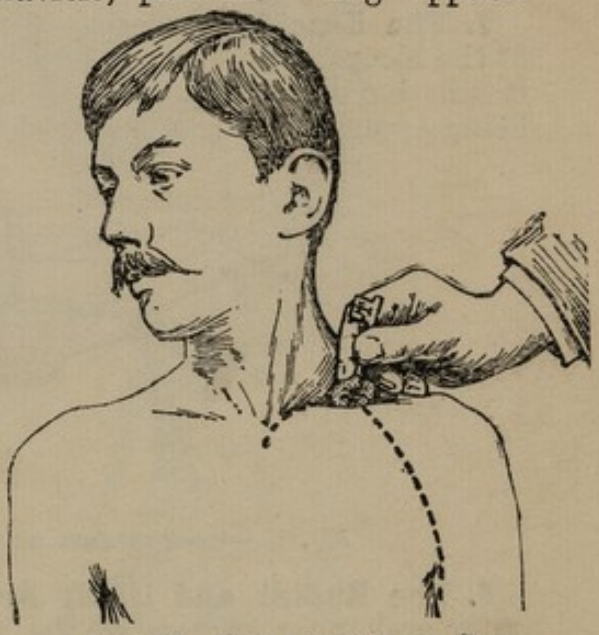


Fig. 85.—Compression of Subclavian with the Handle of a Door Key Padded.

downwards and backwards after first depressing the shoulder, either with the thumb (Fig. 84), or with the handle of a door key padded. (Fig. 85.)

6. The Axillary Artery.—This passes over the apex and along the outer side of the axilla; it can be best compressed at the junction of the outer with the middle third of the armpit, pressure being applied outwards and backwards after first raising the arm. (Fig. 86.)

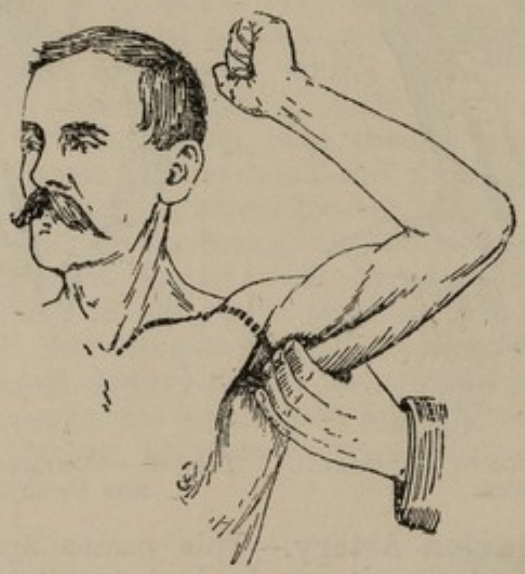


Fig. 86.—Compression of the Axillary Artery.

7. The Brachial Artery.—This passes along the inner border of the biceps muscle, in a line with the inner seam of the coat; it can be best compressed in the middle of the arm, pressure being applied outwards and backwards. (Fig. 87.)

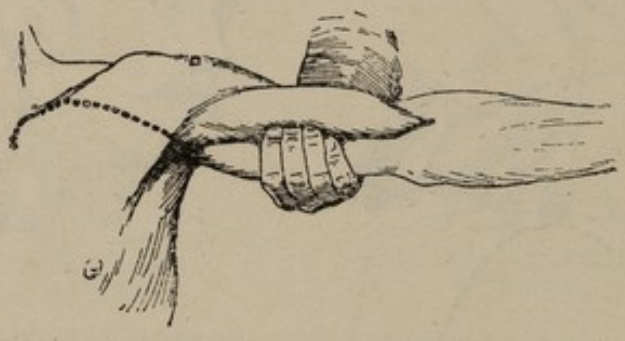


Fig. 87.—Compression of the Brachial Artery.

8. The Radial and Ulnar Arteries.—These pass along the outer and inner borders of the wrist respectively; they can be best compressed at a point one inch above the wrist on each side, pressure being applied directly backwards. (Fig. 88.)

9. The Femoral Artery.—This passes over the centre of the pubes (here it is known as the *common femoral*), and then along

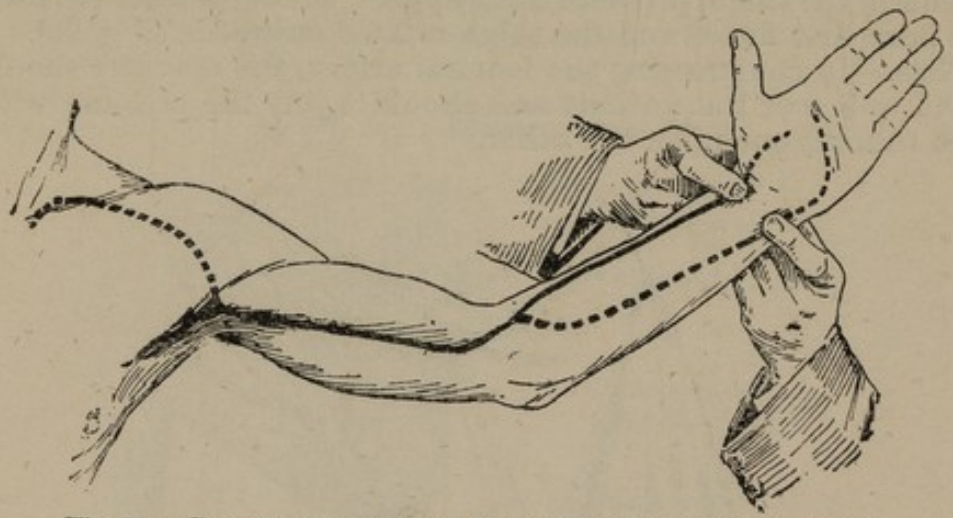


Fig. 88.—Compression of the Radial and Ulnar Arteries.

a line drawn from the middle of the bend of the groin to the back of the internal condyle of the femur (here it is known as the *superficial femoral*); it can be best compressed, either at a point

Fig. 89.—Compression of the Common Femoral Artery.

midway between the symphisis pubis and the iliac spine, pressure being applied directly downwards (Fig. 89), or lower down in the middle of the thigh, pressure being applied outwards after the knee has been first flexed and the thigh rotated outwards (Fig. 90).

Note.—In compressing the femoral artery, the operator should stand well over the patient and should apply the pressure with both thumbs one upon the other.

Fig. 90.—Compression of the Superficial Femoral Artery.

10. The Popliteal Artery.—This passes along the middle of the ham; it can be best compressed in the centre of the middle of the ham, pressure being applied directly forwards.

11. The Posterior Tibial Artery.—This passes below the internal malleolus; it can be best compressed at a point a thumb's breadth from the internal malleolus, pressure being applied forwards and outwards.

12. The Anterior Tibial Artery.—This passes along the middle of the front of the ankle; it can be best compressed at a point midway between the two malleoli, pressure being applied backwards.

Forced Flexion.—In bleeding from the limbs *digital compression* of the artery can be superseded by *compression of the artery*

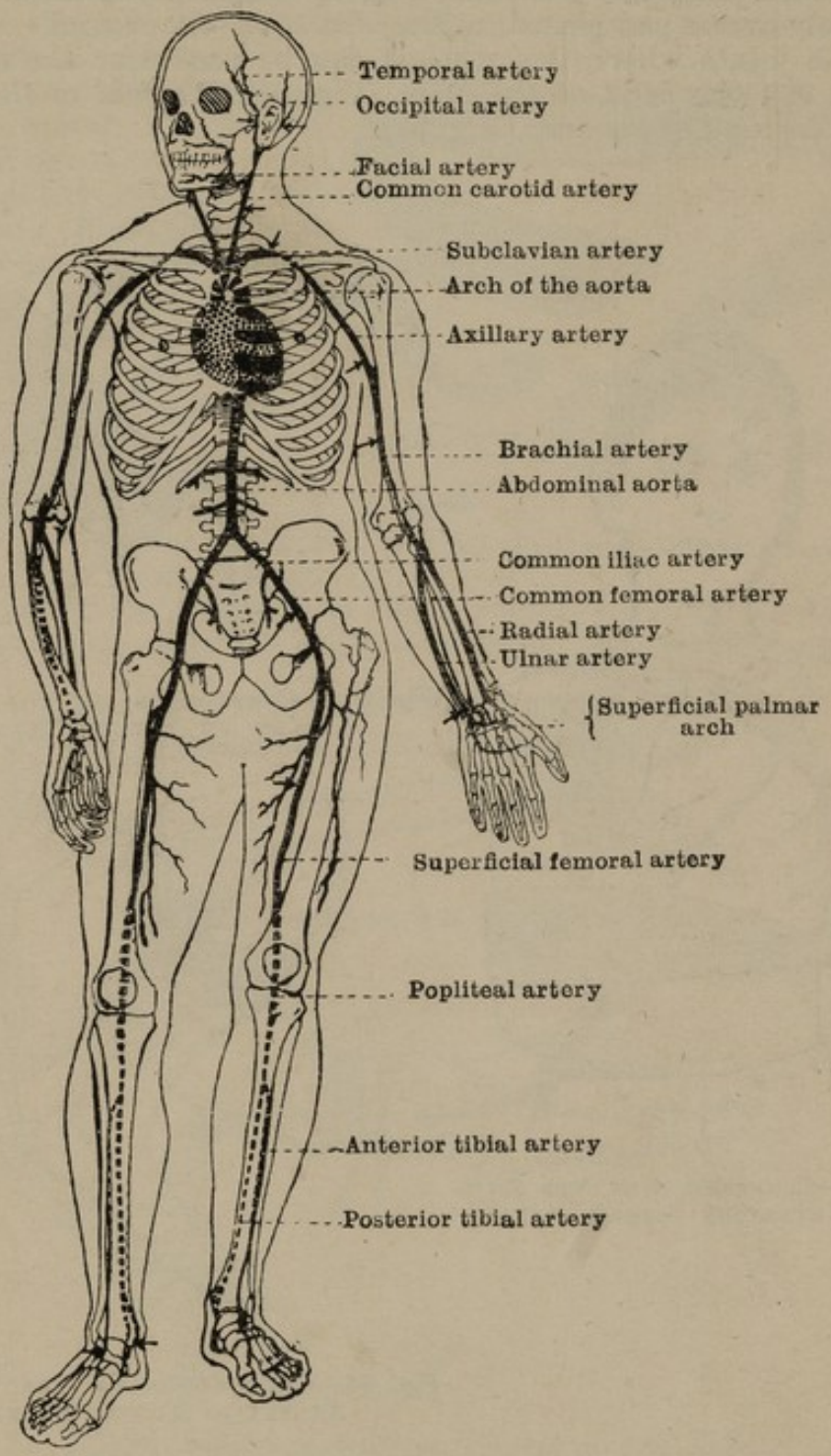


Fig. 91.—Diagram to show the course of the Chief Arteries.

(The arrows indicate the points where, and the direction in which, pressure can be applied most effectively.)

by forced flexion of the limb, i.e., by bending the main artery acutely over a pad placed in the joint *above* the wound.

The joints where this method can be used are: the *armpit*, (Fig. 92), the *bend of the elbow* (Fig. 93), the *fold of the groin* and the *bend of the knee* (Fig. 94).

Fig. 92.—Compression of the Axillary Artery by Forced Flexion.

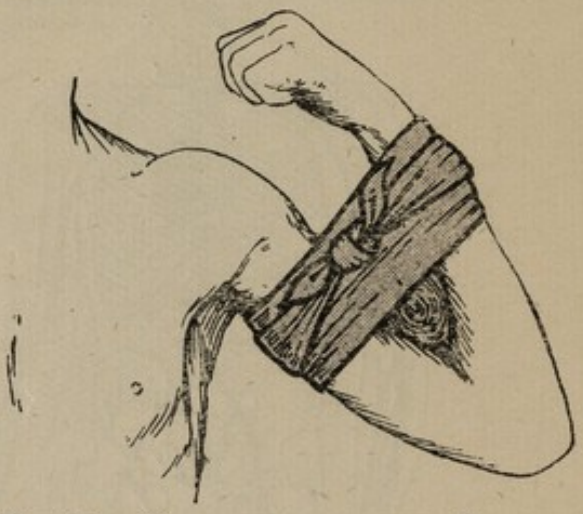


Fig. 93.—Compression of the Brachial Artery by Forced Flexion.

Fig. 94.—Compression of the Popliteal Artery by Forced Flexion.

Mode of Procedure.—Place a hard pad, not too large, in the joint *above* the wound, flex the limb over the pad, and tie it to the part above by means of a triangular bandage folded narrow.

Forced flexion is uncomfortable, and if the patient is left

alone, he may pull the bandage to relieve the discomfort and displace the pad, causing the bleeding to recommence, therefore, *Constriction* of the whole limb above the bleeding point is better; this can be effected by:—

(i), A *Narrow-Fold Triangular Bandage* tied loosely in a knot round the limb, and then twisted round several times by means of a stick inserted into the loop to make it tight, or

(ii,) By *Esmarch's Elastic Band or Tube* (Figs. 95 and 96), which are applied as follows: First, a turn of a wide Roller bandage is fixed round the limb where the band (or tube) is to be applied in order to protect the skin;

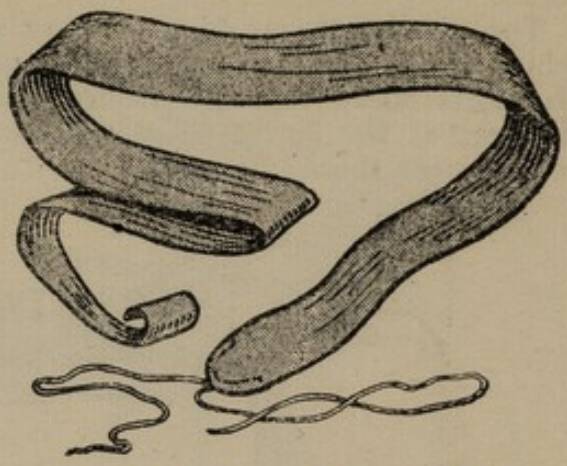


Fig. 95.—Esmarch's Elastic Band.

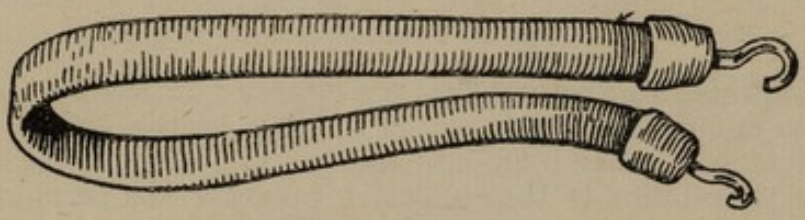


Fig. 96.—Esmarch's Elastic Tube.

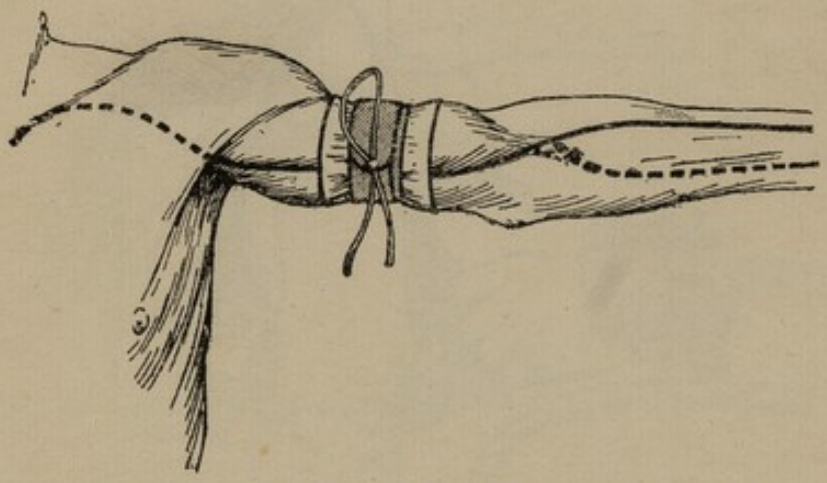


Fig. 97.—The Elastic Band applied to the Arm.

the band (or tube) is then well stretched, the limb encircled with it at this spot two or three times, and the ends are then either tied (Fig. 97), or hooked off (Fig. 98).

CAUTION.—In applying Esmarch's Band care must be taken that it is just tight enough to stop the circulation and nothing more.

The disadvantages of the above method (constriction of the whole limb), are: That complete arrest of the blood supply to the parts below the constriction favours a tendency to mortification of the limb, therefore, in preference to constriction, tourniquets should be used.

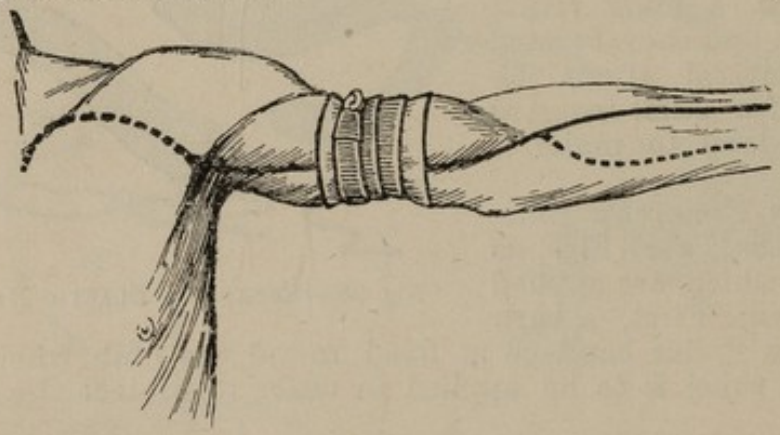


Fig. 98.—THE ELASTIC TUBE APPLIED TO THE ARM.

Tourniquets, are instruments constructed on the principle of a strap to encircle the limb, a pad to place on the artery, and a screw, buckle or other means to tighten the strap. The advantage of a tourniquet is that effective pressure can be applied to the main artery without undue constriction of the whole limb.

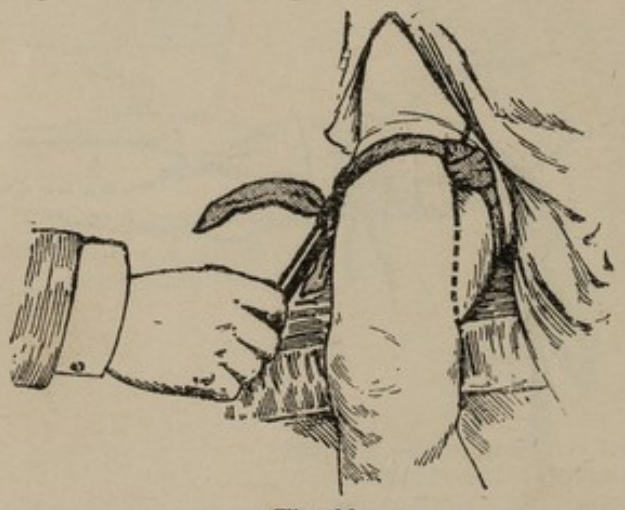


Fig. 99.

The kinds of tourniquets most suitable are :—

The Improvised Tourniquet or Garrot.—This is made by folding a Triangular bandage or an ordinary handkerchief like a cravat,

and placing some hard substance (such as a cork out of a wine bottle) in its folds, to act as a pad: the pad is placed on the vessel, the handkerchief is tied *loosely* once over a soft pad, placed against the limb on the opposite side to the knot, a stick is placed in the tie and the bandage knotted over it, the stick is then twisted round several times till the vessel is compressed (Fig. 99), and then after first placing the pad under it, it is tied to the limb by means of another triangular bandage folded narrow (Fig. 99*a*).

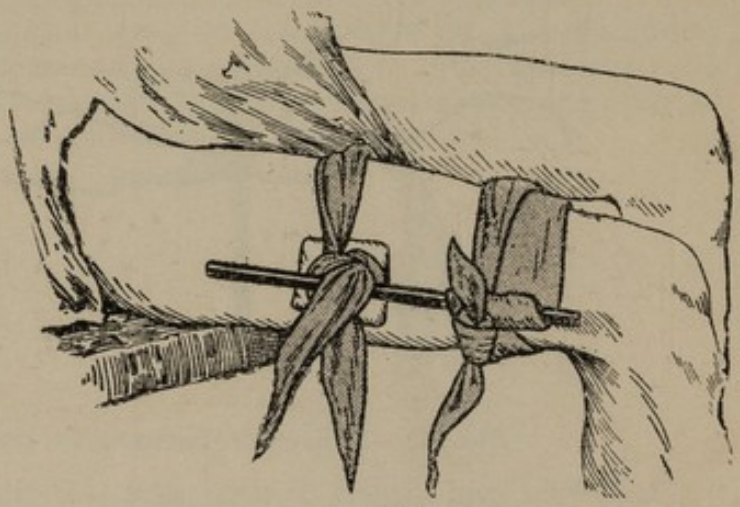


Fig. 99*a*.

Figs. 99, 99*a*.—The Improvised Tourniquet applied to the Thigh.

Völker's Stick Tourniquet.—This can be applied only to the arm; it is made by taking two sticks 6 to 8 inches long, ¾-inch thick, and notched at the ends; after first encircling the limb with a couple of turns of a roller bandage at the spot where the vessel is to be compressed, one stick is placed on the artery, and the other on the opposite side to it, the two are then tied together at their ends, top and bottom (Fig. 100).

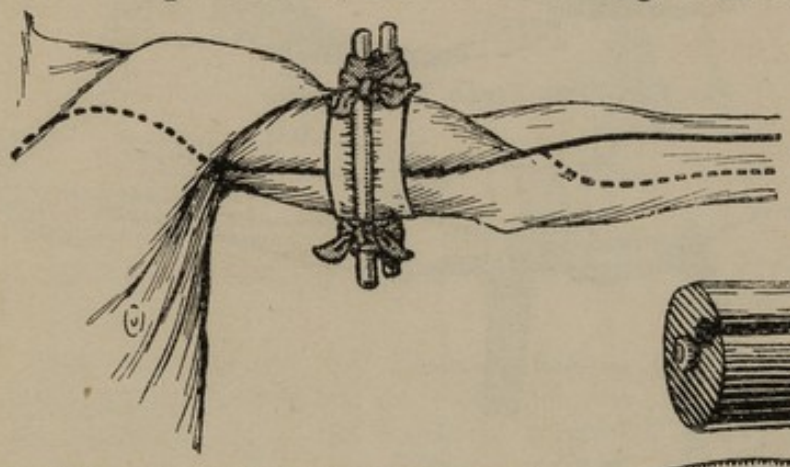


Fig. 100.—Völker's Stick Tourniquet applied.

Esmarch's Tourniquet.—Figure 101 sufficiently explains the

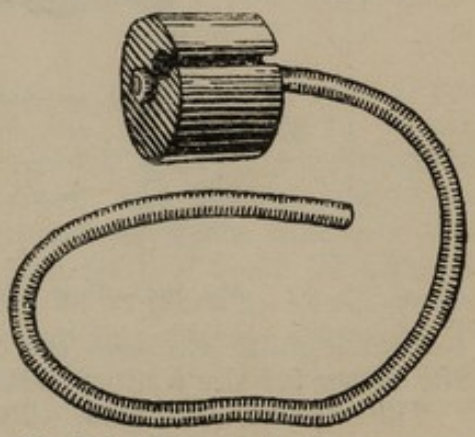


Fig. 101.—Esmarch's Tourniquet.

construction of this; it is applied in the same manner as Esmarch's band (Fig. 102).

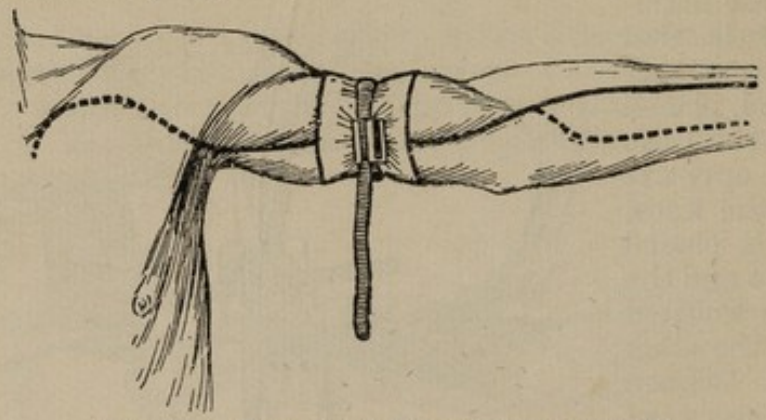


Fig. 102.—Esmarch's Tourniquet applied.

The Field and Screw Tourniquets.—Figures 103-106 sufficiently explain the construction and application of these. The

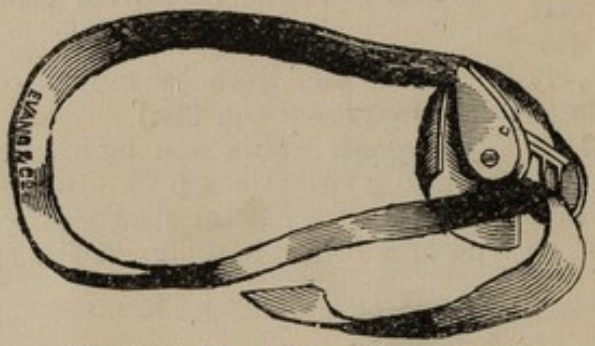


Fig. 103.—The Field Tourniquet.

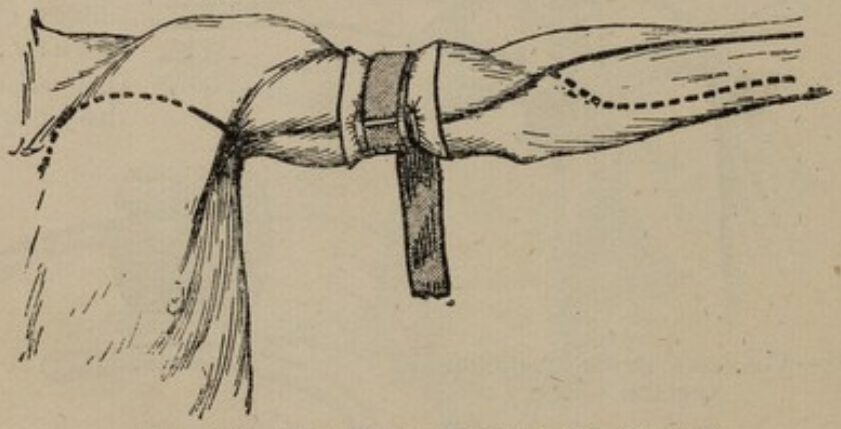


Fig. 104.—The Field Tourniquet applied.

former is more suitable for compression of the brachial artery, the latter for the femoral artery.

The Field Tourniquet.—This has the disadvantage that it can never be drawn tight enough and the pad is therefore liable to slip.

The Screw Tourniquet.—This tourniquet is provided with a screw, by means of which it can be further tightened after buckling off, it is therefore a more efficient instrument.

The *time* a tourniquet may be safely kept on is three hours, but if the bleeding has entirely stopped it is better to loosen the tourniquet slightly after an hour's application, taking care to again tighten it up should the hæmorrhage recur.

Fig. 105.—The Screw Tourniquet.

Fig. 106.—The Screw Tourniquet applied.

The Treatment of Constitutional Symptoms.—In order to counteract syncope or fainting due to the loss of blood, the patient must be kept at absolute rest in a recumbent position with the feet slightly raised; his clothes should be removed, his body should be wrapped in warm blankets, and hot-water bottles should be applied to his feet. If able to swallow, stimulants well diluted are to be given in small quantities, but only after the hæmorrhage has entirely stopped. If the loss of blood has been very excessive, the breathing may become embarrassed, or may actually stop; *artificial respiration* after the Sylvester method must then be resorted to.

