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Contributors

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CIVIL DEFENCE

FIRST AID MANUAL

LONDON: HIS MAJESTY'S STATIONERY OFFICE
1950
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NOTE

The pagination of this manual is not continuous as it may be necessary to introduce new pages at a later date.

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PREFACE

The series of Civil Defence handbooks and pamphlets is produced under the authority of the Home Secretary by the Civil Defence Department of the Home Office with the assistance of and in co-operation with the Secretary of State for Scotland and other Ministers concerned.

Measures for safeguarding the civil population against the effects of war which these publications describe, have become an essential part of the defensive organisation of this country. The need for them is not related to any belief that war is imminent. It is just as necessary that preparations for Civil Defence should be made in time of peace as it is that preparations should be made for the Armed Forces.

The publications cover, as far as is possible, measures which can be taken to mitigate the effects of all modern forms of attack. Any scheme of Civil Defence, if it is to be efficient, must be up-to-date and must take account of all the various weapons which might become available. The scale of bombing experienced in Great Britain during the 1939-45 war might be considerably exceeded in any future war, and types of weapons and tactics which were not experienced in this country might conceivably be used against it in the future. It does not follow that any one of the weapons, e.g. the atomic bomb, will necessarily be used, and it is most important that a proper balance is held between what is likely and what is possible.

The use of poison gas in war was forbidden by the Geneva Gas Protocol of 1925, to which this country and all the other countries of the Western Union were parties. At the outbreak of a war, His Majesty's Government would try to secure an undertaking from the enemy not to use poison gas. Nevertheless the risk of poison gas being used remains a possibility and cannot be disregarded any more than can certain further developments in other scientific fields.

The publications are designed to describe not only precautionary schemes which experience in the last war proved to be extremely effective in preventing avoidable injury and loss of life, or widespread dislocation of national industries, but also the training, both technical and tactical, which will be required of the personnel of the Civil Defence Corps if they are to be ready effectively to play their part if war should ever break out. The publications aim at giving the best available information on methods of defence against all the various weapons. Information is not complete in respect of some of these weapons and the best methods of countering them, but as results of experimental work and other investigations mature, they will be revised and added to from time to time so that the Civil Defence Corps may be kept up-to-date and training may be on the most modern and experienced lines.

INTRODUCTION

Experience has shown that first aid for the injured under air raid and general war-time conditions presents a number of special problems which are not met with in the ordinary course of first aid in peace time.

Air raids frequently occur at night and it is extremely difficult to make a detailed examination of a casualty or to attempt to apply elaborate treatment in the darkness and confusion occasioned by fires, the noise of bursting bombs and the general destruction which may be going on all round. A system of first aid has, therefore, been evolved with the primary object of rendering on the spot only such treatment as may be necessary to save life, to minimise shock, to relieve pain, to prevent the worsening of an injury, and to get the casualty from the scene of his injury to a place of safety where he can obtain skilled care and nursing as quickly as possible.

The purpose of this Manual is to set out in a simple and practical form the main principles of first aid teaching on which the Civil Defence Corps should be trained. The same principles will be found equally useful to anyone who is called upon to render first aid at any time.

In order to understand intelligently the application of these principles of what came to be known as " blitz first aid ", it is essential to have an appreciation of the underlying elements of physiology and anatomy, and a simple description of them has, therefore, been included.

Nobody would attempt even temporary repairs to a broken down motor-car unless he had some knowledge of how the engine is constructed and how the rest of the mechanism works. He should learn, therefore, as much as possible about the construction of his engine and how to carry out simple running repairs.

Without such knowledge mere " tinkering " may be quite ineffectual and may possibly make matters worse. It may well be that the driver has insufficient knowledge to remedy a defect, in which case he will have to obtain help. But the fact that he has this general knowledge will enable him very quickly to know whether the breakdown is serious, and whether, therefore, skilled help will be necessary at once.