Part Wounded.	Artery to Compress.	Course of the Artery.	Point where Pressure is to be applied.
1. The Temple, the Front or the Top of the Head	The Temporal -	Passes over the zygoma	One finger's breadth in front of the opening of the ear
2. The Back of the Head	The Occipital -	Passes over the mastoid process	Two fingers' breadth from the centre of the back of the ear
3. The Face below the Eyes	The Facial -	Passes over the lower jaw	One inch in front of the angle of the jaw
4. The Neck -	The Common Carotid	Passes along the side of the neck, from a point midway between the angle of the jaw and the mastoid process to the sternal end of the clavicle	One and a half inches above the sterno-clavicular joint
5. The Shoulder or the Axilla	The Subclavian	Passes across the upper surface of the first rib	Behind the middle of the clavicle
6. The Upper Third of the Arm	The Axillary -	Passes over the apex and along the outer side of the axilla	At the junction of the outer with the middle third of the armpit
7. The Lower Two-thirds of the Arm	The Brachial -	Passes along the inner border of the biceps muscle, in a line with the inner seam of the coat	The middle of the arm

Direction of the Pressure.	Kind of Pressure to be employed.	Subsequent Treatment after the Hæmorrhage has stopped.
Directly against the bone	First digital, then a pad placed on the artery and retained in position by means of a narrow-fold twisted triangular bandage, or a knotted roller bandage	Dress the wound, placing a *firm clean pad* over it
Ditto - - -	First digital, then a pad on the artery, and retained in position by a narrow-fold triangular bandage	Ditto
Ditto - - -	Ditto - - -	Ditto
Inwards and backwards against the transverse process of the sixth cervical vertebra *Note.*—This vessel requires considerable care to compress, pressure on the neighbouring structures (nerve, vein, trachea, etc.), must be carefully avoided.	Digital - -	When the bleeding has completely stopped, dress the wound, bend the head forward upon the chest and fix it in this position by means of bandages and pillows
With the shoulder and clavicle depressed, downwards and backwards against the upper surface of the first rib	Digital first and then the handle of a door key padded	Dress the wound, apply a spica bandage to the shoulder to retain the dressings and place the forearm in a large arm sling
With the arm raised, outwards and backwards against the humerus	Digital first and then forced flexion	Ditto
Outwards and backwards against the humerus	Digital first and then either Völker's stick tourniquet, or forced flexion, *i.e.*, a firm pad in axilla and arm bandaged to side of chest, or by Esmarch's band or a tourniquet (improvised, screw, or field)	Dress the wound and place the forearm in a large arm sling

Part Wounded.	Artery to Compress.	Course of the Artery.	Point where Pressure is to be applied.
8. The Forearm	The Brachial -	Under the inner edge of the tendon of the biceps muscle	At the bend of the elbow
9. The Palm of the Hand	The Radial and the Ulna	Along the outer and the inner borders of the wrist respectively	One inch above the wrist on each side
10. The Upper Third of the Thigh	The Common Femoral	Passes over the pubes	At the bend of the groin midway between the symphysis and the iliac spine
11. The Lower Two-thirds of the Thigh	The Superficial Femoral	Passes along a line drawn from the middle of the bend of the groin to the inner side of the knee	The middle of the thigh
12. The Leg -	The Popliteal -	Along the middle of the ham	In the centre of the ham
13. The Foot -	The Posterior Tibial	Below the internal malleolus	A thumb's breadth from the internal malleolus
	The Anterior Tibial	Middle of the front of the ankle.	Midway between the two malleoli

Direction of the Pressure.	Kind of Pressure to be employed.	Subsequent Treatment after the Hæmorrhage has stopped.
Downwards and backwards against the humerus	Forced flexion at the bend of the elbow	Dress the wound and sling the elbow
Directly backwards against the radius and the ulna	Digital - -	Dress the wound, place a hard pad in the palm, bend the fingers over it and bandage them to the hand, then place a firm pad in the bend of the elbow, flex the forearm upon the arm and sling the elbow with the injured hand resting against the opposite shoulder
Directly downwards against the pubes	Digital with both thumbs one upon the other, or forced flexion with a firm pad on the artery	Dress the wound, fix the pad on the artery and the dressings on the wound with a spica bandage to the groin, then apply a long splint to the outer side of the injured limb, and keep the patient in a recumbent position with the foot slightly raised
With the knee slightly flexed and the thigh rotated outwards, outwards against the femur	Digital first with both thumbs one upon the other, and then Esmarch's band or a tourniquet	Dress the wound, apply a long splint to the outer side of the injured limb, and keep the patient in a recumbent position with the foot slightly raised
Directly against the posterior surface of the lower end of the femur	Forced flexion at the bend of the knee	Dress the wound and keep the patient in a recumbent position
Forwards and outwards against the tibia Backwards against the tibia	A pad placed on each vessel and a bandage tied round the ankle to retain the pads in position	Dress the wound and keep the foot slightly raised

INTERNAL HÆMORRHAGE.

The **Causes** of internal hæmorrhage are:—

(i,) *Injury* from blows, punctured wounds, severe crushes, and falls from a height causing bruising and laceration of internal organs.

(ii,) *Disease* producing weakening and then bursting of a blood-vessel.

The blood in internal hæmorrhage may either escape into one of the closed cavities of the body, such as the abdomen, cranium, or thorax, or it may make its escape externally through an opening in the body, artificial or natural.

Serious hæmorrhage into a closed cavity is denoted by the history of the accident and the signs of syncope or fainting. The *measures* to be adopted in a condition of this description, are:—

(i,) To send at once for medical assistance.

(ii,) In the meanwhile to treat the constitutional symptoms which are due to the loss of blood.

When blood makes its escape through one of the natural openings of the body, it may take the form of:—

(1,) *Blood Spitting;* (2,) *Blood Vomiting;* (3,) *Nose Bleeding.*

1. Blood Spitting.—This may proceed from:—

(*a*,) *The Mucous Membrane of the Mouth*, especially the gums, or from the cavity left after the extraction of a tooth.

TREATMENT.—If the bleeding is slight, the patient must wash his mouth out with hot water, as hot as it can be borne, or with a solution of alum, or with a strong solution of salt and water, or small pieces of ice must be given him to suck. If the bleeding is from the socket of a tooth, plug it well with a pledget of cotton wool which has been dipped in a solution of salt and water. If the bleeding is severe, apply pressure directly to the bleeding point if possible, by means of a small pad of clean lint.

(*b*,) *The Throat*, caused by injury to the wind pipe or gullet.

TREATMENT.—Keep the patient quiet in a reclining position, and give him small pieces of ice to suck at frequent intervals.

(*c*,) *The Posterior Surface of the Mucous Membrane of the Nose.*

TREATMENT. (*See* Bleeding from the Nose.)

(*d*,) *From the Lungs (Hæmoptysis).*—Bleeding from the lungs is indicated by scarlet and frothy blood being coughed up in mouthfuls. It is usually the result of either disease of the lungs or injury to the ribs.

TREATMENT.—(i,) Send at once for medical assistance, in the meanwhile—

(ii,) Lay the patient down on his side with his head and shoulders slightly raised on a pillow; keep him absolutely quiet, and prevent him from talking or making the slightest exertion.

(iii,) Open the windows and admit plenty of fresh, cool air into the room.

(iv,) Give the patient ice to suck, or let him sip cold water, or vinegar and cold water, or a strong solution of alum and water, or strong cold tea with a lump of ice in it.

(v,) Remove all constrictions round the patient's chest, and apply cold to it either by means of an ice bag, or a cloth which has been rung out in ice-cold water.

(vi,) If the faintness is severe, be cautious in the administration of stimulants.

(vii,) Apply smelling salts to the nostrils, and warmth to the feet.

2. Blood Vomiting (Hæmatemesis).—This is usually caused by disease affecting the *walls of the stomach.*

Its occurrence is preceded by faintness, with a feeling of weight at the pit of the stomach, paleness of the face, and a feeble pulse. The blood vomited up is dark in colour, sometimes coagulated and mixed with food, and presents the appearance more or less of coffee grounds.

TREATMENT.—The same as that for bleeding from the lungs.

3. Bleeding from the Nose (Epistaxis).—This may be due to injury to the nose; it may be an effort of nature to relieve a diseased condition, and if so it is not to be lightly stopped; or it may be the result of general constitutional disturbance.

TREATMENT.—If severe, send at once for medical assistance and take care that the doctor is made acquainted with the nature of the case; in the meanwhile undo all tight clothing round the neck, make the patient sit upright on a chair or sofa, with his head slightly thrown back (never allow the patient to hang his head over a basin), place his legs in a deep foot-pan of hot water, open the window, raise the arms stretched to their full extent, well above and behind the head, and keep them in that position, apply a cold wet sponge, or a wet towel, or a lump of ice to the back of the neck between the shoulder blades, also apply cold to the root of the nose; if the bleeding does not stop, syringe out the nostril from which the blood is flowing with cold water, or with a solution of alum (1 to 2 teaspoonfuls to a pint of water), or with cold tea. Pinch the nose just below the bridge between the thumb and forefinger, or take a piece of soft rag, wrap it up tightly and pass it gently into the bleeding nostril.

CHAPTER XII.

WOUNDS AND THEIR IMMEDIATE TREATMENT.

Wounds—Definition—Kinds and Varieties of—The Immediate Treatment of Wounds in General—The First Field Dressing—The Immediate Treatment of Incised, Contused, Punctured and Lacerated Wounds—Poisoned Wounds—The True Poisoned Wound—The Treatment—Insect Stings—Snake and Dog Bites, and their Treatment.

Definition.—Wounds may be defined as injuries to the body with division of the skin and of the underlying parts, more or less.

Wounds are of two kinds :—I. *Simple* ; II. *Poisoned.*

I.—**Simple Wounds** present the following varieties :—

(*a*,) *Incised or Clean Cut Wounds.*—Wounds with cleanly divided edges and more or less free bleeding, produced by sharp edged instruments.

(*b*,) *Contused or Bruised Wounds.*—Wounds with bruising of the parts and only slight or no external bleeding, produced by blunt instruments.

(*c*,) *Punctured or Stab Wounds.*—Wounds with, as a rule, considerable bleeding and deep internal injuries, produced by sharp pointed instruments.

(*d*,) *Lacerated Wounds.*—Wounds with ragged edges and very little bleeding, caused by tears, as from machinery in motion, the bites of animals, etc.

Bullet wounds generally combine the characters of punctured and lacerated wounds, with, in some cases, injury to the bone.

The Immediate Treatment of Wounds in General.

Here the following points are to be borne in mind :—

(i,) To arrest the bleeding.

(ii,) To cleanse the wound.

(iii,) To keep the wounded parts, if possible, at rest by the application of slings or splints.

(iv,) To protect the wound from outside dust and dirt by means of some antiseptic (clean) dressing material.

(v,) To treat constitutional symptoms, if any, such as shock or syncope.

Therefore, when a wound has been inflicted, the first thing to do is to avoid touching it with dirty hands or dirty instruments ; there is no justification for introducing more dirt into a wound that may be already dirty.

After arresting the bleeding proceed as follows :—

If no means are readily available to render the hands and the wound clean, either leave the wound alone or cover it up with some antiseptic dressing, if one can be got at once, till means are at hand to cleanse the wound.

As an emergency dressing nothing can be better than the *First Field Dressing* used in the British Army. This consists of—

An outer cover (sewn cloth)
Two safety pins
An inside cover (thin waterproof, cemented air-tight)
Thin waterproof (mackintosh) folded over dressings (size 12-in. by 6-in., to be torn in half if required)
Gauze bandage 4¼ yards long, folded flat into 2½-in. by 4-in.
Piece of gauze 17-in. by 13-in., weighing not less than three pennyweights, folded to suit the size of the package
Compress of compressed charpie to be of flax between layers of gauze (like Gamgee's dressing), capable of being teased out into a thick pad. Minimum weight of charpie 155 grains. Maximum weight 165 grains.

The antiseptic agent used is corrosive sublimate 1 in 1000.

To Cleanse the Wound do not attempt to wash it with water procured from any source. Before handling the wound with the fingers wash the hands first with warm water and soap, and then rub them with turpentine or rinse them in carbolic solution 1 in 40, then wash the wound thoroughly with an antiseptic solution, such as carbolic acid 1 in 20 to 1 in 40, or perchloride of mercury 1 in 1000 to 1 in 2000.

If the above solutions are not at hand or cannot be easily procured, any of the following may be used :—

Alcohol, in the form of whisky or methylated spirits, with an equal bulk of water which has been first well boiled and then allowed to cool.

Condy's Fluid, two tablespoonfuls to a pint of warm water.

Common Salt, a dessert-spoonful dissolved in a tumbler of warm water.

In washing the wound be careful not to detach any blood clots which may have formed in it, as they prevent further bleeding and exclude impurities.

After the wound has been well cleansed of all dirt, in order to keep it clean take a pledget of cotton wool, soak it well in the antiseptic solution which has been used to wash the wound, squeeze it dry and place it over the wound as a temporary protection.

To Dress the Wound proceed as follows :—If ready-made antiseptic surgical dressings are at hand use them, if not, place on the wound either—

A piece of clean linen which has been well boiled for five

minutes and then wrung out, or a piece of lint soaked in carbolic solution 1 in 40, carbolic oil 1 in 10.

Over this apply a few layers of clean cotton wool, and then a bandage to keep the dressing in position.

To keep the parts at Rest.—First place the edges as near together as possible by strapping, and then, should the wound be in the upper extremity, put the forearm in a large arm sling; if the wound happens to be near a joint, apply a splint and then put on the sling; if the lower extremity is wounded apply an outside splint to the limb. Should the wound be in the abdomen or chest, bandage firmly.

To treat syncope or shock—(*see* Chapter XI, page 119, and Chapter XVI).

Special Points in the Immediate Treatment of—

1. Incised Wounds.—Arrest the bleeding: then, if necessary, wash and dress the wound as indicated above; if the edges of the wound gape, adjust them by means of strapping, taking care not to completely cover the wound; the strapping is best applied thus—two strips of strapping long enough to reach well beyond the edges of the wound are taken, in the centre of one piece a longitudinal slit is cut, the edges out of the centre of the other piece are cut away, so that this piece can fit into the longitudinal slit, one piece is now placed on one side of the wound, the other piece on the other side, the middle parts are slipped one into the other and an even pull is made simultaneously on both (*see* Fig. 107).

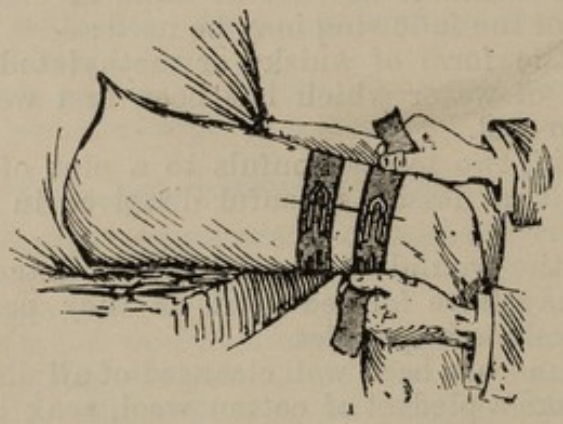


Fig. 107.—Method of applying Strapping.

2. Contused Wounds.—Apply pressure to the part by means of a pad of cotton wool or linen dipped in one of the antiseptic solutions enumerated above if the skin is broken, and fix the pad by a narrow folded triangular bandage, or a figure of 8 roller bandage; should the skin not be broken, apply to the part a piece of

lint which has been soaked in a lotion consisting of spirits of wine one-third, and water two-thirds; and moisten it often.

3. Punctured Wounds.—Arrest the bleeding and wash and dress the wound.

4. Lacerated Wounds.—Wash and dress the wound. Shock usually supervenes after severe lacerations, therefore if present, treat it.

II.—**Poisoned Wounds.**

These may be—

(*a*,) *The True Poisoned Wound.*—Produced by the introduction of decomposing animal matter or other dirt under the skin.

Treatment.—Wash the part immediately with a strong disinfectant.

(*b*,) *Stings of Insects.*

Treatment.—Extract the sting by pressing a small key (a watch key is the best) on to the wounded part, wash the wound with a solution of ammonia, soda or potash, or with an antiseptic solution.

A certain amount of shock may sometimes supervene; if so, give stimulants.

(*c*,) *Snake Bites.*

Treatment.—Send for medical assistance, but in the meanwhile apply a ligature or an improvised tourniquet on the limb between the wound and the heart, to prevent the general absorption of the poison into the system; bathe the wounded part first with warm water to encourage bleeding, then with strong antiseptic solutions, then cauterize the wound with a red hot iron, or nitrate of silver. To extract the poison, sucking the wound may be resorted to, but the operator should see that he has no cuts or fissures about his lips or tongue. Treat shock if present by administering stimulants *freely*, and artificial respiration may have to be resorted to.

(*d*,) *Bites by Mad Dogs.*—Adopt *treatment* the same as that for Snake bites. *Note.*—It is important to trace the dog by which the wound has been inflicted, with a view to ascertaining whether it be mad.

CHAPTER XIII.

SPRAINS, DISLOCATIONS, FRACTURES, AND THEIR IMMEDIATE TREATMENT.

Sprains: Definition, Causes, Signs, and Treatment of—Dislocations: Definition, Causes, Signs, and Treatment of—Fractures: Definition, Causes, Kinds, Varieties, Repair, Signs, and Treatment of—Splints, improvised and their application—the Transport of Patients suffering from Fractures—The Immediate Treatment of a Compound Fracture—Special Fractures—their Causes, Signs, and Treatment, *viz.*, of the Skull: Vault, Base and Jaw; of the Trunk: Spine, Ribs, and Pelvis; of the Upper Extremity: Collar Bone, Arm, Elbow, Forearm, Wrist, Hand or Fingers; of the Lower Extremity: Thigh, Knee-cap, Leg, Foot.

SPRAINS.

Definition.—A sprain is the straining or tearing of the *ligaments* and *capsule* which surround a joint, by a sudden twist or wrench—a sprain is practically a "missed dislocation."

Causes:—Falls on to, or some sudden and unnatural movement of, a joint.

Signs:—Pain, heat, and swelling at the seat of the injury, followed subsequently by discoloration of the skin.

TREATMENT.—Put the parts at complete rest; if the sprain is in a joint of the upper extremity, apply a padded splint to the inside of the limb, and then place the forearm in a large arm sling; if in a joint of the lower extremity, place the patient in bed, apply a padded back splint to the limb and keep it slightly elevated. After the limb has been put at rest, apply bandages dipped in cold water, or an ice bag, to the injured joint; if the pain is severe and cold applications cannot be tolerated, bathe the joint with water as hot as it can be borne comfortably, or apply hot bran poultices to it.

DISLOCATIONS.

Definition.—A dislocation is the displacement of a bone at a joint (Fig. 108).

Causes:—The same as those of a sprain, but applied more violently.

Signs:—(*a*,) Distortion of the joint.
(*b*,) The end of the displaced bone may be felt through the skin.
(*c*,) Alteration in the length of the limb.

(*d*,) Loss of movement at the joint.
(*e*,) Pain in the joint increased on movement.
(*f*,) The limb is fixed when another tries to move it (thus distinguishing it from fracture near a joint).

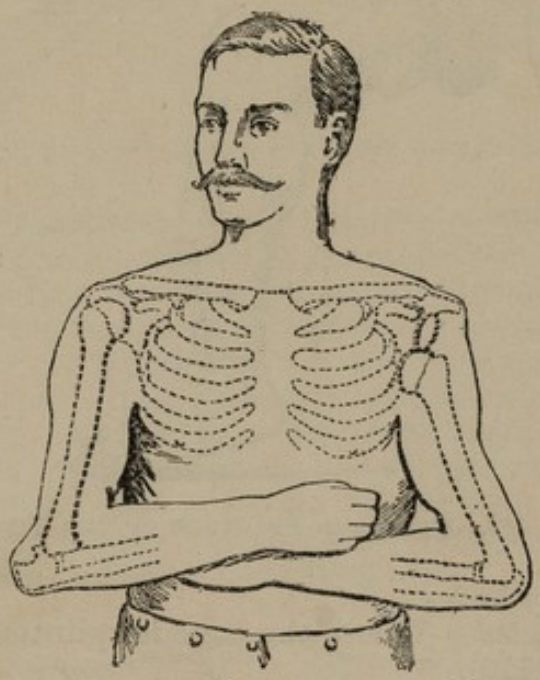


Fig. 108.—Diagram to show Dislocation of Left Shoulder and Right Elbow.

Treatment.—Make no attempt to reduce the dislocation; put the parts at complete rest to relieve pain, place the patient in an easy position and send for medical assistance.

FRACTURES.

Definition.—A fracture is a broken bone.

Causes:—

1, *Direct violence*, by means of which the bone is broken at the seat of the injury.

2, *Indirect violence*, by means of which the bone is broken at some distance from the seat of the injury by transmission of the force applied, *e.g.*, fracture of the collar bone by a fall upon the out-stretched hand; fracture of the base of the skull by a fall from a height upon the feet.

3, *Muscular action*—snapping the bone across by a sudden and violent contraction, *e.g.*, the knee-cap in jumping.

Varieties of Fractures. These are:—

I.—*Simple.*—Where the bone only is broken.

II.—*Compound.*—Where the bone is broken and there is an external wound communicating with the break (Fig. 109).

Fig. 109.—Compound Fracture of the Tibia.

Fractures may be:—

(i,) *Comminuted.*—Where the bone is splintered into several fragments (Fig. 110).

Fig. 110.—Comminuted Fracture of the upper end of the Right Femur.

(ii,) *Complicated.*—Where the fracture is complicated by an injury to some important surrounding parts, *e.g.*, the tearing of an artery, vein or nerve; the opening up of a joint; the wounding of an internal organ, as the lung, bladder, etc.

(iii,) *Impacted.*—Where the bones are broken and the ends are wedged into one another (Fig. 111).

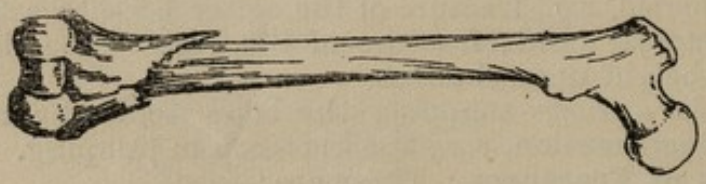


Fig. 111.—Impacted Fracture of the lower end of the Right Femur.

(iv,) *Greenstick.*—Where the bone is incompletely broken or bent—usually met with in children (Fig. 112).

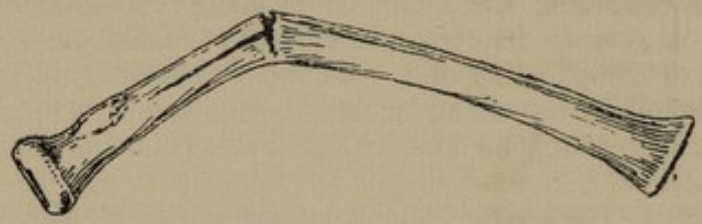


Fig. 112.—Greenstick Fracture of the Radius.

Repair of Fractures.—Fractures are repaired by the space between the broken ends of the bone and the torn periosteum being filled up by a soft mass of new material—termed *callus*, which unites the broken ends together; in course of time this soft material is converted into fibrous tissue, then lime salts are deposited in it and it is gradually formed into bone; the new bone can at first be felt as a thickened mass round the fracture (Fig. 113), but gradually it becomes entirely absorbed. Should the broken ends of a bone not be kept at complete rest *bony union* never results, the callus remains *fibrous* and there is produced what is termed a false joint.

Fig. 113.—Fracture of Femur showing deposit of Callus round the broken ends.

Signs of Fracture.—These are:—

(*a*,) Pain, swelling, and deformity at the seat of the injury.

(*b*,) Unnatural mobility where none should exist.

(*c*,) Loss of power in the limb.

(*d*,) Shortening of the limb.

(*e*,) Crepitus, *i.e.*, a sensation of grating felt when the broken ends of the bones are made to move against each other.

Treatment.—In the immediate treatment of a fracture the following points have to be borne in mind:—*The Prevention of Further Injury. The Proper Transport of the Injured Person.*

The Prevention of Further Injury.—For this adopt the following measures, *viz.*:—

1, Attend to the patient on the spot where the injury has occurred, and especially so if the fracture happens to be in the lower extremity.

2, Don't touch the limb (beyond what is absolutely necessary for diagnosis), until you have got all splints and bandages ready.

3, Use extreme care and gentleness in handling the limb, either for the purpose of trying to make out the fracture (*i.e.*, trying for crepitus, etc.), or in putting on splints: by rough handling a *simple* fracture may very easily be made into a *compound* or *complicated* one. This precaution is to be especially borne in mind in handling broken bones which are immediately under the skin, such as the collar bone (clavicle), and the shin bone (tibia).

4, Without removing the clothes (unless the fracture is compound or there is hæmorrhage), bring the bones into their relative position as follows: First lift the limb by grasping it very gently but firmly *above* and *below* the seat of the fracture, and then make gentle extension and counter-extension to restore to its natural position as far as possible.

5, Fix the limb in this position by means of splints and bandages.

SPLINTS

These are rigid supports, which are applied to parts to increase either their natural stiffness or to prevent their undue mobility. For the surgeon's use, splints are constructed out of various materials and are shaped to fit the limbs.

For the "First Aid" treatment of fractures, splints can be made out of many articles in daily use, etc., varying according to the patient's surroundings at the time of the accident, *e.g.*, in domestic life—broom handles, newspapers, wine bottle covers, stockings filled with straw or sand, umbrellas, walking sticks, etc.; in workshops—pieces of wood, laths, rules, squares, etc. With military surroundings—a rifle for fracture of the thigh, a sword or sword-bayonet for fracture of the leg, a bayonet for fracture of the arm or forearm.

Improvised Splints should be always constructed out of material which is sufficiently stiff to keep the parts in position; they should be made long enough to extend some distance beyond the joint below the fractured bone, and they should be as wide as the limb to which they are to be applied. Before applying splints pad them well on the side next the limb (unless the clothing is allowed to remain), with some soft material, such as tow, cotton wool, old flannel, folded triangular bandages, etc., and make the padding extend well over on each side of the splint.

To apply Splints two persons are required, one keeps up gentle extension and counter-extension in the manner indicated above, while the other person applies the splints, one on each side of the limb, and fixes them in position by tying them above and below the seat of fracture, with triangular bandages folded narrow, or with straps, belts, or tapes. In fixing splints, all knots should be tied over the outer splint and not over the

bone. The methods of fixing splints to limbs with the triangular bandage are given in Chapter X, pages 83 and 84.

Improvised splints should always be put on in such a way as to be easily removed if required.

The Proper Transport of the Injured Person.—It is important to bear in mind that a person suffering from a fracture is not to be removed till the broken bone has been first *put up*. If able to walk, he should not be permitted to leave the spot unassisted, as faintness, giddiness, or even unconsciousness may come on some time after the fracture has occurred; most persons suffering from fractures of the upper limb can walk if assisted. Those suffering from fractures of the lower limb should always be carried on a stretcher, and this should be done in accordance with the instructions laid down in Chapter XVIII.

THE IMMEDIATE TREATMENT OF A COMPOUND FRACTURE.

Here proceed as follows:—

Remove the clothing, if required, from the injured part, with *extreme care*. If there is *hæmorrhage*, arrest it either by elevating the limb, or applying pressure to the main artery, above the wound. If transport is readily available, and skilled help can be quickly obtained, cover the wound temporarily with an antiseptic (clean) pad to prevent the entrance of impurities, apply splints as far as practicable in the manner indicated above and remove the patient from the scene of the accident. If skilled help cannot be speedily procured, thoroughly cleanse the wound with an antiseptic solution, adopting all the precautions laid down in Chapter XII; apply an antiseptic dressing to the wound, then put on the splints and remove the patient.

SPECIAL FRACTURES.

I.—FRACTURES OF THE SKULL.

1. Fracture of the Vault of the Skull (Cranium).

Causes.—Usually direct violence, as blows, or falls upon the head. This fracture is very often compound.

Signs.—The broken bone may be felt, or there may be a depression in the skull at the seat of the injury, with symptoms of concussion, or of compression of the brain; there may also be partial or complete loss of consciousness.

TREATMENT.—(i,) Send at once for medical assistance. In the meanwhile—

(ii,) If there is a scalp wound apply a pad and triangular bandage as laid down in Chapter X.

(iii,) Should there be hæmorrhage arrest it.

(iv,) If the patient has to be removed, place him on a stretcher with the head raised on a higher level than the rest of the body, and with great care carry him in this position.

(v,) Place him in bed in the above position in a darkened room, and keep him absolutely quiet.

(vi,) Apply hot water bottles to the feet, and towels wrung out frequently in cold water to the head, or, what is better, apply an ice bag to the head.

(vii,) *Do not* give any alcoholic stimulants.

2. Fracture of the Base of the Skull.

Causes.—Usually indirect violence, as falls from a height upon the feet or the head.

Signs.—Unconsciousness, accompanied usually with bleeding from the mouth, ears, or nose.

TREATMENT.—The same as that for fracture of the Vault.

3. Fracture of the Jaw.

Causes.—Direct violence. This fracture is often compound.

Signs.—Deformity; unevenness in the line of the teeth; inability to close the mouth; bleeding from the mouth and gums, and crepitus.

TREATMENT.—(i,) With the hand gently push the broken ends of the bone into their natural position.

(ii,) Retain the ends in this position by applying either the triangular (*see below*), or the four-tailed bandage.

(iii,) If the bleeding is troublesome, make the patient rinse his mouth out frequently with cold water, or give him small pieces of ice to suck.

(iv,) Caution the patient not to attempt to talk.

Fig. 114.—TRIANGULAR BANDAGE FOR FRACTURE OF LOWER JAW.

For applying a triangular bandage to a fractured jaw, there are two methods:—

(*a*,) Apply the centre of the bandage folded *narrow* to the point of the chin, carry the ends upwards on each side, pass one end over the top of the head till it meets the other end just above the ear; now cross the two ends over each other, then carry one end in front of the forehead, and the other behind the back of the head well below the occiput, and tie off on the side of the temple just above the ear (Fig. 114).

(*b*,) Take one bandage folded *narrow*, place the middle of it over the point of the chin, carry the two ends upwards and tie them in a half knot just behind the vertex of the skull, then take a second bandage folded *narrow*, place the centre of it under the lower lip, pass the ends backwards, tie them in a half knot at the level of the occiput behind. Now tie the two ends of the two bandages respectively to each other.

The application of the four-tailed bandage is given in Chapter X, page 101 :—

II.—FRACTURES OF THE TRUNK.

1. Fracture of the Spine.

Causes.—Either direct or indirect violence.

Signs.—The body is paralysed below the seat of the injury, *i.e.*, if the injury has been inflicted just below the neck, the patient is unable to move all four limbs ; if the seat of the injury is in the middle of the back, the patient is unable to move his legs. There is usually great shock, and on running the tips of the fingers gently along the back of the spine, an inequality in the spinal ridge may be felt.

Caution.—Under no circumstances attempt to try for crepitus, and use the *utmost care* and *gentleness* in handling the patient.

TREATMENT.—(i,) Send at once for medical assistance.

(ii,) If possible, do not attempt to remove the patient till skilled assistance has been first procured, but, in the meanwhile—

(iii,) Treat the condition of shock, *i.e.*, give stimulants in small quantities and apply hot water bottles to the feet.

(iv,) If the patient has to be removed, proceed as follows :—

Obtain a door or shutter, *not a canvas stretcher*, and with the least possible alteration of his position, lift the patient very carefully on to this, place him on his back, and carry him, avoiding all jolting.

(v,) Place the patient on a fracture bed (*see* Chapter XIX), making him lie as flat as possible with only a very low pillow for the head.

2. Fracture of the Ribs.

Causes.—Either direct or indirect violence, or muscular action. This fracture may be complicated with injury to the lung.

Signs.—Severe pain at the side, generally described as a stitch, increased on taking a deep inspiration; short and hurried breathing. Crepitus may be felt by placing the palm of the hand on the injured side, and asking the patient to take a deep breath. If the lung is injured there may be spitting of blood.

TREATMENT.—If there is no injury to the lung, proceed as follows:—

(i,) Take two triangular bandages folded broad, apply the centre of one bandage over the seat of the fracture, carry the ends round the chest and tie off on the opposite side. Now take the second bandage, apply the centre of it just above the seat of the fracture, making it overlap the first bandage, carry the ends round the chest and tie off on the opposite side. In tying the bandages tighten them till the patient just feels comfortable.

Note.—These bandages should be applied during expiration. Instead of triangular bandages the *roller* bandage may be applied round the chest in the manner indicated in Chapter X, page 98.

If there is injury to the lungs or severe crushing of the walls of the thorax, apply a broad flannel roller bandage to the chest walls, simply to give them very gentle support. Avoid tight bandaging of any description.

(ii,) Place the patient in bed with his head and chest well elevated.

(iii,) If there is bleeding from the lungs, treat it in the manner indicated in chapter XI, page 124, and carry the patient placed on a stretcher according to the rules laid down in Chapter XVIII.

3. Fracture of the Pelvis.

Causes.—Direct violence. This fracture is very often complicated with injury to the bladder and other internal organs.

Signs.—Severe pain in the pelvis with inability to stand; there are symptoms of shock more or less, and blood may be passed with the urine if the bladder is injured.

TREATMENT.—(i,) Send at once for medical assistance. In the meanwhile, before attempting to remove the patient—

(ii,) First apply firmly round the pelvis two triangular bandages folded *broad*, one on top of the other, or a broad flannel roller bandage, then apply two long splints, reaching from the armpits to a little beyond the feet, one on each side of the body, and tie them in position by means of *narrow-fold* triangular bandages.

(iii,) Lift the patient on a stretcher and remove him very carefully.

(iv,) Place the patient on a fracture bed (*see* Chapter XIX).

(v,) Treat the condition of shock.

Instead of the above an alternative method of treatment can be adopted, viz.:—

Procure a firm board, shutter or door long enough to reach from the patient's head to a little beyond his feet and just as wide as the patient's body, place a folded blanket upon it and roll the blanket up at the end to form a pillow, then after applying triangular bandages to the pelvis as above, carefully lift the

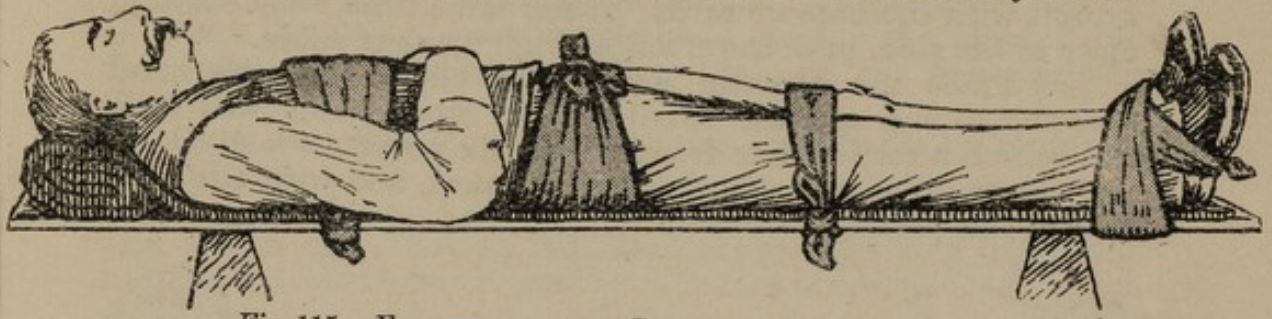


Fig. 115.—Fracture of the Pelvis put up on a Shutter.

patient on to the prepared board, and tie him to the board by three triangular bandages, one folded broad passing round the chest, another folded narrow passing round the thighs just above the knees, and another folded narrow passing round the ankles and tied in a figure of 8 (Fig. 115).

III.—FRACTURES OF THE UPPER EXTREMITY.

1. Fracture of the Collar-Bone (Clavicle).

Causes. — Usually indirect violence, as a fall upon the out-stretched hand, or on to the top of the shoulder.

Signs. — Distortion of the collar-bone, pain and crepitus (on pressing the fragments, and on rotating the arm with the elbow pressed to the side), and depression of the shoulder downwards, forwards and inwards (Fig. 116), usually causing the patient to lean his head to the injured side.

Caution.—Crepitus by unskilled persons is not to be tried for, as this fracture may very easily be made compound or complicated.

Treatment.—The points to be aimed at are: To correct the depression of the shoulder, and thus prevent the overlapping of the broken ends of the

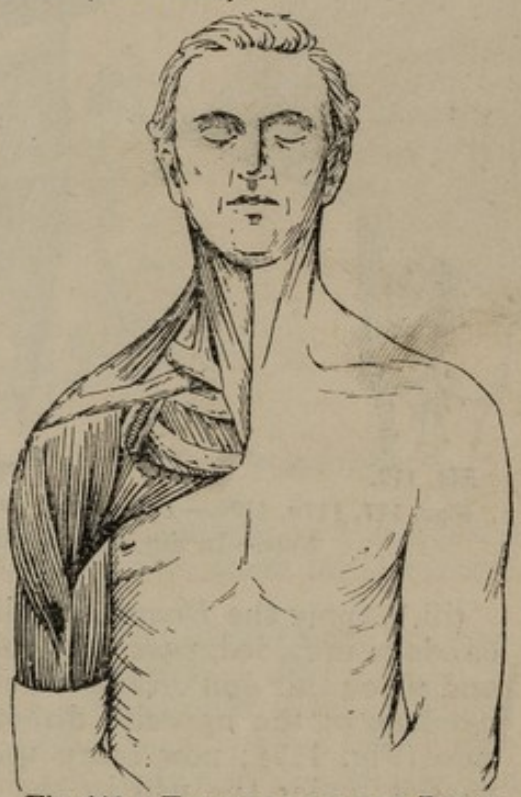


Fig. 116.—Fracture of the Inner Third Clavicle.

(*c*,) After placing a wedge-shaped pad in the armpit as above, "apply the centre of a triangular bandage folded *narrow* to the outer surface of the arm of the injured side, carry the front end horizontally across the chest, bring the back end forward

Fig. 119.

Fig. 119*a*.

Figs. 119, 119*a*.—Fracture of the Clavicle put up—a third method.

between the arm and the chest over the upper margin of the front part of the bandage, then up through the loop formed, carry backwards round the chest (Fig. 120), exercising steady traction so as to draw the arm backwards, then secure the two ends on the opposite side of the chest." Now apply the large arm sling in the same way as it is applied to support

the forearm, but to avoid the injured bone from being pressed upon, after bringing up the lower end in front of the forearm,

Fig. 120.

Fig. 120*a*.

Figs. 120, 120*a*.—Fractured Clavicle put up—a fourth method.

pass it between the arm and the side of the injured shoulder and tie it to the upper end behind the neck (Fig. 120*a*).

2. Fracture of the Arm (Shaft of the Humerus).

Causes.—Direct violence.

Signs.—The usual ones of fracture (Fig. 121).

Treatment. — (i,) Take two splints, one to go along the outer side of the arm, reaching from the tip of the shoulder to just beyond the point of the elbow, and the other to go along the inner side of the arm, reaching from the armpit to just below the point of the elbow, and pad them.

(ii,) Place a small pad in the armpit; make gentle extension and counter-extension on the broken bone to bring the ends into apposition, then apply the splints one on each side, and fix them above and below the

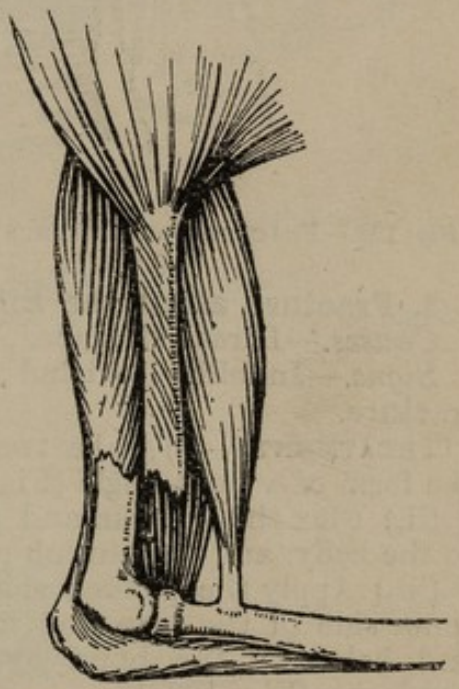


Fig. 121.—To show Fracture of lower third of Humerus.

seat of the fracture by means of narrow-fold triangular bandages.

Note.—In tying the splints, the bandage *above* the fracture must be applied first.

(iii,) Flex the forearm upon the arm and place it in a narrow arm sling, allowing the point of the elbow to hang well down (Fig. 122).

Fig 122.—Fracture of Humerus put up with Venetian Blind Laths.

3. Fracture about the Elbow Joint.

Causes.—Direct violence.

Signs.—Inability to bend the elbow, with the usual signs of fracture.

Treatment.—(i,) Take two splints, tie them at their ends in the form of a right angle (Fig. 123), and pad them.

(ii,) Flex the forearm and place it with the palm of the hand to the body, and the thumb pointing upwards.

(iii,) Apply the padded side of the L-shaped splint along the inner side of the arm and forearm, and fix it above to the arm and below to the hand by means of narrow-fold triangular bandages (Fig. 123*a*).

(iv,) Place the forearm in a narrow arm sling.

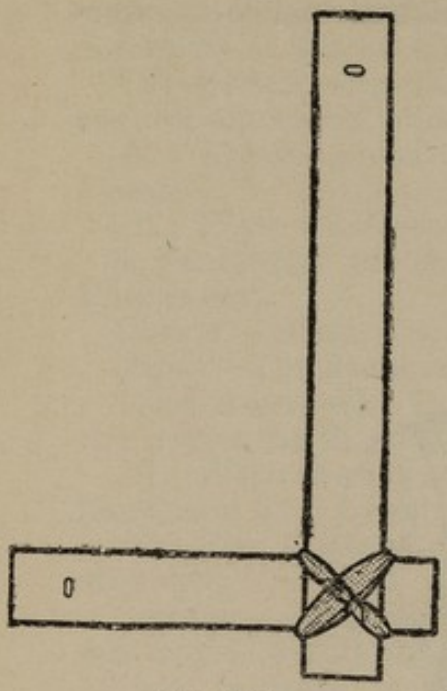


Fig. 123.
THE L.-SHAPED SPLINT.

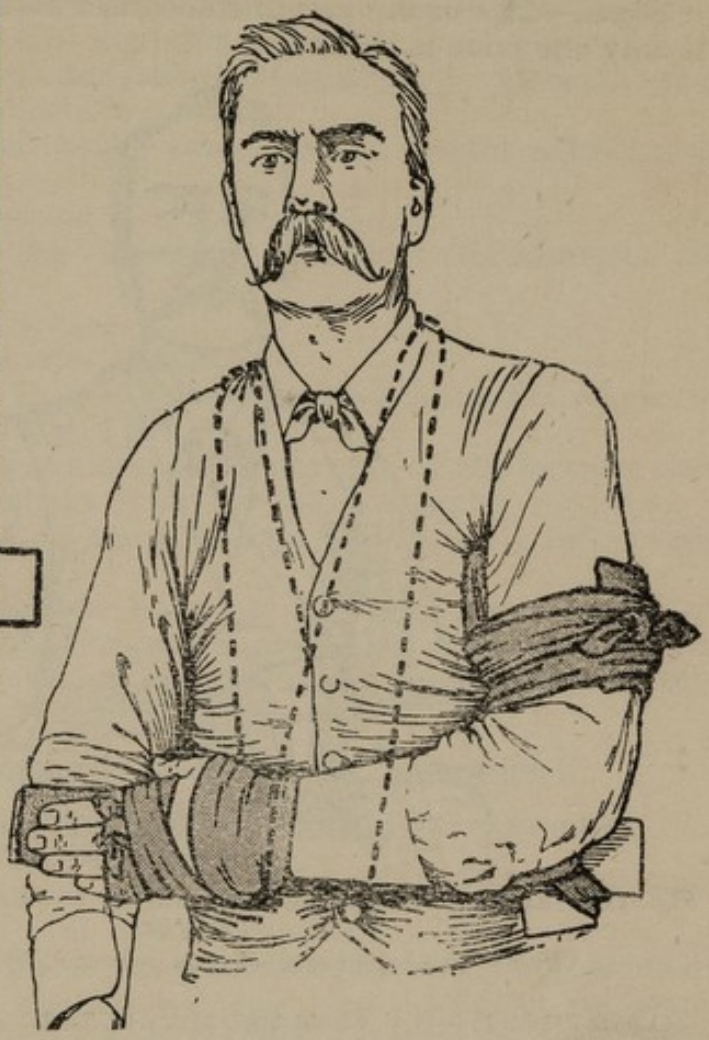


Fig. 123*a*.—FRACTURE ABOUT THE ELBOW JOINT PUT UP WITH THE L-SHAPED SPLINT.

Note.—The narrow arm sling is indicated by dotted lines.

4. Fracture of the Forearm (Radius and Ulna).

Causes.—Usually direct violence. Both bones may be broken or only one (Fig. 124).

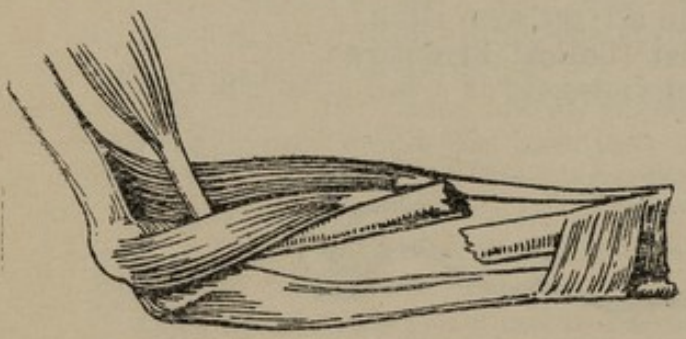


Fig. 124.—FRACTURE OF RADIUS.

Fig. 125.—TO SHOW DEFORMITY OF FOREARM IN FRACTURE.

Signs.—The usual ones of fracture, which are not so apparent if only one bone is broken.

Fig. 126.—To show Fracture of Forearm put up with Venetian Blind Laths.

Note.—The broad arm sling is indicated by dotted lines.

Treatment.—(i,) Take two splints, to reach from the elbow to the tips of the fingers, and pad them.

(ii,) Flex the forearm upon the arm, and place it with the palm of the hand to the body, and the thumb pointing upwards.

(iii,) Adjust the splints on the outer and inner side of the forearm, taking care that they clasp the lower end of the arm in the same plane as the length of the arm, and tie them above and below the fracture (Fig. 126).

(iv,) Place the forearm in a large arm sling.

5. Fracture of the Wrist (Colles' Fracture).

Causes.—Usually indirect violence, as a fall upon the hand.

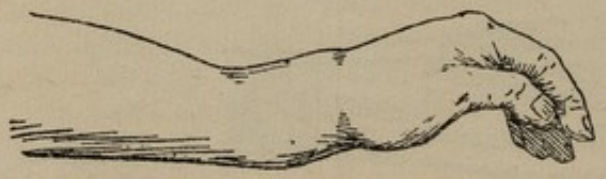


Fig. 127, To show Deformity at back of Wrist in Colles' Fracture.

Signs.—The usual ones of fracture, with a well marked deformity at the back of the wrist (Fig. 127).

TREATMENT.—(i,) Reduce the deformity by extension and counter-extension, and then

(ii,) Apply splints in the same manner as for a fractured forearm.

(iii,) Place the forearm in a large arm sling.

6. Fractures of the Hand or Fingers (Metacarpus or Phalanges).

Causes.—Direct violence.

Signs.—The usual ones of fracture.

TREATMENT.—(i,) Take a splint, to reach from the elbow to the tips of the fingers, and pad it.

(ii,) Place the splint along the inner side of the forearm and hand, and fix it by means of narrow-fold triangular bandages.

(iii.) Flex the forearm upon the arm and place it in a large arm sling.

Caution.—After splints have been applied to fractures of the upper extremity, the pulse at the wrist should always be felt, in order to guard against undue compression of the vessels.

IV.—FRACTURES OF THE LOWER EXTREMITY.

1. Fracture of the Thigh Bone (Shaft of the Femur).

Causes.—Direct or indirect violence.

Signs.—The usual ones of fracture, with considerable shortening of the limb (Fig. 128), and eversion of the foot.

TREATMENT.—(i,) Place the patient comfortably on his back; grasp the foot on the injured side and while an assistant steadies the limb by holding it above the seat of fracture, make extension on the thigh till the limb is the same length as the sound one; see that the outer edge of the foot is perpendicular to the ground, and still keeping up extension, direct an assistant to—

(ii,) Procure two splints, one to reach from the armpit to two or three inches below the foot, and the other to reach from the fork to the knee: see that the splints are padded.

(iii,) Place two soft pads, one in the armpit and the other in the fork, and then adjust the splints respectively to the outer and inner sides of the thigh.

(iv,) Fix the outer splint to the body by two triangular bandages, one broad-fold tied just under the armpits, and the other narrow-fold, tied just above the hips (Fig. 129).

(v,) Now fix the inner splint to the thigh by tying two narrow-fold triangular bandages one above and the other just below the seat of fracture.

(vi,) Then with two similar bandages tie the outer splint to the leg, just below the knee and a little above the ankle.

(vii,) Secure the sound to the injured limb by tying together the two feet by a narrow-fold bandage passed behind the ankles, carried over the instep, crossed, and tied below the soles of the feet.

Fig. 128.—Fracture of Upper Third of Femur.

(viii,) Lift the patient on to a stretcher, and place him inclining somewhat towards the injured side.

(ix,) Remove him on the stretcher and place him on a fracture bed (*see* Chapter XIX), making him lie as flat as possible with only a very low pillow for his head.

The test of *efficient splinting* for fracture of the femur is, that the patient should be able to be carried by the head and heels without any bending, but the actual removal of the patient in this manner should *never be attempted.*

A *Rifle Splint* may be applied to a fractured thigh as follows: "If an old pattern rifle is used, see that the rifle is not loaded. Place it on the side of the injured limb, butt in the armpit, trigger guard to the front; place a pad in the armpit; take a narrow-fold bandage, place its centre over the ankle of the injured limb, pass the ends behind enclosing muzzle of rifle, cross behind; with the outer end take a turn round the muzzle, in front of the sight or D for sling; bring both ends up, cross over instep, and tie off on the inside of the foot. Take a narrow-fold; place its centre on the perinæum, bring one end out behind the other in front of the limb, cross the ends through the trigger guard, take a turn round the small of the butt, just above the trigger guard, and tie off. Take two long splints; place one on the top and the other along the inner side of the thigh, and fix at each end by a narrow-fold, tied off over the rifle. Take a broad-fold bandage; place the centre over the butt of the rifle, pass the ends round the body and tie off on the opposite side. Tie the patient's legs together by placing the centre of a broad-fold bandage over both ankles, pass the ends behind, cross, bring up and tie off on top between the legs" (Fig. 130).

With the new magazine rifle, a fractured thigh is put up as follows:—

"See that the rifle or magazine contains no cartridges. If the splint be for the right side remove the bolt. Take a narrow-fold

Fig. 129.—To show Fracture of Femur put up with a Long Broom.

Fig. 130.—Fracture of Thigh put up by means of the Rifle Splint (old pattern rifle).

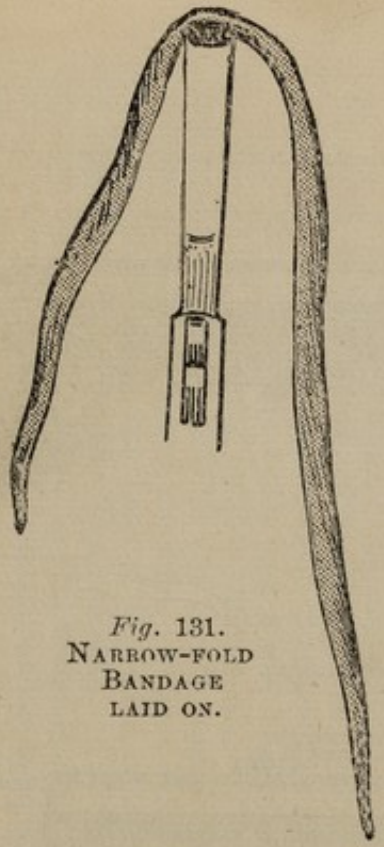


Fig. 131.
NARROW-FOLD
BANDAGE
LAID ON.

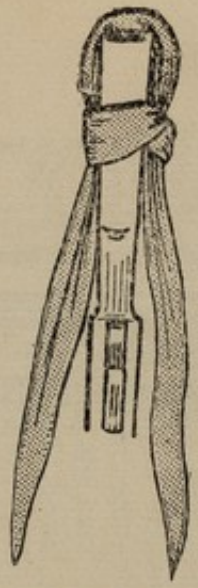


Fig. 131*a*.
HALF HITCH AND
HALF KNOT.

Fig. 131*b*.

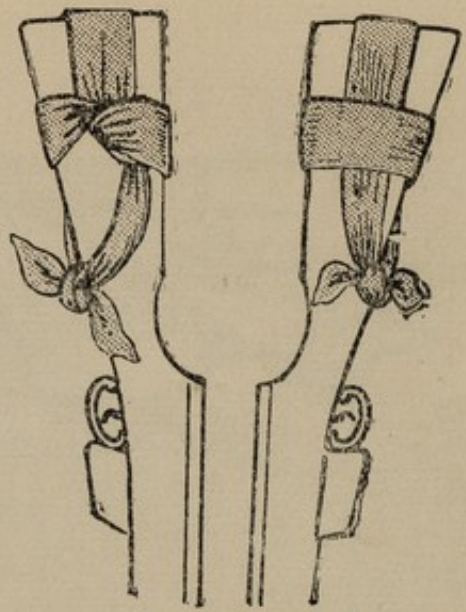


Fig. 131*c*.
BUTT LOOP FORMED.

Fig. 131*d*.

Figs. 131, 131*a*, 131*b*, 131*c*, 131*d*.—DIAGRAMS TO SHOW FORMATION OF BUTT LOOP.

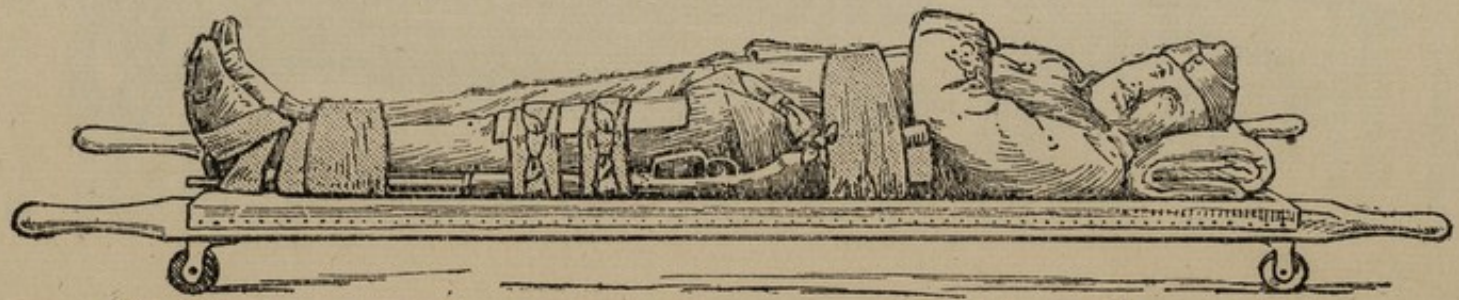


Fig. 132.—FRACTURE OF THIGH PUT UP BY MEANS OF THE RIFLE SPLINT (MAGAZINE RIFLE).

bandage, place it over the heel plate of butt in such a way that two-thirds of its length are on what will be the outer side, and one-third on the other side of the butt (Fig. 131); take a half hitch with the long end round the butt, making a half knot on the outer side (Fig. 131*a*), tie the ends with a reef knot so as to form a loop, the knot of which must come below the stock and be on a level with the projecting part (Figs. 131*b*, 131*c*, 131*d*). This is for the perineal bandage to pass through, and is called the butt loop; leave the magazine in position, place the rifle along the injured limb, butt towards the armpit, trigger guard to the front. Take a narrow-fold bandage, place its centre over the ankle of the injured limb, pass the ends behind enclosing muzzle of rifle, cross behind, with the outer end take a turn round the muzzle in front of the sight or D for sling, bring both ends up, cross over instep and tie off on the inside of the foot. Take a narrow-fold bandage, place its centre on the perineum, bring one end out behind the other end in front of the limb, pass one end through the butt loop and tie, gradually tightening the knot as the limb is gently drawn to its proper length; pass both ends round small of butt and tie off. Take two long splints, place one on the top and the other along the inner side of the thigh, and fix at each end by a narrow-fold bandage tied off over the rifle. Take a broad-fold bandage, place the centre over the butt of the rifle, pass the ends round the body and tie off on the opposite side. Tie the patient's legs together by placing the centre of a broad-fold bandage over both ankles, pass the ends behind, cross, bring up and tie off on top between the legs" (Fig. 132). (*Manual for the Royal Army Medical Corps, 1899.*)

2. Fracture of the Knee-Cap (Patella).

Causes.—Usually muscular action.