In order to get skilled help, expert assistance will be sought from the nearest garage, and if something really fundamental has happened to the car it may even be necessary for it to be towed back to the garage for more extensive repairs than can be carried out on the spot.

The same principles apply to first aid. Every student of first aid should possess a sound elementary working knowledge of the construction of the human body, how its various parts and organs work during normal life and in what way they help to keep a person alive and well.

If damage occurs to any part of the delicate mechanism of the body, a person trained in first aid and possessing such knowledge will be better able to give the help needed to save life or to prevent an injury from becoming worse. The injured person can then be taken to an expert for more skilled treatment under proper conditions.

In the succeeding pages, therefore, before beginning the study of first aid a description is given of the construction of the human body, of its functions and how it is affected by injury and disease. Simple facts of the working of the body as a whole are given to supply a basis upon which every student of first aid can begin his practical studies. The more detailed description of the parts and organs concerned, with various injuries, is given in later chapters (e.g., Description of the skeleton—Fracture of bones, etc., Chapters IX and X)

CHAPTER I

THE HUMAN BODY—SYSTEMS OF

The human body is made up of countless millions of minute bodies to which the name of " cells " has been given. These originate from a jelly-like substance called " protoplasm," and can only be seen with the naked eye when magnified by a microscope. This protoplasm which possesses the property of life contains many chemical substances in its composition, and forms the essential basis of all living animal and plant cells. Each individual cell can live, breathe, feed, and excrete waste substances, just as the living body does as a whole. In the process of development these cells acquire different shapes, and become grouped into patterns according to their future functions. From the gathering together of various types of cells are formed " tissues." These are referred to from time to time, and may be described as the elements from which all parts and organs of the body are constructed. Thus, some kinds of tissue are contained in the skin, others in fat, bone and gristle, others in muscles and nerves, and so on, throughout the body. When groups of tissues which fulfil similar functions congregate together to form distinct anatomical structures these are called " organs," examples of these are the brain, heart, and liver. Each organ has its own special functions but works in harmony with other organs.

When several organs are grouped together to carry out a special function this group is called a " system." ; as an example, the digestive system consists of several organs grouped together to deal with the digestion of food. As in the case of a combustion engine, to which it may be likened, the human body depends upon a supply of air and fuel to keep it working ; it also has to get rid of certain products of combustion, as has an engine, which would otherwise accumulate and clog its delicate mechanism.

The failure of any part of the ignition or petrol feed systems of a motor car may upset the working of the whole machine ; likewise, failure of any part of any system of the human body may prevent its proper working as a whole.

It must be appreciated that although the systems are described separately in succeeding pages they are all closely related and dependent upon one another.

The purpose of this chapter is to give a brief general survey of the body and of its working as a whole.

The systems of the body are :—

(*a*) The Bony (Skeleton)
(*b*) The Muscular.
(*c*) The Circulatory (Blood).
(*d*) The Breathing (Respiratory)
(*e*) The Digestive.
(*f*) The Urinary.
(*g*) The Reproductive.
(*h*) The Glandular.
(*i*) The Lymphatic.
(*j*) The Nervous.

(*a*) *The Bony System or Skeleton*

This is made up of a number of bones of different shapes and sizes connected together by bands of fibrous and elastic material (ligaments) to form a support for all the soft tissues of the body and to

maintain its shape, to provide a protective covering for certain organs and, to give attachment to muscles so that these can move the body and its parts.

Where the ends of two or more bones come into contact a movable joint (articulation) may be formed. This allows movement of the bones to take place on one another in certain directions, e.g., the joints at the bend of the elbow or the knee.

There are also other kinds of joints where no movement or only restricted movement takes place (immovable joints). These are found in many parts of the body where two or more bones are joined or knit together, as in the bones of the skull. An example of a joint with restricted movement is found at the meeting of the lower part of the backbone with the rump bone (sacrum) and the hip bone (ilium).

(*b*) *The Muscular System*

All movement of or in the body is brought about by a tissue known as " muscle." This is the " red meat " of the body and forms a large part of the soft tissue, particularly in those parts which are most frequently in motion, e.g., the arm and leg. Though this " red meat " may appear to be just one mass of tissue, inspection shows that it is made up of a number of separate portions or bundles of muscle tissue of varying shape and size. Each separate portion is known as " a muscle " and a great number of these exists in the body.

Muscle is a form of tissue which possesses the power of contracting and relaxing, thereby producing movements in the parts to which it is attached. When it contracts it becomes shorter and thicker, when it relaxes it returns to its original length and size. Each muscle is capable of contracting or relaxing on its own, or of working in conjunction with a number or group of other muscles. As a general rule, each end of a muscle is attached to a separate bone, either directly by its fleshy fibres or by a strong fibrous cord known as a " leader " or " tendon " into which the muscle tapers. The contraction of a muscle attached above and below a joint causes movement at that joint. (See Fig. 1.)

Much of the body movement is under the control of the will and the muscles which cause this movement are known as " voluntary

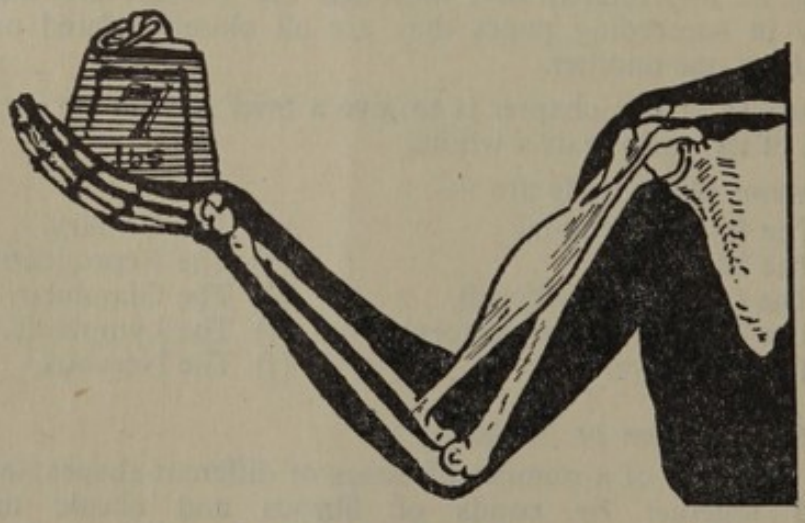

Fig. 1—Muscle in Action

muscles." Similarly, many of the vital movements of the body continue, waking or sleeping, independent of our will and this movement is performed by what is known as " involuntary muscle."

This involuntary muscle is found in the substance or walls of all the tissues and organs in which action is automatic, e.g., in the intestines, and in the arteries, or it may itself form a complete structure or organ such as the heart.

(*c*) *The Circulatory* (*Blood*) *System*

The circulatory system is the body's transport organisation in which the carrying is done by the blood. The heart which is a strong muscular bag acts as a pump and drives the blood round and round the body. The blood travels from the heart in thick-walled tubes known as " arteries." These divide and subdivide until their terminal branches are nothing more than minute thin-walled twigs called " capillaries." Through the thin walls of these capillaries the blood is able to pass the substances it has brought to build up the tissues, and to collect unwanted material or waste products from the tissue cells. The blood having effected this exchange of materials continues its course into minute thin-walled tubes which join together to form larger and larger tubes known as " veins." Through these veins the blood is carried back to the heart. It will thus be understood that capillaries form a network of small blood vessels which joins the terminations of the arteries to the commencement of the veins.

The substances which the blood carries to the tissue cells are necessary for their life, growth and health. They comprise oxygen which the blood has collected in its passage through the lungs, food substances from the stomach and intestines, and various body juices from other organs known as " glands " (See the Glandular System, page 5(*h*),.