Signs.—Inability to move the leg and bend the knee, a considerable interval can also as a rule be felt between the fragments. (Fig. 133.)

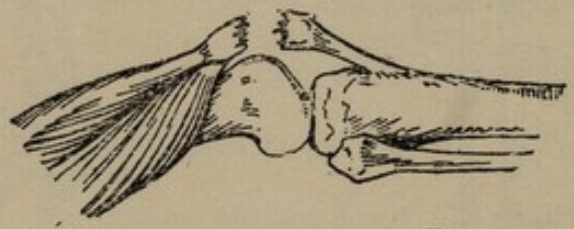


Fig. 133.—Fracture of the Patella.

Treatment.—(i,) Take a splint long enough to reach from the buttock to the heel, and pad it.

(ii,) Extend the leg and place the splint along the back of the thigh.

(iii,) Tie the splint to the leg by means of two narrow-fold

Fig. 134.—Fracture of the Patella put up.
Note.—The Splint is along the back of the leg.

Fig. 135.—Fracture of the Leg put up with Venetian Blind Laths.

triangular bandages, placing one round the thigh and the other round the leg.

(iv,) Take two narrow-fold triangular bandages, and tie them above and below the broken fragments, crossing the lower obliquely over the upper at the sides, thus making a figure of 8 (Fig. 134).

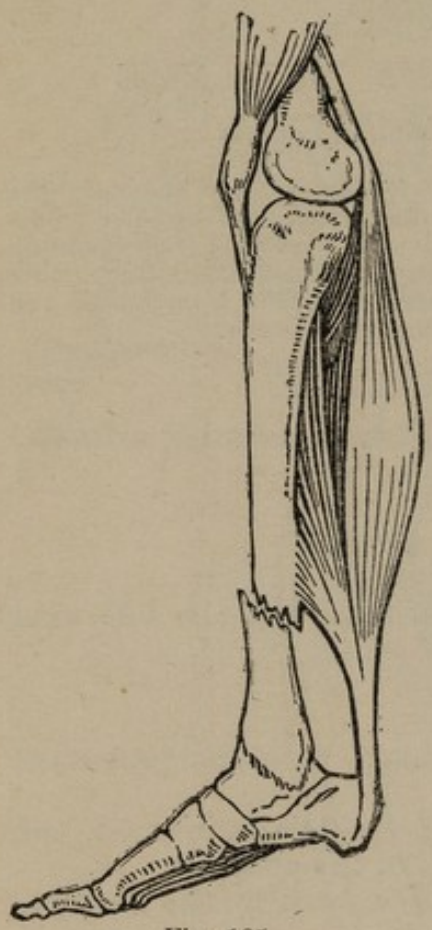


Fig. 135.
FRACTURE OF THE TIBIA (SHIN BONE) IN ITS LOWER THIRD.

(v,) Fix the sound to the broken limb by tying the two feet together in the manner indicated on page 148.

(vi,) Remove the patient on a stretcher, and place him in bed in the same way as for a fractured thigh.

3. Fracture of the Leg (Tibia and Fibula).

Causes. — Direct or indirect violence. One or both bones may be broken (Fig. 135).

Signs.—The usual ones of fracture.

TREATMENT.—(i,) Be careful in handling the broken limb, and especially so if the tibia (shin bone) is broken, as this fracture may very easily be made a compound one.

(ii,) Procure two splints, both to reach from a little above the knee to just beyond the foot; after padding, adjust them to the outer and inner sides of the broken limb, and fix them above and below the seat of the injury by narrow-fold triangular bandages.

(iii,) Fix the sound to the broken limb by tying the feet together (Fig. 136).

(iv,) Remove the patient, and place him in bed in the same way as for a fractured thigh.

4. Fracture of the Bones of the Foot (Tarsus).

Causes.—Usually direct violence. This fracture is very often compound.

Signs.—The usual ones of fracture.

TREATMENT.—The same as that for fracture of the leg; after the patient has been put to bed, elevate the foot by placing a small pillow below it.

CHAPTER XIV.

ARTIFICIAL RESPIRATION AND THE TREATMENT OF ASPHYXIA.

Artificial Respiration, methods of: The Sylvester, the Howard, the Marshall Hall—Asphyxia: definition, causes and treatment of—The treatment of the Apparently Drowned—The treatment of Asphyxia from Choking, from Obstruction of the Larynx by Swelling of the Mucous Membrane, from Attempted Hanging or trangulation, and from Breathi g Irrespirable and Poisonous Gases—The Appearances which accompany Death.

ARTIFICIAL RESPIRATION.

VARIOUS *methods* have been proposed for performing artificial respiration. Those most usually adopted are:—

1, *Dr. Sylvester's Method.*

2, *Dr. Benjamin Howard's "Direct Method."*

3. *Dr. Marshall Hall's "Ready Method."*

1, The Sylvester Method.—This method has the following points to recommend it:—

(i,) It is simple.

(ii,) It is effective.

(iii,) It is to a great extent in harmony with the process of natural respiration.

(iv,) The expansion of the thorax is artificially insured, and the method is wholly under the control of the operator.

(v,) The patient is not liable to be injured by the manipulations.

(vi,) Both sides of the chest are equally inflated and a large amount of air is inspired.

(vii,) The adoption of the method is easy. It can be remembered and it can be efficiently put into operation by one person.

Mode of Procedure.—Lay the patient flat on his back on the floor, loosen all tight clothing about the neck, chest and abdomen, and loosen the braces; place a block or hard pillow under the patient's shoulders (in order to raise the chest, extend the neck and throw the head back), draw forward the tongue and get an assistant to hold it in the corner of a handkerchief between the thumb and finger; if unassisted, fasten the tongue round the chin by an indiarubber band or a piece of string.

Now kneel at the patient's head; take hold of his arms above the elbows and carry them well over the head as far back as they will go (Fig. 137); this will have the effect of expanding

ARTIFICIAL RESPIRATION (DR. SYLVESTER'S METHOD).

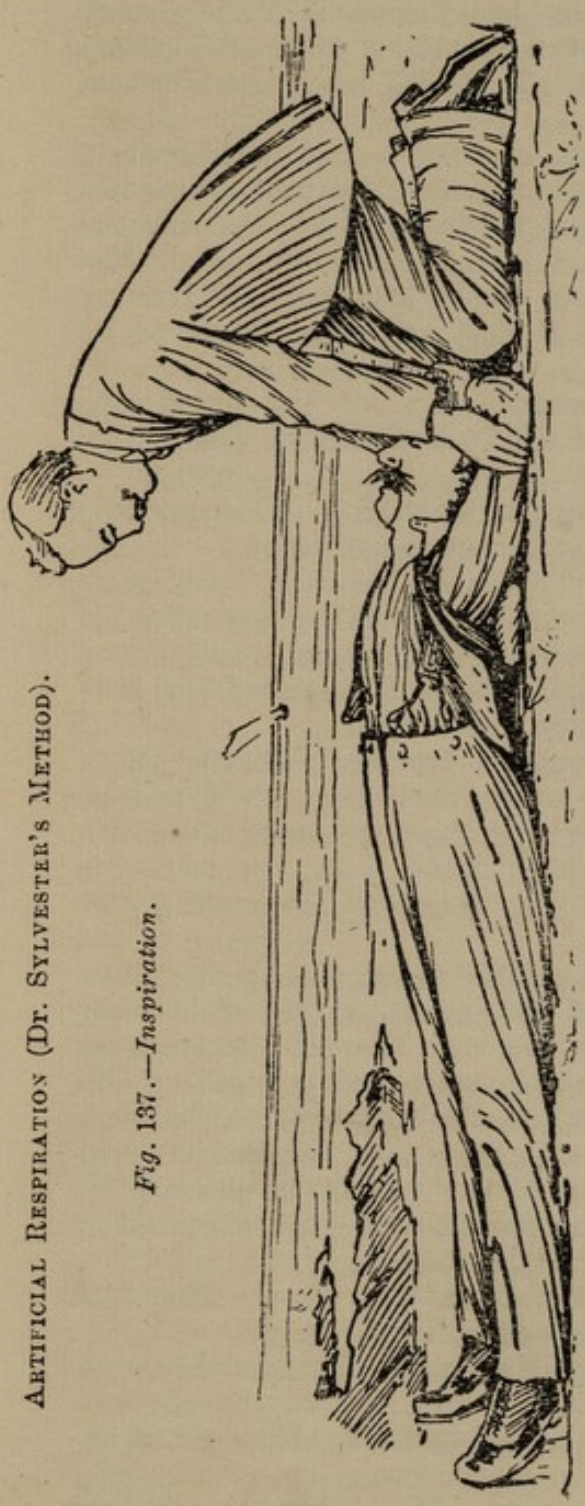


Fig. 137.—*Inspiration.*

Fig. 137*a*.—*Expiration.*

the chest. Hold the arms in this position for two seconds, then bring them down against the ribs, cross the forearms over the pit of the stomach, and, kneeling well forward, make steady pressure upon the sides and front of the chest (Fig. 137*a*), keep up this pressure for two seconds. This will have the effect of expelling the air from the chest.

Repeat the above movements carefully and deliberately about fifteen times a minute till the natural respiration becomes established. This will be indicated by the patient beginning to take short gasps. Then cease the movements, but watch the patient carefully for some time, as the respiration, after being once established, is again liable to fail and may have to be restored.

If the expansion and the compression of the chest are efficiently performed, the flow of air in and out of the larynx can be distinctly heard.

2, Dr. Benjamin Howard's "Direct Method."—This method can be used in cases where there is injury to the arms.

It is more vigorous than the "Sylvester method," and it is easily put into practice, but it has the disadvantage that, if forcible pressure is used by an unskilled operator, the patient runs the risk of being injured during its performance; and it is not applicable where there is injury to the ribs.

Mode of Procedure.—Lay the patient flat on his back, put a hard pillow or roll of clothing (larger than that used in the "Sylvester method") well under the back in order that the lower part of the chest may be the highest, place the patient's forearms crossed on the top of the forehead, and strip the clothing from the waist and neck.

Now kneel astride the patient's hips, facing his head, place the hands, with the fingers spread well apart, on the most compressible part of the lower ribs, taking care that the thumbs do not press upon the pit of the stomach, and squeeze together the two sides of the patient's chest at the same time, leaning gradually forward till the whole weight is over the patient and the mouth is nearly touching that of the patient's; remain in this position for two seconds, then spring back to the kneeling position, lifting the hands off the patient's sides.

Continue these movements at the rate of about fifteen a minute till the respiration becomes established.

3, Dr. Marshall Hall's "Ready Method."—This is the least efficient of the three methods, as only one side of the chest is compressed, and expansion of the lung can only take place on the non-compressed side.

It is also the mildest; it requires considerable practice before one can be efficient in it, and it needs three persons to perform it.

Mode of Procedure.—Take up a position on the left side of

the patient, make one assistant kneel at the patient's head and another assistant at the patient's feet, place a hard roll of clothing (which must be twice as long as that used in Howard's method) in such a manner that when the patient is turned over his chest will be across the roll.

Now with the help of the two assistants turn the patient face downwards, making the body incline over the roll of clothing, and make firm pressure with the hand upon the back, between and on the shoulder blades, then turn the body on the side again. In turning the patient the assistant at the head must see that the patient's arms are not laid upon or twisted.

Repeat these movements and continue them at the rate of fifteen a minute till respiration becomes established.

ASPHYXIA AND ITS TREATMENT.

DEFINITION.—By asphyxia is meant the condition which supervenes when the function of respiration has been interrupted. Death from asphyxia is due to carbonic acid gas poisoning.

Asphyxia may be caused by :—

(i,) Submersion in a liquid medium, as in drowning.

(ii,) Occlusion of the air passages by foreign bodies, as in choking.

(iii,) Pressure on the chest, preventing the action of the respiratory muscles.

(iv,) Closure of the air passages, as in suffocation or smothering.

(v,) External pressure on the air passages, as in strangulation or hanging.

(vi,) Breathing irrespirable gases, such as nitrogen, hydrogen, carbonic oxide, sulphuretted hydrogen, chlorine, chloroform vapour, etc.

THE TREATMENT OF ASPHYXIA.—For some minutes (about four) after the respirations have entirely stopped the heart's action continues, and as long as the heart beats recovery from asphyxia is possible.

The main indications for treatment are :—

(i,) To remove as quickly as possible the cause of the asphyxia.

(ii,) To effect the purification of the blood by introducing fresh air into the lungs by means of artificial respiration or otherwise.

The Treatment of Apparent Death from Drowning.—The appearances presented by a person who has been immersed for some time in the water are as follows:—

The face is swollen and purple, the lips are livid, the eyes are blood-shot, the mouth, wind-pipe and lungs contain frothy fluid,

there is a considerable quantity of water in the stomach, the feet and hands may be swollen and discoloured, and the body is cold.

In treating the apparently drowned the following factors have to be borne in mind :—

(i,) The condition of asphyxia due chiefly to submersion, but also to the blocking of the air passages with water, mud, etc.

(ii,) The shock to the system.

(iii,) The exhaustion from long-continued struggling.

(iv,) The effect of exposure to the cold.

The most important factor, however, in treatment is to remove the condition of asphyxia as soon as possible by artificial respiration.

Directions for Restoring the Apparently Drowned :—

(i,) Send at once for medical assistance, blankets and dry clothing, in the meanwhile—

(ii,) Immediately proceed to treat the patient on the spot, by *first restoring the breathing*, and, after the breathing has been restored, by *promoting warmth and circulation*. It is important not to attempt to restore the circulation till the breathing has recommenced, as by over-taxing an already dilated heart life is endangered.

To Restore Natural Breathing, proceed as follows :—

(*a*,) *Clear the Air Passages.*—To effect this, first remove all tight clothing constricting the neck and chest; next examine the mouth and remove from it all weeds, lumps of mud, food, etc., then in order to drain off water from the throat and gullet (trachea, pharynx, and œsophagus), turn the patient face downwards, place a firm roll of clothing under his stomach and chest, and one of his arms under the forehead so as to raise the mouth off the ground, then press firmly two or three times, for four or five seconds each time, upon the patient's back. Water may also be drained off from the stomach by inverting the trunk thus: turn the patient on his face, get astride him, pass the hands under his abdomen and gently raise his middle.

Inversion of the trunk is easily done in children; in adults it will of course depend upon the weight of the patient and the assistance obtainable.

Note.—Not more than a few seconds should be wasted in attempting to draw off water by either method.

(*b*,) *Adjust the Patient's Position* thus: turn him on to his back with the roll of clothing under his shoulder blades, and allow his head to fall back.

(*c*,) *Maintain a free entrance of air into the Wind Pipe.*—To do this draw forward the patient's tongue and keep it projecting beyond the lips by an elastic band or a piece of tape or string passed over it and under the chin; look to the nostrils and free them from any obstructions.

(*d*,) *Imitate the Movements of Breathing*, *i.e.*, perform "Sylvester's Method" of Artificial Respiration, and continue it till the patient makes an effort to breathe.

(*e*,) *Encourage Breathing.*—If any assistants are at hand during the performance of artificial respiration, get them to excite the nostrils with snuff or smelling salts, or to tickle the throat with a feather, also to rub the face and chest briskly.

While artificial respiration is being performed, make those who are assisting dry the patient's hands and feet, and (if warm clothing has been procured), to strip off the wet clothes and replace them with dry ones, but in doing this, the efforts to restore respiration must not be hindered. As soon as breathing has commenced proceed *to promote warmth and circulation.* To do this, wrap the patient up in dry blankets and commence rubbing the limbs upwards, firmly and energetically, with warm flannels or cloths, either under the blankets or over the dry clothing. Apply hot flannels, hot water bottles, hot bricks, etc., to the pit of the stomach, to the armpits, between the thighs, and to the soles of the feet.

When the patient is able to swallow, give him small quantities of wine, warm brandy and water, or hot coffee.

Put the patient to bed and encourage sleep. During the period of reaction the breathing may become oppressed. To obviate this, apply large linseed meal and mustard poultices to the chest and back. Watch the patient carefully for some time to see that the breathing does not again fail; if any signs of failure appear, resume artificial respiration.

Note.—The above efforts to restore life must be persevered in until the arrival of medical assistance or until the pulse and breathing have ceased for at least an hour.

Cautions.—The following are to be borne in mind:—

(i,) Avoid delay in the application of measures to restore life.

(ii,) Do not waste much time in the preliminary operations, *i.e.*, in clearing the air passages, adjusting the patient's position, and maintaining a free entrance of air into the wind pipe, but proceed to perform artificial respiration as quickly as possible.

(iii), Prevent crowding round the patient, especially if in an apartment.

(iv), Avoid rough usage, and do not allow the body to remain on the back unless the tongue is secured.

(v,) Avoid attempts to give stimulants till the patient is well able to swallow.

(vi,) In performing artificial respiration avoid hurried and irregular motions.

(vii,) Avoid an over-heated room.

(viii,) Under no circumstances hold the body up by the feet.

(ix,) On no account place the patient in a warm bath unless under medical observation.

(x,) Avoid giving up hope for the patient too soon.

Asphyxia from Choking.—Choking is caused by bits of food, foreign bodies, etc., accidentally passing into the larynx.

TREATMENT.—Send at once for medical assistance, but in the meanwhile make attempts to dislodge the obstruction by first placing the patient in the recumbent position with the head turned on one side, and then passing the finger or the handle of a spoon over the base of the tongue, and clawing forward with it. If the patient happens to be a child, it may be held up by the feet and slapped on the back. If, after the foreign body has been extracted, there are no signs of breathing, begin artificial respiration at once and continue it for at least an hour.

Asphyxia from Blocking of the Larynx, caused by Swelling of the Mucous Membrane.– Suffocation in children is often caused by attempting to drink from the spout of a kettle containing boiling water.

TREATMENT.—Send at once for medical assistance, but in the meanwhile wrap the child in a blanket, apply hot sponges, hot flannels (dry or moist) to the mouth; administer, in dessert-spoonful doses, salad, linseed, or cod-liver oil, and also give pieces of ice to suck.

Asphyxia from Attempted Hanging or Strangulation.

TREATMENT.—Release the patient at once, loosen or cut any cords which may be round his neck, also all tight clothing; allow a free current of air to pass over his face, dash cold water on his face and chest, and perform artificial respiration.

Asphyxia from Breathing Irrespirable and Poisonous Gases.—These gases include the vapours from charcoal, coal and coke, lime, brick and cement kilns, coal gas, the foul air from sewers, cesspools and mines (choke damp), the vapour of chloroform, etc.

TREATMENT.—Remove the patient at once from the foul into the fresh air, loosen all tight clothing, commence artificial respiration after drawing the tongue forward and securing it, at the same time apply friction and warmth to the body, and dash cold water upon the head and face.

The Appearances which generally accompany Death are as follows:—

1, The breathing is absent, there is no movement of the chest, no air can be heard passing in and out of it, and there is no watery vapour proceeding from the mouth. To determine the presence of respiration place a glass of water on the chest and watch if any movement is communicated to it; also hold a looking-glass or some bright surface to the mouth and see if the surface becomes dimmed by vapour condensing upon it.

2, The heart's action has stopped, there is no pulse, the movements and sounds of the heart have ceased

To determine this, tie a ligature tightly round a finger. If there is any circulation the end of the finger will become reddened, and the string will leave a white ring round the finger.

3, The eyelids are generally half closed and the pupils are dilated.

4, The coldness and pallor of the surface of the body increase.

CHAPTER XV.

POISONS AND THEIR IMMEDIATE TREATMENT.

Poisons—Definition and Classification of—Evidence of Poisoning—How afforded—How to act in a Case of Poisoning—The General Treatment applicable to a Case of Unknown Poisoning—Special Poisons, their Symptoms and General Treatment.

DEFINITION.—Poisons may be defined as substances which (when introduced into the body or applied externally) injure health or destroy life.

CLASSIFICATION.—Poisons may be classed as follows:—

1. Corrosives.—These soften and destroy the parts with which they come in immediate contact. As examples of corrosive poisons may be mentioned—the mineral acids, the caustic alkalies, corrosive sublimate, the acid, alkaline and corrosive salts (chlorides of zinc, tin and antimony, and nitrate of silver), oxalic acid, etc.

2. Irritants.—These cause inflammation of the part (usually the alimentary canal) to which they are applied. As examples of irritant poisons may be mentioned—arsenic, the salts of zinc, and other metals, elaterium, the essential oils, Spanish fly.

3. Narcotics.—These act chiefly upon the nervous system, producing stupor, delirium, convulsions or coma. As examples of narcotic poisons may be mentioned—opium, prussic acid, belladonna, chloroform, chloral, alcohol, the poisonous gases, etc.

4. Narcotic-Irritants.—These combine more or less the characters of narcotics and irritants. As examples of narcotic-irritants may be mentioned—strychnia, aconite, hemlock, poisonous fungi, etc.

Evidence of Poisoning is afforded by the following circumstances, *viz.*:—

(1,) By the *sudden appearance* of the general symptoms of poisoning, such as vomiting, purging, cramps in the limbs, pains in the stomach or bowels, delirium, unconsciousness, etc., in a person otherwise healthy, or soon after partaking of food, drink or medicine.

(2,) By *several persons* being attacked with similar severe symptoms, soon after a meal of which all have partaken.

(3,) By the *nature of the surroundings*, *i.e.*, by finding a glass or bottle with suspicious looking contents, by the smell of the room, etc.

(4,) By the *history of the case*, *i.e.*, by the patient having

previously shewn a suicidal tendency, or the signs of mental depression, etc.

How to act in a Case of Poisoning:—

(i,) Send at once for medical assistance, and take care that the doctor is made acquainted with the fact that the case to which he is summoned is one of probable poisoning.

(ii,) During the absence of skilled attendance, act as follows, *viz.*:—

(*a*,) *If you are in doubt as to the nature of the poison taken*, adopt the general treatment applicable to a case of unknown poisoning (*see below*).

(*b*,) *If you are aware of the nature of the poison taken*, adopt the general treatment applicable to the special poison (indicated in the table given below).

The General Treatment applicable to a Case of Unknown Poisoning.—Here the objects to be aimed at in treatment are:—

(i,) To *get rid*, if possible, of the unabsorbed poison from the system; this is effected, either by administering an *emetic* to bring the poison up, or an *aperient* to pass the poison through the alimentary canal.

(ii,) To *counteract depression and shock*, by giving stimulants and nourishments, and by the application of warmth by means of poultices, hot fomentations, etc.

(iii,) To *relieve pain*, by administering sedatives and demulcents.

Emetics.—The following may be used:—

Sulphate of Zinc, grs. xx to xxx in half a tumbler of warm water; this is prompt and safe, but is not to be given if salt and water has been already administered.

Ipecacuanha Powder, grs. xv to xxx in half a tumbler of warm water; this produces very little depression and does not irritate the stomach.

Ipecacuanha Wine, 1 to 2 tablespoonfuls in an equal quantity of water; this produces a good deal of depression and is not very prompt in its action.

Mustard, a tablespoonful in a tumbler of warm water.

Salt, two tablespoonfuls in a tumbler of warm water. This is not to be given after sulphate of zinc.

Tepid Water, in large draughts, followed by irritation of the back of the throat by means of the finger or a feather.

Any of the above emetics may be repeated once or twice if necessary. The action of an emetic is facilitated by giving plenty of tepid water.

It is important to remember, that patients suffering from narcotic poisoning are *not easily* made to vomit.

Caution.—Emetics are not to be given in cases of *corrosive poisoning*, which is indicated by stains on the fingers, the lips, in the mouth, etc.

Aperients.—The following may be given:—

Castor Oil 1 to 2 tablespoonfuls for a dose.

Sulphate of Magnesia (Epsom Salts), a tablespoonful in a tumbler of warm water; to be repeated if necessary.

Stimulants.—Administer:—

Sal Volatile (Aromatic Spirits of Ammonia), one half to a teaspoonful in a tablespoonful of warm water.

Spirits (Brandy or Whisky), from a tea- to a tablespoonful, according to circumstances.

Strong Beef Tea, Tea or Coffee.

The Hot and Cold Douche alternately.

NOTE.—It may (in cases where the patient is unable to swallow) be necessary to give spirits, beef tea, tea or coffee by an enema.

Sedatives and Demulcents.—These are non-irritating fluids (which soothe internal local irritation and relieve pain), such as milk, raw eggs, barley water, arrowroot, flour mixed in water, olive oil, linseed tea, gruel, etc

THE POISONS.

Special Poisons.	Their Symptoms.	Their General Treatment.
1. The Acids— (*a*) The strong corrosive ones, viz.:— (i,) Acetic (Glacial, and Aromatic Vinegar). (ii.) Hydrochloric (Muriatic, Spirits of Salt). (iii,) Nitric (Aqua fortis). (iv,) Sulphuric (Oil of Vitriol).	Immediate burning pain in the mouth, throat, and stomach, vomiting and purging may occur. Wherever the skin and mucous membrane are touched they are destroyed, there is more or less suffocation and great shock.	CAUTION. — *Emetics are not to be given.* Administer frequently magnesia or chalk dissolved in warm water, then demulcents, such as lime water and milk, milk and egg, olive oil, ¼ pint to 1 pint of water, thick gruel; if there is depression, give stimulants. If any acid has got into the air passages, make the patient inhale the fumes of ammonia.
(v,) **CARBOLIC** (Phenol).	With the above symptoms there is the voidance of greenish or black urine, and the odour of the acid can be detected in the breath.	Administer Epsom salts, ½ oz. in 8 ozs. of warm water, then white of egg mixed with water in large quantities, or large quantities of milk, or olive oil, 2 to 4 ozs. in 1 pint of water, or castor oil, 1 oz.: also give stimulants freely and apply warmth to the extremities.