As it passes through the lungs the blood gets rid of an excess of unwanted gas (carbon dioxide) which is breathed out from the lungs into the air. Other impurities are filtered off from it as it passes through the kidneys, skin and bowels and are passed out of the body as water (urine), sweat, and motions (faeces).

The blood has many other functions but these are dealt with in detail in the appropriate chapters (See Chapter VI).

(*d*) *The* (*Breathing*) *Respiratory System*

Respiration consists of the alternate drawing in of air and of breathing it out again. When a person takes a breath (inspiration), air enters through the nose and mouth and passes down the windpipe (trachea) into the lungs. Inspiration is a muscular act and the size of the cavity of the chest is increased by the amount of air taken in. When a person breathes out (expiration), the chest and lungs return to their previous size by their own elasticity and the air is expelled from the lungs through the air passages. A more detailed description of this system will be found in Chapter XIV.

(*e*) *The Digestive or Alimentary System*

This system deals with the use and disposal of food, from the time it is taken into the mouth until it has been converted into substances which can be absorbed into the blood for tissue nourishment, or if unsuitable are passed along the bowel and got rid of by defaecation.

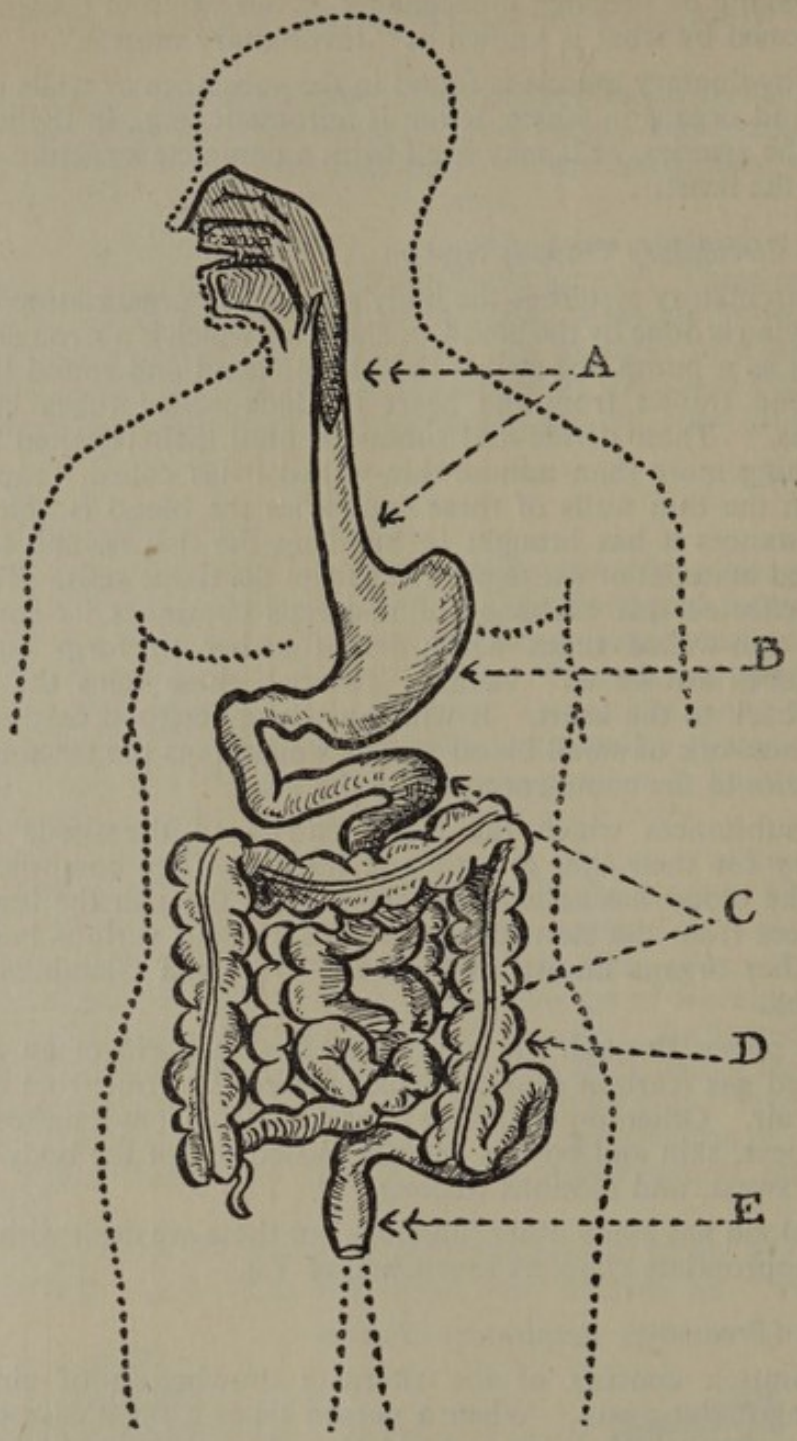

Fig. 2—Digestive Tube

A—Gullet (Oesophagus) B—Stomach C—Small Intestine
D—Large Intestine E—Rectum and Anus

The digestive tract consists of a continuous tube about 30 feet long reaching from the mouth to the anus (" back passage ").

The gullet (oesophagus) is the tube through which food passes from the mouth to the stomach. It extends from the back of the mouth down the neck in front of the spine and through the chest into the upper part of the belly (abdomen). Here the tube becomes dilated and forms a bag which is known as the " stomach." Food is retained in this bag for some time and part of the process of digestion takes

place in it. The tube then narrows to become the " small intestine " sometimes called " the guts." About 22 feet in length this is disposed in numerous coils within the belly. The last portion of the digestive tract known as the " large intestine " or " large gut " has an increased diameter and is some 6–8 feet in length and 2½ inches in width at its widest part. It is not coiled as are the small intestines, but is formed into a horseshoe shaped arch around the circumference of the interior of the belly enclosing the coils of small intestines and terminating in the rectum and anus. (See Fig. 2.)