Special Poisons.	Their Symptoms.	Their General Treatment.
(vi,) **OXALIC** (Salts of Lemon or Sorrel).	Burning pain in the stomach, cramp in the legs, vomiting of dark coloured fluid, hacking cough with feeling of constriction in throat, mouth white and sore; great shock, and death mayrapidlysupervene.	Avoid giving *potash*, *soda*, or *ammonia*, or their *carbonates*, but administer frequently chalk and water, magnesia and water, and lime water, and then give 1 oz. of castor oil, and stimulants freely.
(*b*) **PRUSSIC ACID** (Hydrocyanic Acid, Scheele's Acid), this may also occur in oil of almonds, almond flavour, peach kernels, bitter almond water, laurel water, and cyanide of potassium.	The patient almost immediately after swallowing the acid becomes insensible, with fixed and glistening eyes, the pupils are dilated and insensitive to light, the limbs are flaccid, the skin is cold and covered with a clammy perspiration, the respirations are gasping, and occur at long intervals, and there may be convulsions.	Administer emetics first, then stimulants *ad lib.*, if necessary by an enema, make patient smell ammonia, apply the hot and cold douche alternately, perform artificial respiration steadily (about 20 to the minute), and at the same time use friction to the extremities. When from the acid itself, use the cold water douche without *any* delay, followed immediately by strong stimulants as ammonia or brandy. NOTE.—If life can be maintained for about half an hour, recovery is almost certain.
2. **Aconite** (Monkshood, Blue Rocket) and its alkaloids; occurs in aconite liniment, neuraline, etc.	Warmth at pit of stomach, tingling of mouth, lips and tongue, feeling of constriction in throat, difficulty in swallowing, numbness of tips of fingers, loss of sensation, deafness and dimness of sight; followed by paralysis, first of lower and then of upper extremities, pulse is irregular and almost imperceptible, respirations shallow, feeble and infrequent, there may be convulsions, pupils generally dilated, great prostration, and death may take place suddenly after slight exertion.	Give emetics first, then stimulants freely, apply warmth to the lower extremities, by hot water bottles and by friction with the warm hand. Apply a mustard poultice or a mustard leaf over the heart, keep the patient strictly in the recumbent position and perform artificial respiration if necessary. NOTE. — Stimulants may have to be given by an enema.

Special Poisons.	Their Symptoms.	Their General Treatment.
3. **Alcohol**, as in rectified, proof, and methylated spirit, brandy, rum, whisky, gin, etc.	Giddiness, inability to stand or walk, the gait is tottering, the expression is vacant, the face is flushed, the conjunctivæ are congested, the lips are livid, the breath smells of alcohol, the skin is covered with sweat, the pupils are dilated and fixed but may be contracted, convulsions occur and are followed by stupor and coma.	Give emetics; if the patient is insensible rouse him and keep him awake, administer hot strong coffee, apply the hot and cold douche alternately; when the patient has sufficiently recovered, wrap him up in warm blankets and put him to bed.
4. **The Alkalies**, the strong caustic ones, viz.:— (i,) Ammonia (Spirits of hartshorn, etc.), as in caustic ammonia, ammonia liniment, compound camphor liniment, liquid ammonia. (ii,) Lime, as caustic lime, quicklime. (iii,) Potash, as caustic potash. (iv,) Soda, as caustic soda.	Immediate burning pain in the mouth, throat and stomach, vomiting and purging, the mucous membrane of the mouth is destroyed, and there are symptoms of suffocation and of great shock.	CAUTION. — *Emetics are not to be given*, but administer vinegar, lemon or orange juice, tartaric or citric acid in plenty of water; give demulcents and stimulants if required; if the power of swallowing is lost, give inhalations of acetic acid or vinegar from a pocket handkerchief.
5. **Antimony**, as chloride or tartarated antimony (tartar emetic), occurs also in antimonial wine, and in Hooper's or Hall's specific.	There is a metallic taste in the mouth, with nausea and incessant vomiting, a feeling of heat, constriction and choking in the throat, pain in the stomach, violent purging, and cramps in the limbs, the skin is cold, the head and face are congested, and there is great depression and collapse.	Encourage vomiting by giving large draughts of tepid water, when the vomiting subsides administer strong tea or coffee, also white of egg mixed in water, barley water, arrowroot or milk. Give stimulants if there is collapse. Wrap the patient up in warm blankets and put hot water bottles to his feet.

Special Poisons.	Their Symptoms.	Their General Treatment.
6. **ARSENIC** (Arsenious acid, White arsenic), may also occur in Aqua Tofania, fly papers, mineral, Vienna and Scheele's emerald green, Fowler's solution, Simpson's rat paste, Roth and Ringeisen's vermin killer, cheap ices, crayons, French chalks, wall papers, tinned fruits (as an impurity of the tin), and beer as an impurity of the sweetening material, etc.	Faintness and depression followed by a burning pain in the stomach, vomiting of brown matter mixed with mucus and streaks of blood, purging, severe cramps in the calves of the legs, constriction and dryness of the throat, great thirst, hiccough, loss of voice, cold sweats, profound shock and exhaustion.	Give emetics, and then large draughts of tepid greasy or soapy water, or salt and water, dialysed iron in 1 oz. doses, or magnesia in large quantities, these are to be frequently repeated; give olive oil ½ pint in 1 pint of lime water, administer demulcents; if there is depression, give stimulants freely, and apply warmth and friction; after the acute symptoms have passed off, apply linseed meal poultices to the abdomen
7. **Belladonna** (the Deadly Nightshade) and its alkaloid atropine.	Heat and dryness of the mouth and throat, suppression of saliva, difficulty of swallowing and great thirst, the face is flushed, the eyes are prominent and sparkling, the vision is double or indistinct, the pupils are dilated and insensible to light, there is great excitement and noisy delirium, the gait is unsteady and staggering, there is a frequent desire to pass water, with inability to do so, the skin is dry and there may be a rash like that of scarlet fever.	Give emetics first, then strong hot coffee and stimulants, apply mustard to the calves of the legs and hot water bottles to the feet, administer the hot and cold douche alternately, and perform artificial respiration.
8. **Cantharides** (Spanish Fly, Blister Beetle), occurs also in blistering fluid.	Burning sensation in the throat and stomach, with pain and difficulty in swallowing, vomiting of mucus and blood, diarrhœa with blood and slime in the motions, incessant desire to pass water, high temperature, quick pulse, headache, loss of sensibility, and convulsions.	Give emetics and then demulcents, especially white of egg and milk or thick gruel, but avoid giving *fats* and *oils*; when the acute symptoms have been relieved, give the patient a hot bath or apply hot linseed meal poultices to the abdomen.

Special Poisons.	Their Symptoms.	Their General Treatment.
9. **Camphor**, as in the essence, liniment and spirits of camphor, and in Rubini's solution.	Odour of the breath, languor, giddiness, faintness, disturbance of vision, noises in the ears, delirium and convulsions, a cold and clammy skin, weak pulse and difficult breathing.	Give emetics and then stimulants freely, apply warmth to the extremities and administer the hot and cold douche alternately.
10. **Caustic Lunar** (Nitrate of silver).	Pain and discolouration of the mouth and throat, followed by vomiting of whitish flakey matter which turns black.	Give common salt dissolved in water or milk freely, give emetics (but not sulphate of zinc), and demulcents.
11. **Chloral** (Chloral hydrate, Syrup of chloral, Hunter's chloral).	Deep sleep, with loss of muscular power, diminished sensibility, the face is livid and bloated, the pulse is slow or very weak, the respirations are diminished, and the surface of the body is cold.	Give emetics, wrap the patient up in warm blankets, and apply hot water bottles to the feet, keep the patient roused by shouting or flapping his face with a wet towel, give hot strong coffee, and perform artificial respiration if there is the slightest failure of the breathing.
12. **Chlorine Gas**, as in chloride of lime.	Irritation of the throat, cough, tightness of the chest, difficulty of breathing and inability to swallow.	Admit plenty of fresh air, give inhalations of steam or of very dilute ammonia.
13. **Chloroform** (inhaled).	The respirations are arrested, the breathing is stertorous, and the face is livid.	Pull the tongue forward, see that the mouth and throat are clear, loosen everything tight about the chest, flap the face and chest with a wet towel, give plenty of fresh air, apply the hot and cold douche alternately to the chest and head, and perform artificial respiration.

Special Poisons.	Their Symptoms.	Their General Treatment.
14. **Chloroform** (swallowed).	The breath smells of chloroform, the gait is staggering, this is followed by insensibility, the pupils are dilated, the breathing is stertorous, the skin is cold, and the pulse is imperceptible.	Give emetics first, then carbonate of soda dissolved in plenty of water, rouse the patient in every possible way, apply mustard to the calves of the legs and a mustard leaf over the heart.
15. **Copper**, as the sulphate (blue vitriol, blue stone), or the acetate (verdigris).	There is a metallic taste in the mouth, constriction in the throat and gullet, griping and colicky pains in the abdomen, nausea, vomiting and purging, difficult breathing, quick pulse, great weakness and thirst, cold perspiration, coldness of the limbs, headache, giddiness, and finally coma.	First give large quantities of milk and eggs, then emetics (if there is no vomiting), and then large draughts of tepid water, after that barley water, arrowroot or gruel, and apply hot linseed meal poultices to the abdomen.
16. **Croton Oil.**	Great pain in the abdomen, with vomiting and purging, the face is pale, the features are pinched, the pulse is small the skin is moist, and there is great collapse.	Give emetics first, then demulcents, especially white of egg in milk, and stimulants freely, and apply hot linseed meal poultices to the abdomen.
17. **Ergot of Rye** and its alkaloids, ergotine, etc.	Tingling and cramp of the limbs, dizziness, weakness, itching, vomiting and diarrhœa.	Give emetics first, then castor oil, after that strong tea and stimulants, keep the patient in a recumbent position, and apply warmth to the extremities.
18. **Ether** (inhaled)	Same as chloroform inhaled.	Same as chloroform inhaled.
19. **Fungi** (Fly fungus, poisonous mushrooms).	There is violent colic, with vomiting and diarrhœa, great excitement and then coma, the pulse is slow, the breathing is stertorous, the pupils are dilated, and the extremities are cold.	Give emetics first, then castor oil 1oz., then stimulants freely, apply warmth to the extremities and hot linseed meal poultices to the abdomen.

Special Poisons.	Their Symptoms.	Their General Treatment.
20. **The Gases,** *viz.*, carbonic acid or carbonic oxide gas, coal gas or sewer gas, choke damp or after damp, marsh gas, charcoal fumes, and acetylene.	There is irritation of the throat, with headache, drowsiness, giddiness, and singing in the ears, loss of muscular power, lividity, hurried respirations and coma.	Remove quickly to the fresh air, and perform artificial respiration, apply smelling salts to the nostrils, and cold to the head and chest, and give stimulants.
21. **Holly Berries.**	There is vomiting, with pain in the head and abdomen, and purging, the pupils are contracted, then drowsiness followed by unconsciousness and collapse supervene.	Give emetics, and then stimulants freely, apply friction and warmth to the extremities.
22. **Hyoscyamus** (henbane), and its alkaloids hyoscyamine, etc.	Much the same as belladonna, *i.e.*, thirst, dilated pupils, delirium, etc	Give emetics first, then stimulants moderately, and apply the hot and cold douche alternately.
23. **Iodine** and **Iodoform.**	There is pain and heat in the throat and stomach, with vomiting and purging (the vomited matter may be yellow or blue), followed by giddiness and faintness with convulsive movements.	Give emetics first, then starch and water, or gruel and water, or white of eggs and water freely.
24. **Laburnum** and its active principle cytisine, which is also present in Arnica.	There is purging, vomiting, and great restlessness, this is followed by drowsiness, insensibility and convulsive twitchings.	Give emetics first, then stimulants in moderation, and administer the hot and cold douche alternately to the head and chest.
25. **LEAD** as acetate (sugar of lead), lead paint or white lead; may occur in crayons, French chalk and hair dyes.	There is dryness of the throat, with a metallic taste and great thirst, colicky pains in the abdomen which are relieved by pressure, constipation, cramps in the legs, cold sweats, paralysis of the lower extremities, and convulsions.	Give emetics freely, then Epsom salts (½ oz. in a tumbler of warm water), then demulcents, and apply hot linseed meal poultices to the abdomen.

Special Poisons.	Their Symptoms.	Their General Treatment.
26. **MERCURY**, as corrosive sublimate, perchloride of mercury, red and white precipitate, red oxide of mercury, and the acid nitrate of mercury.	If corrosive sublimate or the acid nitrate is taken, the lips and mouth are white and swollen, the tongue is white and shrivelled, and there is a sense of constriction in the throat; in all cases of poisoning by mercury there is a metallic taste in the mouth, pain in the stomach, nausea, vomiting of stringy mucus mixed with blood, profuse purging with bloody stools, a cold and clammy skin, difficult respirations, syncope and convulsions.	First give white of egg mixed with water or flour and water, then give emetics freely, after this demulcents and stimulants.
27. **Mussels**, also **Ptomaines** (animal alkaloids, poisonous meat, poisonous fish).	There is uneasiness and weight at the pit of the stomach, a sensation of numbness in the extremities, heat, dryness and constriction in the throat, thirst, shivering, difficulty of breathing, cramps in the legs, inflammation of the eyes, colic, vomiting and purging, itching of the skin, failure of the heart's action and collapse.	Give emetics first, then castor oil 1 oz., then stimulants freely, apply hot water bottles to the feet, and wrap the patient up in warm blankets.
28. **Nitrous Oxide Gas** (laughing gas).	Same as chloroform inhaled.	Same as chloroform inhaled.
29. **Nitro-Benzol** (nitro-benzine, artificial oil of bitter almonds, essence of henbane). Also present in aniline dyes, liqueurs, sweetmeats, pomades.	There is weakness and discomfort, great nausea and anxiety, confusion of the mind, lividity of the face and body, dilated pupils and convulsions.	Give emetics first, then stimulants freely, apply the hot and cold douche alternately, and perform artificial respiration.

Special Poisons.	Their Symptoms.	Their General Treatment.
30. **NUX VOMICA** (St. Ignatius Bean), and its alkaloid **STRYCHNIA** (as in Butler's, Battley's, and Gibson's vermin killer).	Violent rigid convulsions, with lockjaw during the convulsive attack; the eyeballs are prominent, the pupils dilated, the respirations impeded, the pulse feeble and very rapid. Death usually occurs from asphyxia or from collapse during a paroxysm.	Give emetics first, then animal charcoal *ad lib.* mixed in water, followed by an emetic; if possible perform artificial respiration.
31. **OPIUM** (laudanum), and its alkaloids (morphine, codeine, etc.), occur in tincture and wine of opium, Battley's sedative solution, Black Drops, Chlorodyne, Dalby's Carminative, Godfrey's Cordial and Elixir, Mother's Friend and Soothing Syrup, Nepenthe, Syrup of Poppies, Paregoric and Dover Powder.	Mental excitement, followed by headache, uneasiness, a sensation of weight in the limbs, incapacity for exertion, sleepiness, diminution of sensibility, and contraction of the pupils; at first the patient can be roused with difficulty, but later on he becomes quite insensible, his muscles are relaxed, his skin is cold, the pupils fail to respond to light, his face and lips are cold and blue, the respirations are slow, irregular, and stertorous, and the pulse is weak and compressible.	Give emetics first, rouse and keep the patient awake by making him walk about, or flapping him with a wet towel, apply ammonia or sal volatile to the nostrils, give a pint of hot strong coffee, or 1 to 3 grs. of permanganate of potash dissolved in half a tumbler of water, apply the cold douche to the head frequently, perform artificial respiration and keep it up at least for two hours. *Do not* give wine or brandy. CAUTION.—In making the patient walk about be careful not to over-exhaust him, as with opium poisoning there is always a certain amount of depression.
32. **Paraffin Oil.**	The symptoms vary very much, there may be a burning sensation in the mouth, gullet or stomach, and great thirst; the extremities are cold, the face is pale, the pulse is feeble, the respirations are weak, and often there is coma.	Give emetics first, then stimulants freely, and apply warmth to the body.

Special Poisons.	Their Symptoms.	Their General Treatment.
33. **PHOSPHORUS** (as in matches, phosphorus paste, rat poison, vermin killer, rat paste, Roth & Ringeisen's, with arsenic).	Pain in the stomach, vomiting, the vomited matter may be luminous in the dark, odour of phosphorus in the breath, bleeding from the nose, blood stained motions, and convulsions.	Give emetics first, then Epsom salts (½ oz. in a tumbler of water), stimulants if required, and demulcents, especially milk. *Avoid* giving *fats* and *oils*.
34. **Tin** and its salts.	The same as in lead poisoning.	Give emetics first, then sal volatile in water, and white of egg in milk.
35. **Tobacco** and its alkaloid, nicotine.	Nausea and vomiting, accompanied with great weakness and faintness, confusion of ideas, dimness of sight, weak pulse, cold skin, covered with clammy perspiration, pupils at first contracted and then dilated.	Give emetics first, then strong tea, and stimulants freely, apply warmth to the extremities and keep the patient in a recumbent position.
36. **Turpentine** (oil and spirits of turpentine, turps, camphene).	Odour in the breath, intoxication, pupils contracted, breathing stertorous, coma, collapse and tetanic convulsions, irritability of the bladder, the urine having the smell of violets. The symptoms of turpentine poisoning resemble somewhat those of opium.	Give emetics first, then Epsom salts (1 oz. in half a tumbler of warm water), and demulcents.
37. **Zinc**, as sulphate (white vitriol), and chloride (Burnett's Disinfecting Fluid).	Corrosion of the lips and of the mucous membrane of the mouth, pain and incessant vomiting, the pulse and respirations are quickened, the pupils are dilated, the muscles are paralysed, and coma supervenes.	Do not give *emetics* but give first large draughts of milk and white of egg, and then bicarbonate of soda or common soda in large quantities dissolved in warm water, and then strong tea, apply linseed meal poultices to the abdomen.

Note.—The following Poisons are frequently taken either accidentally or for suicidal purposes, viz.: *Carbolic acid*, *Oxalic acid*. *Prussic acid*, *Arsenic*, *Opium*, *Phosphorus*, *Strychnia* (Nux vomica), *Lead (Sugar of)* and *Mercury (Red and White Precipitate)*. In the foregoing table these are printed in heavy capitals.

CHAPTER XVI.

THE IMMEDIATE TREATMENT OF INSENSIBILITY AND FITS.

Insensibility, its causes—Fits, kinds of—The Causes, Symptoms and Treatment of Syncope, Shock, Concussion and Compression of the Brain, Apoplexy, Alcoholic Intoxication, Sunstroke and Freezing—Test for Insensibility—How to act if a patient is found in a state of Unconsciousness—The Symptoms and Treatment of Epileptic Fits, Hysterical Fits and the Convulsions of Infants.

INSENSIBILITY.

Loss of consciousness may be produced by the following *causes*:—

1, Syncope, or fainting.
2, Asphyxia, or suffocation.
3, Shock and collapse.
4, Concussion of the brain.
5, Compression of the brain.
6, Apoplexy.
7, Alcoholic intoxication.
8, Narcotic poisoning, as opium poisoning.
9, Sunstroke.
10, Freezing.

Unconsciousness is also present in the following:—

1, Epilepsy.
2, The convulsions of infants.
3, Uræmic poisoning, which often comes on in the course of kidney disease and is due to the non-excretion (by the kidneys) of the waste material in the blood.

But as convulsions form the most prominent symptom, these diseases are dealt with separately under "Fits."

1, Syncope, or **Fainting,** may be due to mental emotion, pain, extreme exhaustion (as from hunger, fatigue, etc.), hæmorrhage, cold, heat (particularly if combined with a close atmosphere, as in heated rooms, in large crowds, etc.), constriction of the chest (as in tight lacing, etc.), and organic disease of the heart.

Symptoms.—Fainting is generally ushered in by a feeling of giddiness and fluttering at the heart. This is followed by the face becoming suddenly pale and the lips white; the pulse becomes weakened and the breathing quickened; a cold sweat appears on the brow and the palms of the hands; the patient staggers and finally falls to the ground in an unconscious state

Rarely convulsive movements of the whole body may also be present.

TREATMENT.—As fainting is caused by a diminution of the supply of blood to the brain from partial paralysis of the heart, the object to be aimed at in treatment is to restore the cerebral circulation; therefore, when a person has fainted, do not attempt to place him in a sitting or standing posture (as this will only embarrass the already weakened action of the heart, and may be fatal), but lay him flat on his back, or, better still, on his left side with his pelvis and feet slightly raised; loosen all tight clothing about his body and neck; give him plenty of fresh air; sprinkle cold water on his face; apply smelling salts to his nostrils; when able to swallow, give him a glass of water or a little brandy, whisky, or sal volatile mixed in water, and keep him in the recumbent position for some time after he has recovered. If the faint is prolonged and consciousness does not return, send for medical assistance, but in the meanwhile apply warmth to the feet and a hot mustard plaster over the region of the heart, and if natural breathing has not returned, perform artificial respiration by the "Sylvester" method.

In a crowded room a fainting fit may be prevented by placing the patient in a stooping position on a chair and bending his head between his knees. The person must be held, for if he faints in this position he dives forward on to his head, and may turn a somersault or might break his neck. If the patient has completely fainted this treatment is not to be attempted, as it only helps to obstruct the circulation and respiration.

2, Asphyxia.—This has been dealt with in Chapter XIV.

3, Shock, or **Collapse,** may be produced by severe injuries or emotional disturbance, causing a profound depressing effect upon the central nervous system.

The injuries most liable to produce shock are:—

(i,) Those involving large surfaces of the skin, as in burns and scalds.

(ii,) Those causing crushing or tearing of the body, as machinery and railway accidents.

(iii,) Those affecting the abdomen and viscera.

Loss of blood and exposure to cold intensify the condition of shock.

Symptoms.—A person in a state of shock presents the following appearance: He lies flat on his back, his limbs are flaccid, and he makes no spontaneous movements; his body is cold and clammy, his face is pale, his eyes are sunken, his pulse is small, feeble and irregular, his respirations are shallow, feeble and sighing, his temperature falls to 97° F. or a degree or two lower, and he is semi-unconscious.

Should a case of shock tend to terminate favourably, the

condition known as that of "Reaction" comes on. This is usually ushered in by the patient vomiting, the pulse then becomes stronger, the body warmer, and colour returns to the face.

TREATMENT.—The object to be aimed at in treatment is to bring about reaction by the application of warmth and the administration of stimulants. Therefore, to treat shock place the patient in bed between blankets as soon as possible, keeping his head quite low. Apply hot water bottles to his feet and between his thighs, and apply friction to his arms and legs.

If able to swallow, give him small quantities of hot stimulants, and frequently repeat them till reaction takes place, then lessen the stimulants considerably, taking care not to over stimulate.

During the state of collapse, should the breathing become embarrassed, perform artificial respiration according to the "Sylvester" method.

4, Concussion of the Brain is caused usually by blows or falls upon the head, or falls upon the feet or lower end of the spine, the effect being a severe shaking up of the brain substance.

Symptoms.—These vary in their severity according to the force of the blow applied. The patient may present the appearance of being merely stunned, or he may be in a condition identical with that already described under "Shock."

TREATMENT.—The same as for shock; and at the same time apply cold in the form of ice or wet cloths to the head. Avoid alcoholic stimulants, but give instead hot beef tea or hot coffee, and keep the patient absolutely quiet in a darkened room.

5, Compression of the Brain is caused by injuries to the head producing pressure of the brain substance either by the depression of a piece of bone on to it, or by a blood clot (produced by the rupture of a blood-vessel).

Symptoms.—Resemble those of apoplexy, which see.

TREATMENT.—If there is a wound on the head, dress it; otherwise adopt the same treatment as for apoplexy.

6, Apoplexy is caused by the bursting of a diseased blood-vessel into the substance of or upon the surface of the brain, causing compression of that organ. It usually occurs in elderly persons.

Symptoms.—Just before the attack there are generally some premonitory symptoms, such as headache, giddiness especially on stooping, weight and fulness in the head, noises in the ears. When the actual attack occurs, the patient is more or less unconscious, his face is flushed, his breathing is shallow and stertorous; his eyes are insensible to light and touch, the pupils are fixed, and are either unequally dilated, or one or both may be contracted; his pulse is full and slow, and there is paralysis more or less affecting one side of the body.

TREATMENT.—The object of treatment is to get the circulation

quiet and the heart's action free from embarrassment; therefore loosen all tight clothing about the neck and chest, put the patient to bed with his head raised, and apply cold to it; apply hot water bottles to his feet and mustard poultices to the calves of his legs. Be careful to give nothing by the mouth (as it may choke the patient), and send for medical assistance.

7, Alcoholic Intoxication:—

Symptoms.—A person in a state of stupor from alcohol presents the following picture: He is semi-unconscious, and can be partially roused, his face is flushed and bloated, his eyes are reddened and blood-shot but are not insensible to touch, his pupils are equally dilated and fixed, his lips are livid, his breathing is slow, the surface of his body is cold, and he may smell of liquor.

Note.—Alcoholic stupor may be hard to distinguish from apoplexy, but the state of the pupils, the sensitiveness of the eyes to touch, and the presence or absence of paralysis will help to determine the condition.

TREATMENT.—(See "Poisons," Chapter XV, page 166.)

Caution.—If in doubt as to whether a person is suffering from drunkenness or apoplexy, treat him for the latter and be particularly careful *not to make him vomit.*

8, Narcotic Poisoning.—(See "Opium Poisoning," Chapter XV, page 172).

9, Sunstroke is caused by exposure to the rays of the sun.

Symptoms.—Sunstroke is ushered in with giddiness, nausea and weakness; this is followed by drowsiness and more or less unconsciousness. The eyes are blood-shot, the skin is hot and dry, the breathing is quick and noisy; the pupils are contracted at first and become dilated afterwards; the pulse may be slow or quick, and there may be convulsions.

TREATMENT.—Place the patient in a cool, shady spot; remove the clothing from the neck and upper part of the body and raise the head; douche the head, neck, chest and spine with cold water, or wrap cold sheets round him, and continue these cold applications till he becomes conscious, then remove him to bed, keep the room darkened, and watch him carefully; if the unconsciousness returns, renew the application of cold.

10, Freezing:—

TREATMENT.—Take the patient into a room which has no fire in it, rub the body with ice-cold or snow water and restore warmth gradually.

It is dangerous to apply heat too early; as soon as the patient is able to swallow give him stimulants and hot drinks.

Test for Insensibility.—To determine whether a person is insensible, raise the eyelid and touch the white of the eye,

blinking, which cannot be avoided if the person is conscious, does not occur.

How to act if a Patient is found in a state of Unconsciousness.—Before efficient help can be rendered, the first thing to do, is to try and arrive at the cause which has produced the state of unconsciousness, and in order to do this a systematic examination of the patient and his surroundings must be made, therefore proceed as follows:—

(i,) Notice the position of the body and its surroundings.

(ii,) Notice whether the body is lying still or there are convulsive movements, and also if the convulsive movements are general, or only confined to one side of the body.

(iii,) If possible obtain all information as to the cause.

(iv,) Lay the patient on the back, inclining the head to one side (to prevent the tongue from falling back or vomited matter going down the trachea); if the face is flushed slightly raise the head, if the face is pale keep the head flat, place the arms by the sides and extend the legs, and loosen all tight clothing about the neck and chest.

(v,) Examine the head, to ascertain whether there is a depressed wound (which would suggest compression), or a mere bruising (which would suggest stunning).

(vi,) Examine the eyes to see if they are sensitive to light and touch, if there is any squinting, and the state of the pupils;

(*a*,) If sensitive to touch, no brain injuries are present.

(*b*,) If the pupils are unequally contracted, there is brain trouble.

(*c*,) If the pupils are equally contracted, there is opium poisoning.

(vii,) Examine the face;

(*a*,) If it is drawn to one side, this will indicate apoplexy or compression of the brain.

(*b*,) If it is bloated and flushed, this will suggest the excessive use of alcohol.

(viii,) Smell the breath, the odour of opium or alcohol may be detected.

(ix,) Examine the mouth and tongue, froth in the mouth and a bite on the tongue will indicate fits, particularly epileptic.

(x,) Notice the breathing;

(*a*,) If it is slow, it indicates great weakness, as in shock.

(*b*,) If it is snoring (stertorous), it indicates brain trouble.

(xi,) Examine the pulse;

(*a*,) If it is slow, there is brain trouble.

(*b*,) If it is rapid, there is sunstroke or fever.

(*c*,) If it is quick and thready, there is great weakness—such as shock.

(xii,) Feel the surface of the body;

(*a*,) If the skin is abnormally cold, there is either freezing, intoxication, collapse, or fainting.

(*b*,) If the skin is hot, there is sunstroke or high fever.

(xiii,) Examine the ribs, collar bones and limbs for fractures.

(xiv,) Examine the limbs to see if there is any paralysis; this is done by raising the limbs and allowing them to fall, if they do so lifelessly it suggests paralysis.

(xv,) If convulsive movements are present, the patient is subject to fits of some kind (either epileptic, hysterical or uræmic in an adult, or convulsions of infants).

(xvi,) Examine the neck for evidence of strangulation or hanging.

FITS.

1, Epileptic Fits.—The distinguishing features of these fits are convulsive movements and unconsciousness. An epileptic fit begins by the patient suddenly falling unconscious, with strained and rigid muscles; as he is seized he may utter a sharp shrill cry or yell. This stage of rigidity is then succeeded by a stage of convulsions in which the patient's body is thrown into violent twitchings and contortions with foaming at the mouth. During this stage the tongue may be bitten. After the patient has been in the convulsive stage for a few minutes, he may at once regain his consciousness or he may be more or less confused for a time, or more frequently he becomes drowsy and passes into a deep sleep or stupor, which may last several hours.

TREATMENT.—During the convulsive stage place the patient in a safe place to prevent him from hurting himself; put a piece of wood or other hard substance well padded between his teeth to prevent him from biting his tongue, loosen all tight clothing about the neck, chest and abdomen, and *do not* attempt to restrain the convulsive movements or to administer anything by the mouth.

After the convulsive stage has passed off and the patient seems drowsy, encourage natural sleep. If on waking he seems exhausted, give him a little soup or beef tea, but do not give stimulants.

2, Hysterical Fits.—These occur more often in females than males, and are ushered in with crying, sobbing or laughing without any cause; then follow jerky movements of the limbs (not truly convulsions), at the same time the breathing is quickened, the eyelids are closed, and in severe attacks the patient falls down apparently but not actually unconscious, taking care never to hurt herself.

TREATMENT.—The best treatment for a hysterical patient is to

exclude all fussy friends and let her alone. The patient will come to herself when she realizes that her condition is exciting no sympathy or alarm.

3, The Convulsions of Infants.—These are usually caused by teething, constipation, indigestion, worms, etc., but they may be due to fever or brain disease.

Symptoms.—Just before the occurrence of a fit the child is usually peevish and fretful. During the fit the body first becomes stiff, the pulse is rapid and weak, the breathing is hurried, the skin is wet with a cold, clammy perspiration, and there is complete loss of consciousness. The rigidity of the body lasts a few seconds, and is succeeded by a stage of convulsive movements in which the muscles of the face twitch and the limbs jerk violently. As one fit passes off another may supervene, or the child may pass into a semi-comatose condition and then into a natural sound sleep.

TREATMENT.—The course to adopt is to relieve as quickly as possible the cerebral circulation, therefore place the child at once in a bath as warm as can be borne comfortably from ten to twenty minutes, or put the feet in hot water with mustard in it; at the same time apply cold sponges to the head and quickly change them, and send for medical assistance.

4, Uræmic Convulsions.—In the course of Bright's disease convulsions and unconsciousness may occur.

TREATMENT.—The course to adopt here is to encourage the action of the skin, therefore place the patient in bed between warm blankets, pack hot water bottles round him, and send for medical assistance.

CHAPTER XVII.

BURNS AND SCALDS AND THEIR IMMEDIATE TREATMENT; ELECTRIC SHOCK AND ITS IMMEDIATE TREATMENT; THE REMOVAL OF FOREIGN BODIES FROM THE EYE, EAR, AND NOSE.

Burns, degrees and treatment of—Burns from Acids and Alkalies, their treatment—To Extinguish the Flames from Burning Clothing—Shock by Electricity, the treatment of—Removal of Foreign Bodies from the Eye, Ear and Nose.

BURNS AND SCALDS.

Burns are caused by the application of a fire or dry heat.

Scalds are caused by the application of hot liquids or moist heat.

Burns are divided into the following *degrees*, according to the extent of injury inflicted, viz. :—

1st degree.—A mere reddening of the skin.

2nd degree.—The formation of blisters.

3rd degree.—Charring and the destruction of tissues.

In addition to the actual damage caused by burns and scalds there is also present :—

(i,) *Shock to the System.*—This is in direct proportion to the superficial extent of the burn. Burns of the abdomen and chest are especially liable to produce marked shock, and in children suffering from burns and scalds the shock is usually profound.

(ii,) *Congestion of Internal Organs.* This usually comes on after the shock.

Treatment.—In the management of burns and scalds the following points have to be borne in mind :--

(*a*,) The local injury.

(*b*,) The shock to the system.

If the shock is severe it should be treated first, and the local injury afterwards, when reaction has set in.

The Local Injury.—In attending to a burn care should be taken that the clothing is removed with the *utmost care* from the burnt part, and that no blisters are broken in removing it. The clothing should therefore be cut off, and if parts adhere to the body they should be gently removed after first soaking them in oil ; if this is not sufficient, the part should first be

immersed in a bath of warm water. If the burns are extensive only one portion of the body should be dressed at a time, the rest being kept covered up.

To dress the Burns proceed as follows: Either apply over the burnt parts pieces of lint which have been soaked in carron oil (a mixture consisting of equal parts of linseed oil and lime-water), or in carbolic oil, 1 in 40, or in a saturated solution of common washing soda, or spread boracic acid ointment (which has been diluted with an equal part of vaseline) upon pieces of lint and apply it to the burnt parts.

Note.—Strong antiseptics for dressing burns should be avoided, and the dressings should not be changed too often.

Burns from Acids.—First drench the parts with water, wash them with a solution made by dissolving washing soda in water, and then treat as for an ordinary burn.

Burns from Alkalies.—Drench the parts first with water, then wash with a solution of dilute vinegar and water, and finally treat as for an ordinary burn.

To Extinguish the Flames from Burning Clothing.—Throw the person down whose clothes are on fire, and cover him up as quickly as possible with a rug, coat, shawl, blanket or other article of covering.

SHOCK BY ELECTRICITY.

This may be produced by :—

(i,) *Natural Electricity.*—As lightning.

(ii,) *Artificial Electricity.*—As currents from telegraph, telephone, electric lighting and motor wires.

Natural Electricity.—The effects of lightning vary according to circumstances; there may be only *slight shock* with dizziness, or there may be *violent convulsions, insensibility* or immediate *death.*

Artificial Electricity.—The danger of a current of electricity is in proportion to its intensity and quantity—thus, the low tension currents of the telephone and telegraph wires would probably only produce *slight shock*, while the high tension currents (and especially the alternating ones), for lighting and motor purposes are extremely dangerous.

The current from a dynamo may be 10,000 volts, for arc lamps the current is usually 2,400 volts, and for lighting (in houses) 100 volts.

A current of 100 volts would be very dangerous; a current of from 20 to 30 volts is as much as can be comfortably borne by a strong man.

When electric wires have a current passing through them, they are termed *live wires*, and it is from these that there is

danger, as they may be exposed either by accident or for repairs.

Symptoms.—A person taking hold of naked live wires (*i.e.*, those that are not covered with an insulating material), with a current of high tension passing through them, would most likely be *violently convulsed and be unable to let go*, or there might be *insensibility* with suspended animation or even *death*. Parts of the body or clothes in contact with the wires may be scorched or burnt.

TREATMENT.—Here proceed as follows:—

(i,) Remove the sufferer from the source of danger; this must be done with the greatest care, or the person giving assistance may himself receive the shock and be rendered incapable.

"When the injured person retains his hold of the wire, it is dangerous to touch any part of him, even the parts of the body covered by clothes." A case of this kind is recorded in the *Electrical Review*—"While a man was cleaning an electric street lamp in Boston, he received a shock and was killed, his body being suspended from the wires; a man who endeavoured to remove the body came in contact with the current and was dashed to the ground with such violence that he died shortly afterwards."

Therefore, before removing the sufferer, first protect the hands whenever possible with india-rubber gloves (these are used in electrical works and may be at hand): if these cannot be procured use india-rubber tobacco pouches, or wrap a macintosh coat or a thick *dry* woollen cloth coat, or other *dry* article of clothing round the patient (damp articles of clothing are good conductors of electricity, and the sufferer's own clothes may be damp from perspiration), and then standing on an india-rubber mat or a pile of *dry clothes* pull the sufferer away from the source of danger.

(ii,) Send at once for medical assistance, but in the meanwhile place the patient in a comfortable position, loosen all tight clothing round the body, and if there is any difficulty with the breathing begin at once to perform *artificial respiration*.

Two live naked wires of which the sufferer may have hold, may be *short circuited* by dropping (not placing, as then the assistant might get the shock), an iron bar or other metallic tool across them, in this way carrying the current from one wire to the other instead of through the body of the sufferer.

REMOVAL OF FOREIGN BODIES.

1. From the Eye.—Foreign bodies may be removed from the surface of the eye as follows. If under the *upper* lid, first evert the lid by placing a bodkin or match over it, and then

gently pull the lid over; in this way the whole of the upper surface of the conjunctiva is exposed and may be very gently swept over with a camel's hair brush, or with a piece of soft linen dipped in warm water.

If under *lower* lid, the whole of the conjunctiva under the lower lid may be exposed by gently pulling the eyelid down with a finger, and the foreign body removed as described above.

2. From the Ear.—Great care should be taken in these cases not to poke any instrument into the ear, as the drum might easily be injured. The case is not one of urgency, therefore do nothing but take the patient to a doctor.

3. From the Nose.—The nose should either be blown forcibly, or gently syringed out with warm water, or the patient may be made to sniff pepper and sneeze.

CHAPTER XVIII.

THE TRANSPORT OF SICK AND INJURED.

The Position of Sick or Injured during Transport—Means adopted for the removal of the Sick and Injured—Removal by Hand, *i.e.*, by Single Bearers—On Hand Seats—On Improvised Seats and in a Horizontal Position. Removal on Stretchers—The Regulation Field Stretcher—Preservation of Stretchers—to Open (prepare) and Close a Stretcher—Various methods of Improvising Stretchers—The "Lowmoor" Jacket—Loading and unloading Stretchers with four, three and two Bearers—The Position of the patient on the Stretcher—Rules for the carriage of Stretchers. Removal on Wheeled Litters—Removal in Cacolets—Removal in Ambulance or Ordinary Wagons—Ambulance Wagons (The "Furley," The "Tortoise," The British Army)—To load and unload an Ambulance or an ordinary Wagon with Patients on Stretchers—To load and unload a Wagon with a Patient if no Stretcher is available—Removal by Railway. Zavodovski's method of adapting a Railway Wagon for the reception of Sick and Injured.

The Position of Sick or Injured Persons during Transport.—Patients may be removed in any of the following positions:—

1.—*The Sitting Position.*—This is to be adopted for patients who are slightly injured in the upper part of the body, and are without constitutional symptoms.

2.—*The Semi-Recumbent Position.*—This is to be adopted for those who are injured about the region of the chest, and are suffering more or less from shortness of breathing.

3.—*The Recumbent Position.*—This is to be adopted in all cases where persons have been dangerously injured about the head, chest or abdomen, also in fractures of the long bones, injuries to joints of the lower extremity, and in cases of faintness, shock and excessive hæmorrhage.

Note.—Before a patient is removed, the necessary "First Aid" treatment should always be rendered, and the clothes about the chest should be loosened.

The Means adopted for the transport of sick and injured are as follows:—

(I,) Removal by Hand.
(II,) Removal on Stretchers.
(III,) Removal on Wheeled Litters.
(IV,) Removal in Cacolets.
(V,) Removal in Ambulance or Ordinary Wagons.
(VI,) Removal by Railway.

I.—REMOVAL BY HAND.

This may be effected by—

(i,) The help of a single bearer.
(ii,) The help of two bearers.

(i,) **Removal by the Help of a Single Bearer.**—Patients suffering from injuries to the head, neck, or upper part of the trunk, or in a state of unconsciousness, may be removed in several ways by single bearers, but the following four methods are the most useful:—

(*a*,) *In an Upright Position*, thus: the bearer places his shoulder under the injured man's axilla on the sound side, the patient passes his arm behind the back of the bearer's neck and over the distant shoulder, the bearer then grasps the wrist of the patient's arm which is over his shoulder, with the hand of that side and with his other arm he encircles firmly the patient's waist (Fig. 138). The bearer is in this way able to entirely support the patient should he become faint.

Fig. 138.—Method of removing a Patient in an Upright Position.

Fig. 139.—Method of removing a Patient in the Arms.

(*b*,) *In the Arms like a Child*, thus: The bearer lifts the patient by placing one arm round the patient's waist and the other arm under the patient's knees, the patient being in a sitting position and assisting by placing one or both arms round the bearer's neck (Fig. 139). This method is suitable where the patient is light and the distance is short.

(*c*,) *Pick-a-Back*, or *En Cheval*, thus: The patient places himself on the bearer's back with his arms over the bearer's shoulders; the bearer gets both his arms well under the patient's knees and grasps with one hand the patient's wrist on the

Fig. 140.—Method of Carrying a Patient Pick-a-Back.

opposite side, thus preventing the patient from slipping off (Fig. 140). In this way a bearer can carry a patient of his own or greater weight a considerable distance.

(*d*,) *The "Fireman's Lift."* In order to lift by this method proceed as follows:—

Fig. 141.—First Position, The "Fireman's Lift."

Kneeling down on both knees, first turn the patient face downwards, straighten his arms down by his sides (Fig. 141),

and take hold close up under each armpit; then raise the body as high as it can be lifted in that position, and allow it to rest on one of the knees (141*a*) ; then shift the arms round the waist,

Fig. 141*a*.—Second Position.

and after interlocking the fingers lift the person to an upright position (Fig. 141*b*) ; after this, take hold of the patient's right wrist with the left hand, bring his right arm round your neck, place your head beneath his body and drop into a stooping position, at the same time pass your right arm between or around the patient's legs, and bring his weight well on to the centre of the back (Fig. 141*c*), then

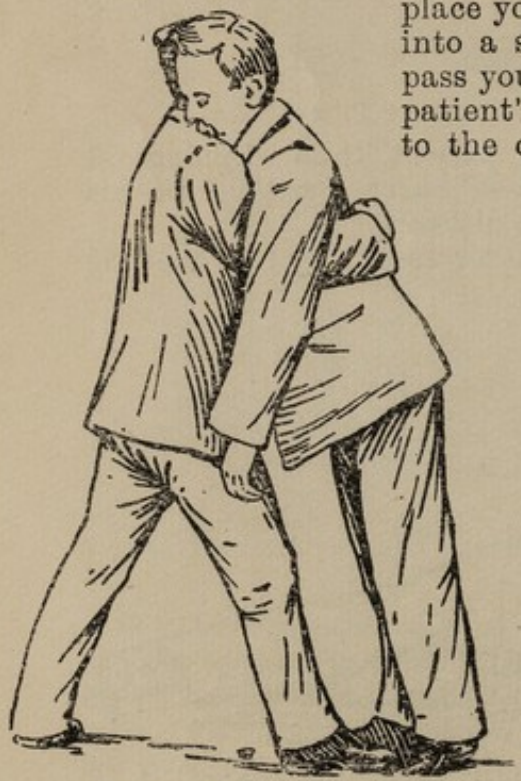


Fig. 141*b*.—Third Position.

Fig. 141*c* —Fourth Position

grasp the patient's right wrist with your right hand, and balancing the body on the shoulders rise to the erect position (Fig. 141*d*).

A woman would be carried as depicted in Fig. 141*e*, with the bearer's right arm round both the legs.

This method is applicable to a person who is in a state of unconsciousness, but in whom the extremities are uninjured.

Fig. 141*d*.—Fifth Position (Male).

Fig. 141*e*.—Fifth Position (Female).

Figs. 141, 141*a*, 141*b*, 141*c*, 141*d*, 141*e*. THE "FIREMAN'S LIFT."

(ii,) Removal by the help of Two Bearers.—Two bearers can remove a patient by—

(*a*,) Hand seats.

(*b*,) Improvised seats.

(*c*,) In a horizontal position.

(*a*,) **The Hand Seats.**—These are as follows:—

The Two-handed Seat.—This seat (Fig. 142) is suitable for patients who are more or less helpless and have to be lifted from the ground.

MODE OF PROCEDURE.—The bearers take up their position on the right and left of the patient, they face inwards and kneel down on the knee nearest his feet. Then placing their hands beneath the patient's armpits, they raise him into a half-sitting position, and rest him against their other knees. Now

passing their arms in front beneath the patient's thighs, and locking the fingers with the palms uppermost, they form the seat, and rising steadily together, lift the patient from the

Fig. 142.—The Two-handed Seat.

Fig. 142*a*.—The Patient lifted by means of the Two-handed Seat.

Figs. 142, 142*a*.—The Two-Handed Seat.

ground, and at the same time they place their disengaged hands on each other's hips to afford a support for the patient's back, who, if he be able, will be instructed to pass one arm round the neck of each bearer (Fig. 142*a*).

The disadvantages of the Two-handed seat are :—

It is very trying to bearers and cannot be endured for any long distance.

The entire weight of the patient is thrown on the two arms, and chiefly on the interlaced fingers ; consequently, only a limited number of muscles are brought into action to meet the strain.

The Three-handed Seat.—This seat is suitable for patients who can support themselves, more or less, while they are being lifted. It is unsuitable for patients in a fainting condition, as

they are carried in a too elevated position and might tumble forwards.

It is, however, firmer than the two-handed seat, and as the bearers can turn more to the front, they can march better with it than they can with either the two or the four-handed seat.

Mode of Procedure.—The bearers place themselves on the right and left of the patient and turn inwards. The bearer on the right grasps his own left forearm with his right hand, and with his left hand he grasps the left forearm of the bearer on the left. The latter grasps with his left hand the right forearm of the bearer on the right and places his right or disengaged hand on the left shoulder of the right bearer (Fig. 143). The

Fig. 143.—The Three-handed Seat.

Fig. 143*a*.—The Patient lifted by means of the Three handed Seat.

Figs. 143, 143*a*.—The Three-handed Seat.

two bearers then stoop down and place the seat thus formed beneath the patient's hips and lift him, the patient at the same time helping to support himself by clasping each bearer round the neck (Fig. 143*a*).

The Four-handed Seat.—This seat (Fig. 144) is suitable for patients who are well able to support themselves by placing their arms over the shoulders of the bearers.

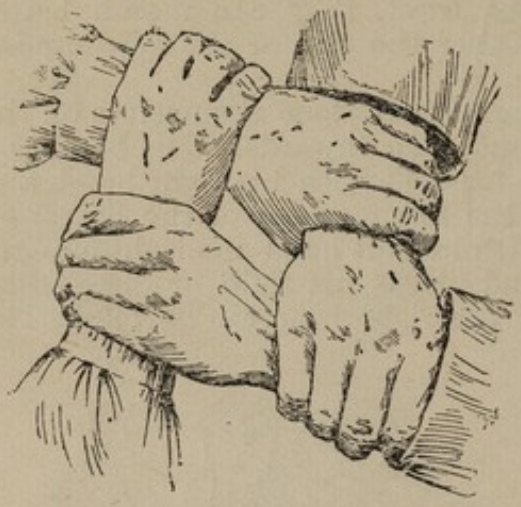


Fig. 144.—To show the Position of the Hands in the Four-handed Seat.

The seat is an easy and secure one for the person who is carried, and as the ordinary muscles of the arms are used the weight is well borne by the bearers.

Mode of Procedure.—The bearers, after taking up their position on each side of the patient, turn inwards, grasp their own left wrists with their right hands, and each other's wrists with their left hands (Fig. 144*a*), stoop down, pass the seat thus formed beneath the hips of the patient, who having placed himself well on it, passes his arms round the shoulders of the bearers as they rise up to the erect position (Fig. 144*b*).

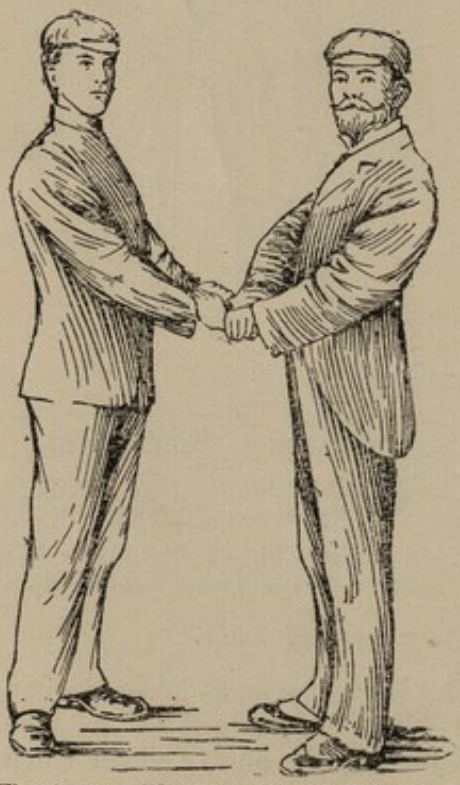


Fig. 144*a*.—The Four-handed Seat.

Fig. 144*b*.—The Patient lifted by means of the Four-handed Seat.

Figs. 144, 144*a*, 144*b*.—The Four-Handed Seat.

Note.—To increase the ease of carrying by the hand-seats, the bearers should, when marching together, press strongly inwards.

In marching with patients on hand-seats, the bearer on the right of the patient steps off with the right foot and the bearer on the left with the left.

(*b*,) **Improvised Seats.**—These can be constructed out of canvas, straps, a conveniently shaped board, a roller towel, etc., and on them patients can be carried in a comfortable sitting position with less fatigue to the bearers than is experienced with the hand-seats.

(*c*,) **In a Horizontal Position.**—This may be effected either by the method termed the "fore and aft carry," thus:—

No. 1 bearer places himself at the head of the patient, stoops down, passes his arms under the patient's armpits and clasps his hands in front of the patient's chest; No. 2 bearer places himself in front of and between the patient's feet with his back to the patient, stoops down and grasps the patient's legs behind the knees. Both bearers then rise together (Fig. 145).

Fig. 145.—Method of Removing a Patient by the "Fore and Aft Carry."

In some cases it may be better for No. 2 bearer to have both the patient's legs under his arm at one side (this would be adopted in carrying a woman), or thus:—

Both bearers place themselves on the same side of the patient —No. 1 opposite his shoulders; No. 2 opposite his hips—and kneel down. No. 1 bearer now passes his hands under the shoulders and back of the patient, No. 2 bearer passes his hands, wide apart, under the thighs and calves of the patient; the two bearers then rise steadily together. The patient, if he is able, clasps with his two hands the shoulders of No. 1 bearer.

Note.—Patients should never be carried by what is termed the "frog's march."

II.—REMOVAL ON STRETCHERS.

A Stretcher may be described as a piece of canvas stretched within a specially constructed oblong frame, forming a firm support on which a patient can be carried in a horizontal position.

Various forms of these appliances are in use, these forms depending upon the requirements for which the stretchers are needed, whether military or civil. But the principle of construction is the same in all and can be best explained by a detailed description of

The Army Regulation Field Stretcher Mark V.—This stretcher (Fig. 146, 146*a*), which was designed by Surgeon-Major Faris, consists of—Two poles, two traverses, the canvas,

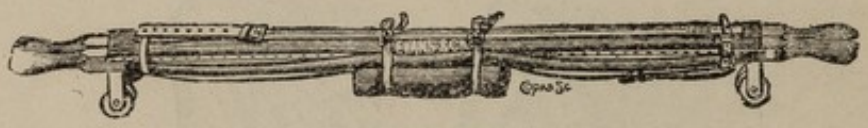


Fig. 146.—The Field Stretcher (closed).

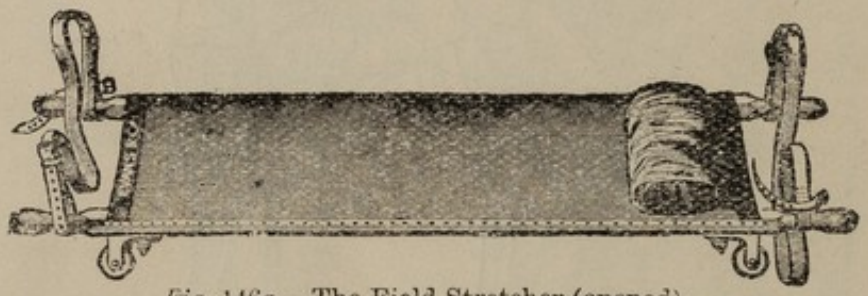


Fig. 146*a*.—The Field Stretcher (opened).

Figs. 146, 146*a*.—The Faris Field Stretcher Mark V.

a separate canvas pillow, feet with rollers, and a pair of slings, all of which fold up into a convenient package for the purposes of carriage.

The Poles are made of strong seasoned ash. They are 7ft. 9ins. long, and are square throughout their whole length except the handles, which are rounded to fit the hands of the bearers. The poles are held apart to the required width by the two traverses.

The Traverses are flat wrought iron jointed bars, and are fastened to two strong plates of the same material, which are rivetted to the under surface of the poles twelve inches from their extremities. These traverse plates are fitted with rackets each carrying a 3-inch wooden roller, by means of which the stretcher is raised from the ground. Each traverse joint, which is of the scissor variety, closes inwards and allows the poles to approximate each other.

The Canvas, which is tanned, is attached along the outer side of each pole by copper nails through an edging of leather; there are eyelet holes in the canvas at both ends for the attachment of the pillow.

The Pillow is also made of tanned canvas. It is wedge-shaped and is attached to the canvas by two laces or strings which pass through the eyelet holes and are fastened underneath.

The Feet or Rollers are made of boxwood, and are fixed to the rackets on the under surface of the poles. They are large, raising the stretcher about 5⅞ inches from the ground.

The Slings are either strong leather straps or strips of tanned web, sixty inches long and two inches wide, with a loop at each end; one loop is furnished with a buckle by means of which the sling can be lengthened or shortened according to the height of the bearers, and at the opposite end there is a narrow transverse strap, twenty-one inches long, fixed at right angles, this is used to buckle round the stretcher when closed.

The *dimensions* and *weight* of the stretcher are as follows:—

Length of Canvas	6 ft.
Length of Pole	7 ft. 9 ins.
Width, total	1 ft. 11 ins.
Height	5⅞ ins.
Weight	34 lbs.

Preservation of Stretchers.—Stretchers, if neglected, become stiff, and get out of order. Therefore, they should be kept in a dry store, leaning at an angle against the wall. They should be opened and dried from time to time; if the canvas becomes dirty it should be scrubbed with a little soap and plenty of water. The woodwork should be polished with oil waste, and the hinges oiled. If the slings are made of leather, soft soap should be worked into them to make them pliable.

Stretchers should never be folded up with the slings lying loosely upon them.

To Prepare (Open) a Stretcher, proceed as follows:— Unbuckle the transverse straps of each sling, remove the slings, separate the poles, straighten the traverses; now take the slings, fold them neatly half way, slip the loop of each sling on to the near handle of the stretcher and pass the free end over the opposite handle with the buckle of the sling uppermost.

To Close a Stretcher.—Remove the slings and place them on the ground, push in the traverses, raise the canvas, approximate the poles, roll the canvas tightly round the poles to the right, lay the slings along the stretcher, and fix them to the handles by the transverse straps.

Improvised Stretchers.—For extemporising stretchers the best methods are those by which a stretcher can be easily and efficiently constructed at the time and on the spot. The following are some of the methods of improvising stretchers —

(*a*,) *The Rifle Stretcher.*—This is formed by two rifles with fixed bayonets, and a rug. — "Spread a blanket on the ground, lay two rifles on it parallel to one another, each ten inches from the centre of the blanket, both muzzles pointing in the same direction, trigger-guard outwards. Turn a fold of the rug six inches wide over the ends of the butts, fold the right side of the rug over the rifle on that side to the rifle on the opposite side, then similarly fold the left side. A stretcher is thus formed consisting of three folds of blanket, the end at which the butts are being the head end."

Caution.—Before using the rifles inspect them; should they be loaded withdraw the cartridges and empty the magazines.

(*b*,) *The Blanket Stretcher.*— This is made with a rug or blanket placed on two poles of sufficient length and thickness, and the sides rolled on and tied, with two pieces of wood attached to them to keep the sides from approximating one another.

(*c*,) *The Coat Stretcher.*—This is made thus:—Two coats are procured, and after the sleeves have been turned inside out, the coats are then placed with their lower ends touching each other, a rifle or pole is now passed through the sleeves on each side, the coats are then buttoned up, and the buttoned side turned downwards. Instead of two ordinary coats a great coat may be used.

(*d*,) *The Rug and Pole Stretcher.*—This is made by placing two poles along the edges of a rug longitudinally, and rolling the sides of the rug over the poles until they are twenty inches apart.

(*e*,) *The Pole and Rope Stretcher* is made by taking two poles, placing them twenty inches apart, and then winding a long strong rope alternately from side to side round each pole; this rope forms the body of the stretcher.

Note.—An improvised stretcher should always be tested before placing a patient on it.

The Rifle, the Blanket, and the Rug and Pole stretchers can be carried in the same manner as is laid down for carrying stretchers when loading wagons (page 209).

The Lowmoor Jacket.—An ordinary stretcher cannot be used in pits with narrow shafts. This difficulty can be obviated by

using the "Lowmoor Jacket," by means of which the patient can be securely fastened to any stretcher, and the stretcher drawn up *perpendicularly*. The construction of the jacket is sufficiently explained by the illustration (Fig. 147).

Fig. 147.—The "Lowmoor Jacket."

Loading and Unloading Stretchers.

Stretchers may be loaded and unloaded by means of four, three, or two bearers.

To Load and Unload with Four Bearers.—The method laid down in the Manual for the Royal Army Corps, 1899, is as follows:—

The bearers are numbered 1, 2, 3 and 4.

All the orders are given by No. 4 bearer, who also looks after the injured part.

The closed stretcher is carried by Nos. 1 and 3 bearers, who take hold of the front and rear ends of the poles, while Nos. 2 and 4 bearers march on the left and right of the centre of the stretcher (No. 2 bearer being between No. 1 and No. 3).

When No. 1 bearer arrives one pace from the patient's head the squad halts and lowers the stretcher, placing it in a line with the patient's body, the stretcher is then prepared by Nos. 1 and 3.

To Load:—

On the word *For Loading—Lift Wounded*, "Nos. 1, 2 and 3 advance to the left side of the patient, No. 4 to his right, No. 1 halting opposite the knees, Nos. 2 and 4 opposite the hips and No. 3 opposite the shoulders (Fig. 148), the whole then turn inwards together."

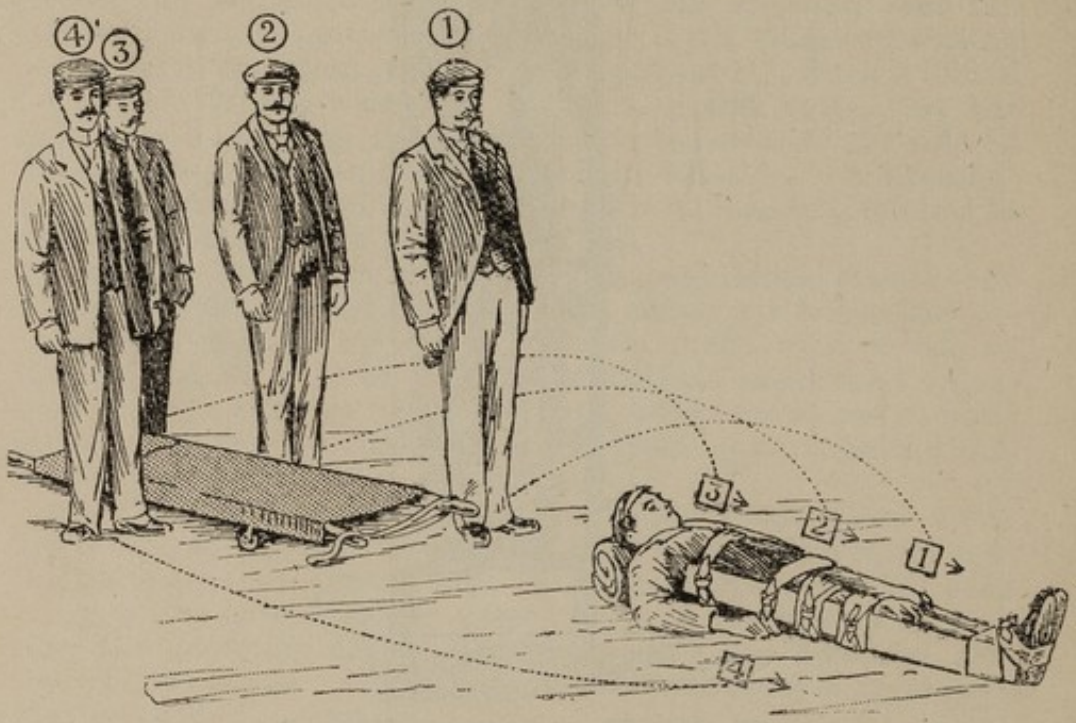


Fig. 148.—"For Loading—Lift Wounded."

On the word *Two*, "They kneel on the left knee and take hold of the patient; No. 1 passing his hands and forearms beneath the patient's legs (hands wide apart), Nos. 2 and 4 pass their hands and forearms beneath the patient's hips and loins, No. 3 passes his left hand across the patient and under his right shoulder, and the right hand beneath the left shoulder of the patient."

On the word *Three*, "All slowly lift the patient off the ground and rest him on the knees of 1, 2 and 3 (Fig. 148*a*); No. 4 disengages, doubles to the centre of the stretcher, grasps a pole in each hand (left hand across), lifts the stretcher and places it directly beneath the patient (Fig. 148*b*), kneels on the left knee and again assists in supporting the patient."

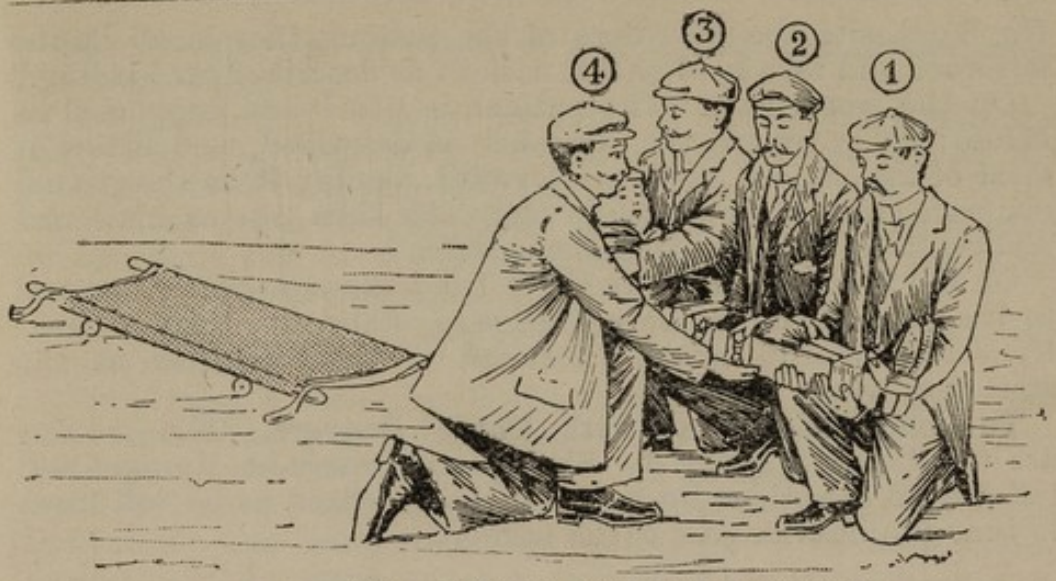


Fig. 148*a*.—"Three" (Patient lifted off the ground).

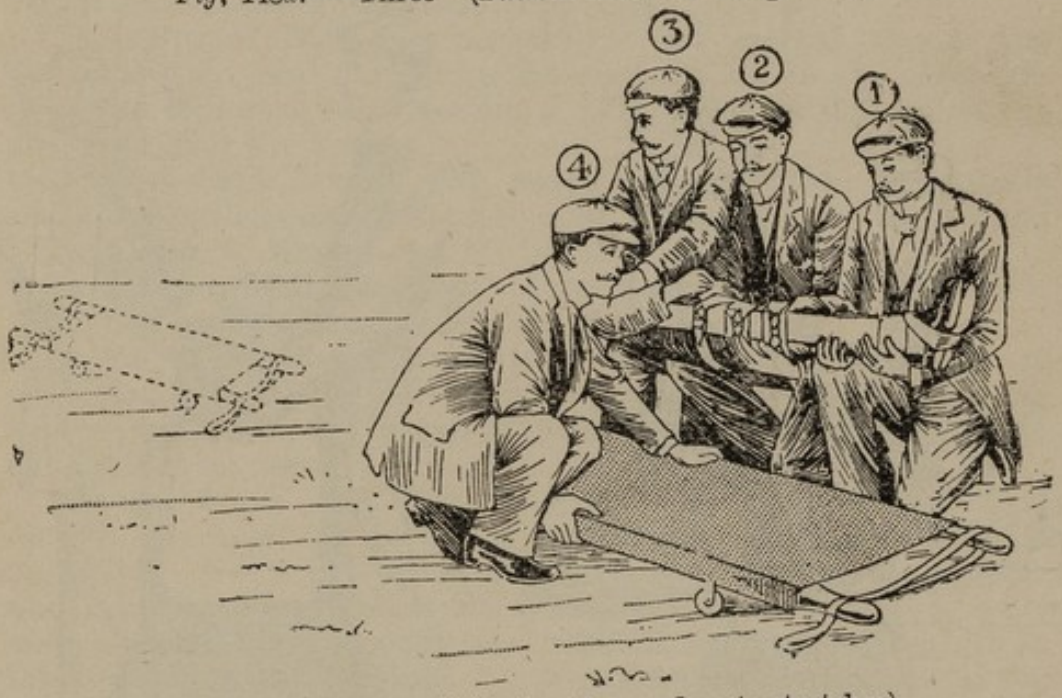


Fig. 148*b*.—"Three" (Patient lowered on to stretcher).

Figs. 148, 148*a*, 148*b*.—To Illustrate the Method of Loading a Stretcher with Four Bearers.

On the word *Lower Wounded*, "The patient is lowered slowly and gently on to the centre of the canvas, the bearers disengage, stand up and front, No. 1 stepping forward and No. 3 stepping back to place themselves opposite the handles of the stretcher."

To Unload:—

On the word *For Unloading—Lift Wounded*, "The whole turn inwards together; No. 1 placing himself opposite the knees and

No. 3 opposite the shoulders of the patient, they kneel on the left knee and take hold of the patient as described for loading."

On the word *Two*, "The patient is lifted and supported as before; No. 4 grasps the stretcher as described, and lifting it clear of the patient carries it forward, placing it on the ground one pace clear of the patient's feet. He then rejoins his squad and resumes the support of the patient."

On the word *Lower Wounded*, "The patient is gently lowered to the ground, the bearers disengage, stand up, turn to their front and march straight forward to their position at the stretcher, where they halt."

To Load and Unload with Three Bearers.—The bearers are numbered 1, 2 and 3. Should one bearer be stronger and taller than the others he is styled No. 1 bearer, as he will have to bear the heavier part of the burden.

Fig. 149.—Lifting the Patient off the Ground.

Fig. 149*a*.—Carrying the Patient to lower him on to the Stretcher.

Figs. 149, 149*a*.—To Illustrate the Method of Loading a Stretcher with Three Bearers.

All orders are to be given by No. 3, who has to look after the injured part.

The stretcher is carried by Nos. 1 and 2 (who take the front and rear respectively of the stretcher), placed at the patient's head in a line with his body, and prepared. To lift the patient either on to or off the stretcher, No. 1 places himself on the right side of the patient, No. 2 on the left side near the hips, and both face inwards.

No. 3 bearer places himself on the injured side opposite the patient's knees.

Nos. 1 and 2 then sink down on their left knees, pass their arms under the back and thighs of the patient, and, locking the fingers, raise and support the trunk on their knees.

No. 3 bearer kneels down on the left knee, places his hands underneath the lower limbs, in the case of a fracture taking care to have one hand on each side of the seat of the injury, raises and supports the limbs (Fig. 149).

On the word *Lift*, The bearers lift the patient, rise to the erect position, and carry him horizontally on to the stretcher over the foot of it, head foremost (Fig. 149*a*), or if from off the stretcher over the head.

On the word *Lower*, The bearers stoop down and gently place the patient on the stretcher (in loading), or on the ground (in unloading), disengage their hands and stand up.

To Load and Unload with Two Bearers.—The stretcher is placed as above and all orders are given by No. 1.

If one of the lower limbs is severely injured, or there are symptoms of shock, both bearers place themselves on the injured side, No. 1 in line with the patient's hips, No. 2 opposite the patient's knees.

On the words *Lift and move forward*, The bearers stoop down. No. 1 passes his hands beneath the patient's shoulders and back. No. 2 passes his hands beneath the patient's thighs and calves. The bearers then raise the patient (who, if he is able, passes his arms round the neck of No. 1), keeping him as far as possible in a horizontal position, and carry him on to the stretcher over the foot, head first, or off the stretcher over the head, head first.

If the lower limbs are intact or only slightly injured, and there are no symptoms of shock, the patient may be lifted on to or off the stretcher by one of the improvised seats.

In *mines* and *narrow cuttings*, two bearers can lift a patient on to a stretcher according to the method laid down in *Shepherd's Handbook*:—

"No. 1 places his feet on each side of the patient between his body and arms, the toe of each foot as near the armpits as possible, standing over the man. He then stoops down, and

passes his hands between the sides of the chest and the arms underneath the shoulders and locks the fingers."

"If the patient's arms be uninjured he may put them round the neck of No. 1, and by this means greatly assist him in lifting."

"No. 2 at the same time places his right foot between the calves of the injured man's leg as close to the knees as possible, and his left foot at the injured man's right side close to the crest of the hip (when the patient's legs are in splints and tied together the feet of No. 2 must necessarily be placed outside), he then stoops and passes his arms round the outside of the patient's thighs at the lowest part, and locks his fingers behind just at the bend of the knees."

"When both are ready No. 1 will give the order *Lift and move forward*; the patient is then slowly lifted just sufficent to allow his body to clear the stretcher. Both bearers will slowly and gradually move forward, No. 1 by very short steps and No. 2 by bending his body forward over his left thigh, by means of which he exercises a pushing movement which very greatly assists No. 1; No. 2, when he has bent his body as much as he can without moving his feet, advances his right foot to his left, then again advances his left foot and bends his body forward. This movement is to be repeated until the patient is laid on the stretcher."

The Position of the Patient on the Stretcher.—Before placing a patient on a stretcher, notice the *part injured* and the *nature of the injury*. In all cases (except injuries of the chest), keep the head low, and see that it is not pressed forward on to the chest.

(*a*,) *For Injuries of the Head.*—Place the patient in such a position as to avoid any pressure against the injured part.

(*b*,) *For Injuries of the Lower Limbs.*—Place the patient upon his back, inclining towards the injured side.

(*c*,) *For Injuries of the Upper Limbs.*—Place the patient on his back or on the uninjured side.

(*d*,) *For Injuries of the Chest.*—Place the patient with his chest well raised, and his body inclined towards the injured side.

(*e*,) *For Injuries (Wounds) of the Abdomen.*—(i,) If the wound is *transverse* or punctured, place the patient on his back, place some folded clothing in his hams to keep his knees bent, and flex the thighs so as to relax the abdominal muscles. (ii,) If the wound is *vertical* place the patient on his back and extend his legs.

The Carriage of Stretchers.—Two main objects are to be kept in view in carrying patients on stretchers, *viz.* :—

(i,) To prevent as much as possible the impulse connected with the progression of the bearers being communicated to the stretcher.

(ii,) To keep the stretcher level and as near the ground as is consistent with free carriage and the absence of risk of contact.

Rules for the Carriage of Stretchers (Longmore).

(1,) "The front and rear bearers must 'break' the step by starting with opposite feet. By this means the stretcher is kept level and does not 'dip' so much from side to side."

(2,) "The pace should be eighteen inches, and made with a steady but easy step, particularly avoiding elevation of the bodies by springing from the fore-part of the feet. The feet should be firmly planted and the knees slightly bent."

(3,) "The slings should be lengthened or shortened by the buckle till the extremities of the loops reach the wrists of the bearers standing at attention."

(4,) "The bearers should, as far as possible, be of a uniform height, build and age."

(5,) "As most ground over which bearers have to carry wounded presents irregularities of surface, it becomes an important matter for bearers to practise the transport of wounded under such circumstances, and to keep the stretcher level. The concerted action of the bearers is the principle upon which this rule is based."

(6,) "A sick or wounded person should as a rule be carried with his face in the direction in which the bearers walk."

(7,) "If the bearers have to carry a sick or wounded man uphill, the patient is taken head first, and the reverse takes place going downhill."

(8,) "With fractures of the lower extremity, as a rule the patient should be carried uphill, feet first, and downhill head first, in order to prevent the weight of the body pushing the upper end of the broken bone down upon the helpless and motionless portion of the limb below the seat of fracture."

(9,) "No attempt should ever be made to carry a helpless patient over a high fence or wall if it can possibly be avoided, as such is always a dangerous proceeding. A portion of the wall should be thrown down, or a breach in the fence made, so that the patient may be carried through on the stretcher, or if this is not practicable, the patient should be carried to a place where a gate or opening already exists."

(10,) "In crossing a ditch or stream the stretcher should be first laid upon the ground near its edge. The two leading bearers descend into the ditch, and, assisted by the other bearers, advance the stretcher until the rear end rests on the ground above; the two other bearers descend, and all four raise the stretcher and carry it to the opposite side, the fore-part being now made to rest upon the edge of the ground, while the rear part is supported in the ditch, the two leading bearers jump out of the ditch, and with the remaining bearers

carry the stretcher until the rear end rests upon the ground; the bearers then resume the carriage of the stretcher. In crossing a narrow ditch, the bearers on either side jump in and steady the stretcher so as to allow the head bearer to cross without shaking the patient."

(11,) "Patients should never be carried with the stretcher supported upon the shoulders, or like a dandy supported upon the head. It is a most dangerous and hazardous position."

(12,) "Each of the four bearers to every stretcher must understand his particular duty intelligently. The front and rear bearers attend to the carrying of the stretcher, and the two remaining ones march on each side of the stretcher, carefully watch the patient and assist and change with those responsible for the carriage as occasion may require."

(13) "If a stretcher has to be carried over ground which presents a general ascent and the bearers are of different heights, No. 3 bearer should be the taller. Should the ground present a general descent, then No. 1 bearer ought to be the taller and stronger."

III.—REMOVAL ON WHEELED LITTERS.

A **Wheeled Litter** is practically a stretcher on wheels.

A useful form of litter is the *Ashford Litter* (Fig, 150) used by the St. John Ambulance Association.

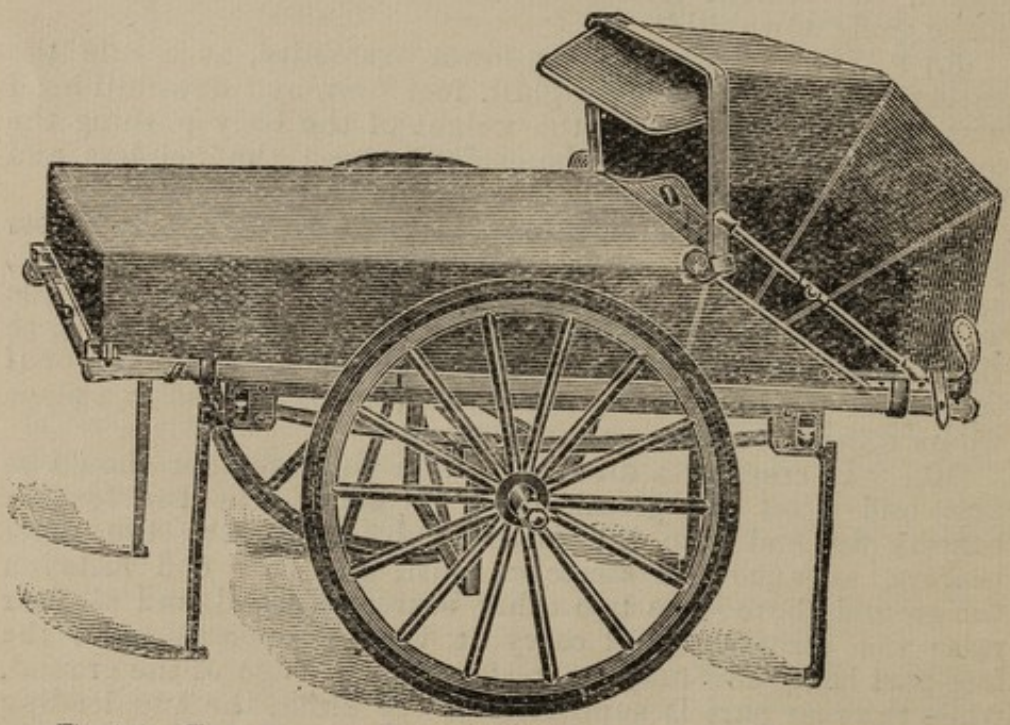


Fig. 150.—The Ashford Litter (for Stretcher with Hood and Apron).

"It consists of a stretcher fitted with a hood or cover and an under carriage with a crank axle in the centre; the parts of the under carriage on which the stretcher rests are the two wooden sides. At either end of these are strong iron legs, which are so formed that they can be used as supports for the litter or as handles for the bearers, when required for lifting the litter. Each of the four legs is provided with a locking apparatus, consisting of two small holes and a pin, one hole for use when the legs are on the ground, and the other for use when they are raised. In either position security is obtained by means of the pin which passes through the hole in the hinge or ratchet in which the leg is placed. When the stretcher is adjusted on the under carriage, the rollers must be inserted into the slots at the end. By this method, and the weight of the patient, jolting in the stretcher is prevented"

IV.—REMOVAL IN CACOLETS.

This method of transport is used in hilly country where no suitable roads for carts or wagons exist.

Cacolets are practically folding chairs which are carried by pack-animals (mules), suspended from a pack-saddle.

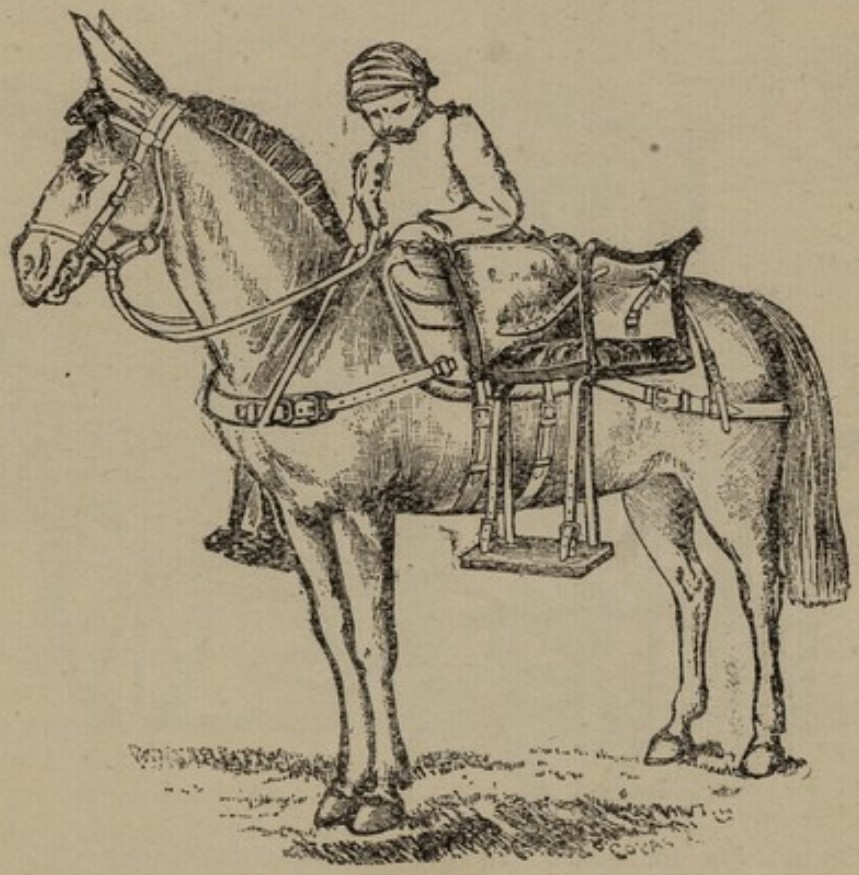


Fig. 151.—Mule Cacolets.

A cacolet consists of the following parts: "A seat or cushion, two hanging bars terminating in hooks, by which the cacolet is attached to the pack-saddle, a foot board and slings, two uprights, a side rail, and front and waist straps."

A mule carries a pair of cacolets, the patients sitting facing the animal's head (Fig. 151).

"When not in use, the pair of cacolets is closed by being folded against the saddle, to which they are then secured by a surcingle."

Note.—Cacolets are not suitable for patients in a weak condition, or those suffering from fractures of the lower extremity.

Loading and Unloading Cacolets.—Patients are placed in or removed from cacolets by means of the two-handed seat.

V.—REMOVAL BY WAGONS (AMBULANCE OR ORDINARY).

1. Ambulance Wagons.—There are several kinds of specially constructed ambulance wagons; the points which chiefly determine the choice of any one wagon, are the state of the roads over which it has to travel, and the number of patients it is required to accommodate. The following may be taken as types of wagons.

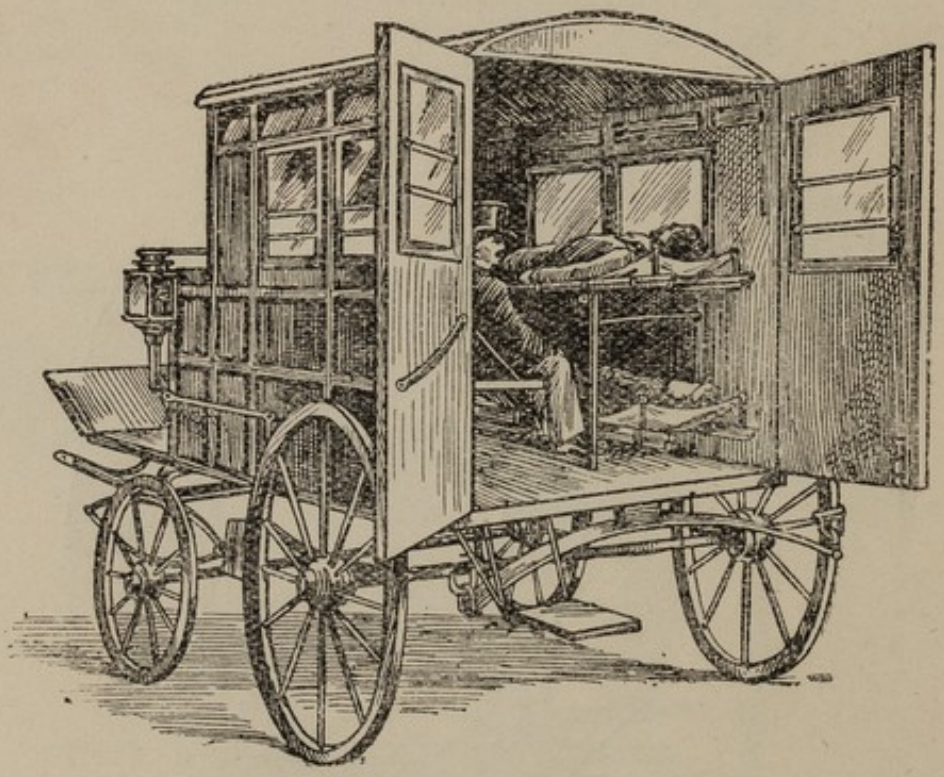


Fig. 152.—The "Furley" Ambulance Wagon.
(For Three Stretchers, showing Patent Elevator.)

(*a*,) *The "Furley" Ambulance Wagon* (Fig. 152), used by the St. John Ambulance Association. This is built something after the style of a railway omnibus; it will accommodate two patients on stretchers and four persons seated inside, or it will carry three patients on stretchers and one attendant; there is also space for two persons to be seated with the driver. The upper stretcher is placed in position by an elevator. On good and level roads one horse is quite sufficient for the wagon.

(*b*,) *The "Tortoise" Wagon and Tent* (Fig. 153).—This wagon is an exceedingly useful one, it carries on its roof the "Tortoise" tent and inside twelve stretcher beds and a cooking stove; it has also water tanks and lockers.

It can be drawn by two horses and will carry when empty (that is, when the stove is slung under the wagon, which can be done with the "Congo" Service Stove), either two patients on stretchers, or one patient on a stretcher and three sitting. At the end of a march the "Tortoise" tent can be very quickly pitched, it is 20 feet square, 9 feet high at the ridge and 6 feet at the doors, well ventilated, and will hold twelve stretcher beds comfortably.

Fig. 153.
THE "TORTOISE" WAGON WITH THE TENT ON THE ROOF.

If the tent is only required for the night the wagon can be left inside of it, if for a longer time the wagon can be withdrawn, and poles substituted (Fig. 154); the wagon can then be used for ambulance purposes, etc.

(*c*,) *The British Army Ambulance Wagons.*—These are strong wagons suitable for rough ground, the two latest patterns in use are:—

(i,) Mark III. Ambulance Wagon.—This is designed to be drawn by two horses and appliances are provided for attaching an extra pair. It can be driven either from the box or the saddle, and is constructed to carry six patients—two slightly wounded sitting in front with the driver, two badly wounded lying on stretchers on the floor of the wagon, and two slightly wounded seated behind with the wagon orderly; the front seat is reached by a ladder and the hind seat by a step attached to the tailboard; a water tank is carried under the body.

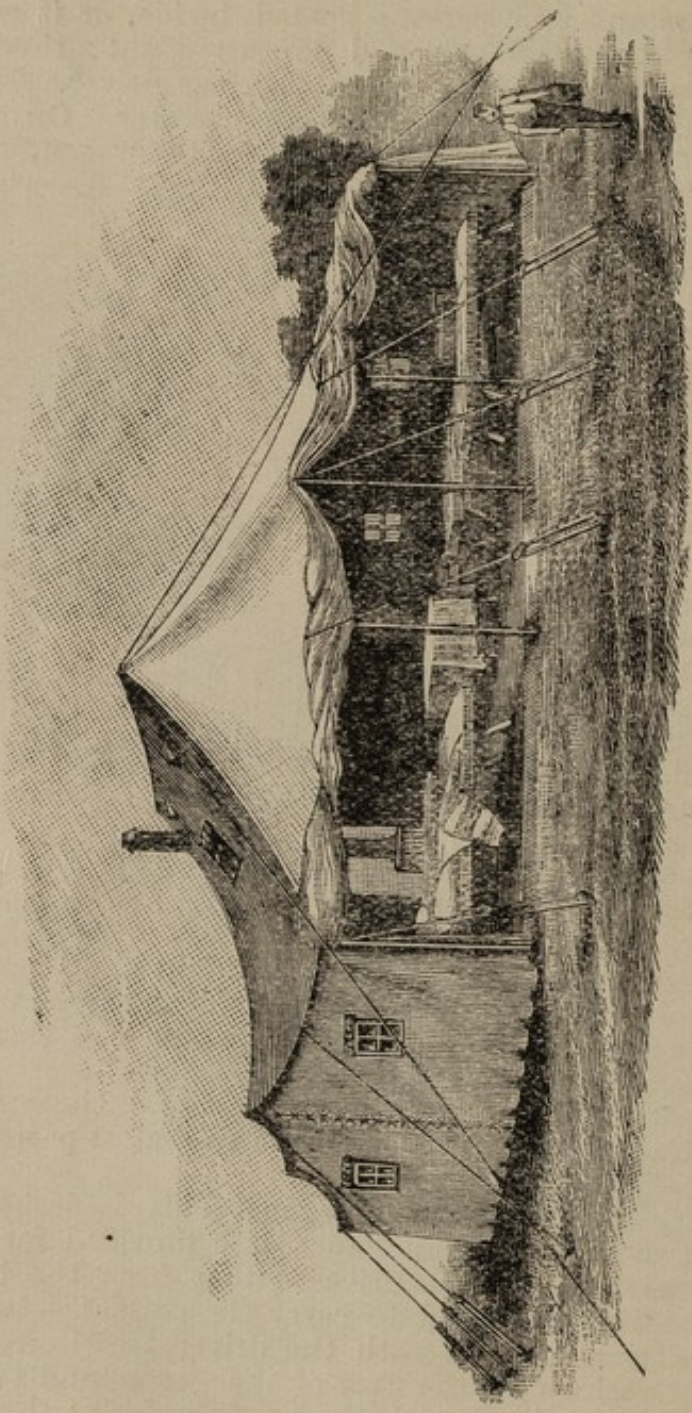


Fig. 154.—The "Tortoise" Tent fitched with twelve Stretcher Beds inside, and Wagon removed.

(ii) Mark V. Ambulance Wagon.—This is fitted with a pole and swingle-trees for long-rein driving, and is constructed to carry twelve men seated, or two men on stretchers and four seated.

The front of the wagon is partitioned off, and is provided with seats to accommodate two men; the body of the wagon is fitted with seats along the sides, arranged to fold upwards when not in use, to make room for the stretchers; a water cask is secured under the rear of the wagon.

2. Ordinary Wagons.—When it is necessary to use ordinary wagons or country carts for ambulance purposes, the floors on which the stretchers are to be placed should be thickly covered with straw.

Loading and Unloading an Ambulance Wagon with Patients on Stretchers.—An ambulance wagon of the kind described above will hold on its floor two stretchers placed side by side.

To Load with Four Bearers.—The method laid down in the Manual for the Royal Army Medical Corps, 1899, is as follows:—

The two loaded stretchers are carried (feet first) by Nos. 1 and 3 bearers (No. 2 bearer marching on the left of the stretcher midway between Nos. 1 and 3 bearers, and No. 4 bearer marching on the right of the stretcher in a line with No. 2 bearer) to the wagon; when the squad is ten paces from the wagon No. 2 bearer doubles out with the patient's rifle and secures it in its place in the wagon, and rejoins the squad, placing himself on the right of No. 1 bearer; as No. 2 bearer doubles out, No. 4 bearer marks time two paces, and places himself on the right of No. 3 bearer; when the squads arrive one stretcher's length from the tailboard of the wagon, they halt and lower the stretchers (the stretcher on the right being placed directly in a line with the off wheels, and the stretcher on the left directly in a line with the near wheels); Nos. 1 and 3 bearers step over the handles and place themselves on the left of the stretchers, the slings of the stretchers are next "fixed" by Nos. 1 and 3 bearers by being wound round the handles of the stretcher poles.

The wagon is then loaded first with the stretcher on the off side, thus:—

On the word *For Loading—Lift Stretchers*, "All turn inwards together, stoop, and grasp the stretcher poles, Nos. 1 and 4 the handles with their left hands and the centre of the poles with their right: Nos. 2 and 3 the handles with their right hands and the centre with their left, palms uppermost."

On the word *Two*, "The bearers acting together slowly lift the stretcher off the ground and stand up, holding it at the full extent of their arms."

On the word *Load*, "Nos. 2 and 4 step off with the left foot, and Nos. 1 and 3 with the right, halting without further word of command one pace from the floor of the off compartment.

On the word *Two*, "The stretcher is raised on a level with the floor and the front pair of rollers rested on it; Nos. 1 and 2 stand by allowing the stretcher to be passed through their hands by Nos. 3 and 4, who give it the proper direction and gently push it home. The bearers then fall in one pace from and facing the wagon, No. 1 on the left, No. 4 on the right, and Nos. 2 and 3 between them."

"The bearers are then moved off by the following words of command—'*Left Turn*,' '*Left Wheel*,' '*Quick-March*'; and when clear of the stretcher on the left, *Halt! Stand at Ease!*"

The stretcher on the left or near side is then loaded in a similar manner.

To Unload with Four Bearers.—The squads wheeling by the right retire on the wagon, and halt when one stretcher's length from it.

The wagon is then unloaded first from the off side, thus:—

On the word *Unload*, "Nos. 2 and 4 bearers (of the squad on the off side), take a side pace of 27 inches to the right, and one of 30 inches to the front, aligning themselves with Nos. 1 and 3."

On the word *Two*, "The squad steps forward three paces, Nos. 3 and 4 pass up between Nos. 1 and 2, the latter closing outwards stand by to support the stretcher as it is withdrawn; Nos. 3 and 4 now take hold of the handles nearest them, No. 3 with the right and No. 4 with the left hand, withdraw the stretcher till the rollers at the front end rest on the edge of the floor, supporting it at the centre of the poles with the disengaged hands; Nos. 1 and 2 now take hold of the handles at the front ends, and the whole lift the stretcher clear of the wagon and lower it to the full extent of their arms, the squad then wheels by the right to the front and advances five paces."

On the word *Lower Stretcher*, "The squad stoops and lowers the stretcher gently to the ground, the bearers stand up and turn to the front."

On the word *Two*, "The squad stands to the stretcher as follows: No. 2 wheels round by the left of No. 1 to his place, and No. 4 steps up to the centre of the stretcher."

The stretcher on the left or near side is then unloaded in a similar manner.

To Load and Unload an Ordinary Wagon with Patients on Stretchers.

With Four Bearers.—Here loading and unloading is done in precisely the same way as for an ambulance wagon, except that in loading Nos. 1 and 2, after the end of the stretcher has been placed on the floor, spring into the wagon and with the assistance of Nos. 3 and 4 lift the stretcher into position.

Note.—To prevent jolting, the handles of the stretchers should be lashed to the framework of the wagon.

To Load and Unload a Wagon with a Patient if no Stretcher is available.—This may be done in two ways, *viz.* :—

(i,) The patient is lifted as in loading a stretcher, and carried to the wagon. On arriving at the back of the wagon No. 4 will get into it, and, supporting the patient under both shoulders, will lift him in assisted by the other bearers, who will subsequently get into the wagon and help to place the wounded man in the most advantageous position possible. Unloading is the converse of this proceeding.

(ii,) With two bearers, thus: The patient is carried by means of the two-handed seat to the wagon, the bearers then turn round, placing the patient with his back to the tailboard of the wagon, and lift him on to the floor with his legs hanging down; one bearer now holds him to prevent him from falling out, while the other bearer gets into the wagon and holds him by the shoulders till the second bearer gets in, the two bearers then again lift him by the two-handed seat and move him to a comfortable position.

VI.—REMOVAL BY RAILWAY.

For removing patients in ordinary railway carriages, second class carriages, which are cushioned but are without partitions, are the best.

The carriage door, which is 1ft. 10ins. wide, readily admits a stretcher by slightly reducing the traverse bar. Two cross-pieces of wood one foot from each door should be placed across from seat to seat to support the stretcher. To remove a patient safely from a carriage, three bearers are required.

Zavodovski's Method of Adapting a Railway Wagon for the Reception of Sick and Injured (Fig. 155).—This method is

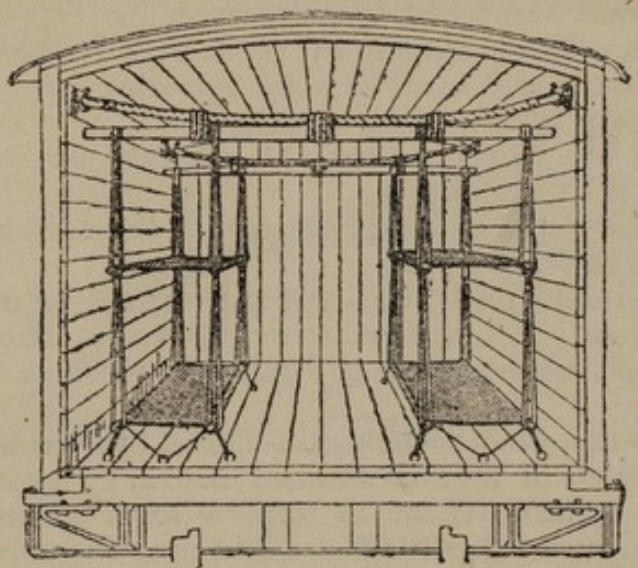


Fig. 155.—Showing the Interior of one half of a Goods Wagon with the Stretchers *in situ*.

most efficient, economical and convenient. When a number of patients have to be transported by rail, the *kinds* of wagons to select for the purpose are those which are free from all projecting obstructions. Hence, goods wagons are the best; but they have the disadvantage of being without light and ventilation. Any covered wagon can be used, but those which open at their ends, such as a Pullman car, or by wide sliding doors at their sides, are the most suitable.

A Pullman drawing-room car and a third-class carriage will each hold sixteen patients lying down. A goods wagon can carry eight or twelve patients lying down.

The Materials required for a goods wagon are :—

Eight large blunt hooks with bolts.

Four 1½-in. cables (8 ft. long) with iron bound eyelet holes at each end.

Four 4-in. ash poles (7 ft. 6 ins. long).

Thirty-two small ring bolts (twenty-four in the floor and eight in the sides).

Eight stretchers.

Twenty-eight stout cords for lashing.

Seventy-five yards strong cording to make sixteen ropes for the stretchers.

Twenty-five yards light cord.

A strand of cobbler's thread and a piece of wax.

The Hooks.—These must be of good material, as they have to bear the weight and strain. They should be 6 ins. deep and 5 ins. wide, and should pass through plates, which are applied to the sides of the carriage to steady them. The screws pass through and are fixed to the outside by washers and bolts. The hooks are to be screwed into the sides of the wagon 6 ft. 4 ins. from each other, and 9 ins. from the roof.

The Cables.—These should be 7½ ft. to 8 ft., not longer, 1½ ins. thick, strong, and made of good material; they should terminate in a loop with an iron bearing.

The cables are placed across the carriage on corresponding hooks.

The accurate fixing of the hooks and of the cables is of paramount importance.

The Poles should be 7½ ft. long, and should be made of ash. Single stretcher poles will answer very well. The manner in which the poles are bound to the cable is shown in the diagram (Fig. 153).

Ropes supporting the Stretchers.—These are made out of the seventy-five yards of rope mentioned above, by cutting lengths of 12 ft. and splicing them to form a loop. Each stretcher requires four loops. The loops are laid over the pole, commencing six inches from each end; the second loops are twenty-two

inches from these and nearer to the centre. With wax and twine each loop is tightly bound round just beneath the pole and at a point half-way between the pole and the end of the loop. There is a tendency to leave too little space for the lower tier. To obviate this the lengths cut must be proved in the following manner:—Take the rope, lay it over the pole, and draw the two pieces straight down to within 6 ins. of the floor of the wagon. Then leaving sufficient length for splicing, there will remain after the shrinking due to binding the loops just below the poles and in the centre, and allowing for the stretch of the rope, sufficient length to allow the stretcher to swing about 6 ins. to 8 ins. from the floor of the wagon.

The Ring Bolts.—These are to be placed in the sides and in the floor of the wagon.

Six are placed under each stretcher in the floor of the wagon, thus:—

No. 1 ring under the near handle, No. 3 under the off handle, No. 2 equidistant between No. 1 and No. 3 rings.

Four rings are placed on each side of the wagon opposite the handles of the stretcher (in the upper tier), nearest the sides of the wagon.

Fastening the Stretchers.—Each stretcher in the *lower tier* is lashed to the floor of the wagon thus:—

The rope is looped at one end, laid over the near handle, and threaded through No. 1 ring; after being drawn as tightly as possible, it is taken up to the same handle and turned round it twice, the second time overlapping the first. It is then taken across, through the ring No. 2 and over the off handle, and directly through the ring No. 3; returning to the off handle, it makes one turn, and at this point the whole is drawn tight, a second turn overlapping the first is then made, and the rope fastened off (Fig. 155*a*).

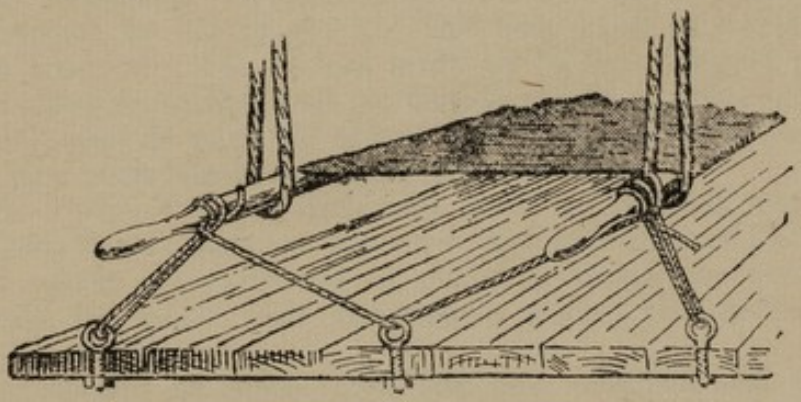


Fig. 155*a*.—Showing the manner of lashing the Stretcher to the floor of the Wagon.

Figs. 155, 155*a*.—Railway Wagon fitted up by the Zavodovski Method.

The stretchers in the *upper two tiers* are lashed to the sides of the wagon by tying a rope in one of the ring bolts in the side of the wagon, taking a firm hitch round each of the handles of the stretchers and tying off at the opposite ring bolt. In fastening the stretchers two practical points are to be remembered :—

(i,) The tiers are only to be tied after the sick are loaded.

(ii,) The tighter the ropes are drawn the more comfortable is the transport.

Method of Loading Injured.—Patients are placed in the *right half* of the wagon first, the upper tiers being loaded before the lower ones.

The stretchers, which are carried unto the wagon *head* first, are placed thus :—

The first stretcher into the upper loops, in the far right-hand corner.

The second stretcher into the upper loops, in the near right-hand corner.

The third stretcher into the lower loops, in the far right-hand corner.

The fourth stretcher into the lower loops in the near right-hand corner.

Method of Unloading Injured.—This is the converse of the above, the *left half* of the wagon being unloaded first. The lashings being unfixed the unloading is commenced with the lower stretcher on the left, each stretcher being brought out *foot* first.

CHAPTER XIX.

PREPARATION FOR THE RECEPTION OF A CASE OF ACCIDENT OR SUDDEN ILLNESS.

Selection and Preparation of the Room—The Bedstead and Bed—How to put on a Draw-sheet—Fracture Bed—Carrying the Patient upstairs to his Room—Removing the Clothes—Lifting the Patient into Bed—Preparation for the Surgeon's Visit.

WHILE engaged in attending to a case of accident or sudden illness, if possible, send a messenger to the patient's house, in order that arrangements may be made for his reception.

1. Selection and Preparation of the Room.

(i,) *Selection of the Room.*—The points to attend to are: that the room should be easily accessible, it should be large and lofty with a south or south-west aspect, the windows should admit sufficient light, and should be made to open top and bottom, and there should be a fireplace with a chimney that does not smoke.

(ii,) *Preparation of the Room.*—The room should be thoroughly cleansed (if time will permit of it), well ventilated by drawing down the top windows, a fire should be lighted in it, it should be warmed to a temperature of 60° Fahr. and maintained at this, a thermometer being hung in the room for the purpose of regulating the temperature; the carpet and all superfluous furniture should be removed from the room.

2. The Bedstead and Bed.

(i,) *The Bedstead.*—Wide bedsteads are to be avoided, as the patient cannot be easily got at; the best kind of bedstead to use is an iron one, 3 to 3½ feet wide by 6½ feet long, it should be placed away from the wall (so that it can be approached from either side), and if possible across the room between the door and fireplace with the head facing the window.

(ii,) *The Bed.*—Feather beds and flock mattresses are to be avoided, hair mattresses are the best; the bed clothes should be light and warm, no vallances or curtains should be used, and care should be taken that the space under the bedstead is vacant.

The bed should be made and the bed clothes well turned down, two stout chairs should be placed next to the bed, on which to rest the stretcher while the patient is being undressed. It may (in cases where the injuries are severe, or mud-stained

clothes have to be removed or extensive dressings applied), be necessary to have a second bed or couch in the room on which to first lay the patient. Extra blankets and hot water bottles should be kept in readiness.

In cases of collapse the blankets should be made hot and flannel should be wrapped round the hot water bottles.

If there is any likelihood of the bed clothes being soiled, *i.e.*, in cases of extensive injury, or where dressings have to be applied, or where the patient is unconscious or extremely weak and passes his evacuations under him, a *draw-sheet* should be placed on the bed.

To put on a Draw-Sheet—proceed as follows:—

Procure a large cotton sheet, fold it lengthways into four and place it across the bed so that it will reach from just below the patient's shoulders to his knees, now place a piece of macintosh between the draw-sheet and the under sheet, the draw-sheet being about 4 inches wider than the macintosh; one end of the draw-sheet is tucked in under the mattress, the other end is rolled up on the opposite side of the bed; when the part of the draw-sheet under the patient becomes soiled it is withdrawn a little to one side by being rolled up a little more.

In cases of fracture where the patient will have to lie in bed for several weeks, it is important to have a properly arranged bed—termed a "fracture bed."

The Essentials of a "Fracture Bed" are:—

(i,) That there should be no sagging or giving way;

(ii,) That the surface should be evenly smooth and comfortably elastic;

(iii,) That the foot of the mattress should be a little higher than the head.

The best way to arrange a fracture bed is as follows: first place a straw palliasse on the bedstead, then on the palliasse place two horsehair mattresses 3½ to 4 inches thick, and on the top mattress one blanket; to raise the bedstead place a thin board under the legs at the foot.

In fracture of the lower extremity or of the spine, there should be no bolsters or pillows for the head, but only a thin cushion, and boards should be placed across the bed under the mattress.

A *cradle* to take off the weight of the bed clothes may be necessary in fracture of the lower extremity, or sprain of the ankle joint; for a cradle, a cardboard box with the ends cut out, or a three-legged stool, may be used.

3. Carrying the Patient upstairs to his Room.—Before removing the patient to his room, the hall and staircase should be so far cleared as to allow sufficient room for those carrying him to pass.

The particular method to be adopted for carrying will depend in each case upon the nature and extent of the injury, and the condition of the patient.

A patient may be carried upstairs by—

(i,) A single bearer, according to the methods laid down in the previous chapter (pages 184 and 185).

(ii,) By two bearers, according to any of the methods laid down in the previous chapter (pages 187 to 192).

(iii,) On a stretcher. Here the head should go first, and the stretcher should be carried in the same manner as is laid down for carrying stretchers when loading wagons (page 207), the two bearers at the foot should take care to keep the stretcher as nearly horizontal as possible by raising it, or

(iv,) By placing the patient in a strong chair and carrying him up backwards, while a third person walks after the chair, helps to support it, and prevents the patient from falling out.

4. Removing the Clothes.—Before putting the patient to bed the clothes should be first removed, and great care should be taken in doing this; in serious cases it is better to remove the clothes by cutting them away.

In removing a coat from an injured arm, draw out the uninjured arm first, and in putting on anything put the injured arm in first.

In removing trousers from an injured limb rip up the outside seam.

In removing clothing in cases of burns and scalds, cut away the parts which are not adhering, and soak the adhering parts well with oil before removing them.

5. Lifting the Patient into Bed.—This may be done as follows:—

(i,) If the bed is narrow and there is room for the stretcher, place it on the floor with the head close to the foot of the bed, three bearers can then lift the patient in the way described in the previous chapter (pages 198 and 199), head foremost over the foot of the bed.

(ii,) If the bed is wide, place the stretcher close alongside the bed, the patient's head corresponding to that of the bed, Nos. 1, 2 and 3 bearers place themselves on the far side of the stretcher, and No. 4 bearer on the near side; the patient is then lifted in the manner described in the previous chapter (page 196), and supported on the knees of Nos. 1, 2 and 3 bearers, No. 4 bearer pulls away the stretcher and stands aside, while the other bearers lift the patient, stand up, and place him in position on the bed.

6. Preparation for the Surgeon's Visit.—When summoning a doctor, inform him as far as possible of the nature of the case so that he may come prepared.

The following should be in readiness:—

Plenty of hot and cold water, clean towels and soap, and a receptacle for dirty water.

For Burns and Scalds.—A good supply of clean old linen, cotton wool, olive oil, "carron" oil and bandages.

For Hæmorrhage.—Ice, sponges, and plenty of water.

For Drowning.—Plenty of blankets heated before the fire and several hot water bottles, the sheets from the bed should also be removed.

For Open Wounds of any kind.—Plenty of antiseptic dressings, lotions, etc., as boric lint, double cyanide or salalembroth wool or gauze, boric lotion (saturated solution), carbolic lotion (1 to 25 or 1 to 50), crystals of permanganate of potash, boric or carbolic ointment, sticking or court plaster, waterproof (as thin mackintosh or oiled silk), tincture of Eucalyptus (B.P.C.), iodoform, and plenty of roller and triangular bandages (see also pages 127 and 128).

If *poultices* and *fomentations* are required, plenty of boiling water, linseed meal, mustard, a small basin, a large spoon, olive oil, tow, flannel, a kitchen roller and two sticks or a large towel.

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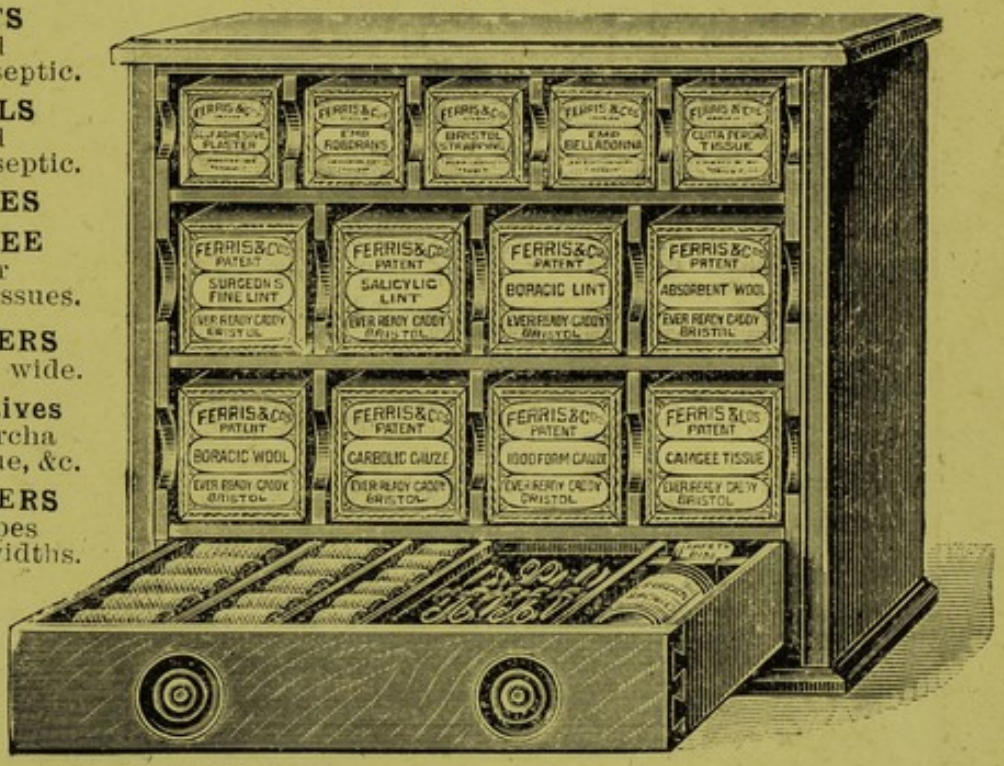

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