Other organs which play a prominent part in the digestion of food are the liver and the pancreas (known as the " sweetbread ").

In the liver and pancreas, in the mouth and in the whole length of the digestive tube, there are various kinds of juices which break down or digest the particles of food into chemical substances which can be used by the body. Bile is an example. This juice which is manufactured in the liver is poured into the digestive tube to assist the process of digestion. The final stage of digestion is reached when the food has been reduced to substances capable of being absorbed into the blood and used as nourishment by the body.

Food is not allowed to remain in any part of the digestive system longer than is necessary for the special juices of that part to act upon it. The contraction of the muscles in the wall of the digestive tube moves it on to the next part where other juices continue the process.

(*f*) *The Urinary or Excretory System*

The function of this system, as its name implies, is to get rid of waste products from the tissues by means of a fluid known as "urine."

The chief organs concerned in the urinary system are the kidneys, the ureters, the bladder and the urethra.

(i) The kidneys, two in number, each one shaped like a large kidney bean, are situated at the back of the belly and lie in the loin, one on either side of the spine. They act as filters and separate the waste products and a certain amount of water from the blood.

(ii) The ureters are two tubes through which urine passes from the kidneys to the bladder.

(iii) The bladder is a reservoir in which the urine is collected.

(iv) The urethra is a tube through which the bladder is periodically emptied in passing water.

(*g*) *The Reproductive System*

This deals with the begetting of children from the earliest stages of development until the full time is completed and birth takes place.

The organs which make up this system cannot be described intelligibly in a small space ; moreover, it is considered that no useful purpose will be served by attempting to describe them in these pages as the subject is rather outside the realm of first aid instruction.

(*h*) *The Glandular System*

Scattered throughout the body are numbers of more or less compact masses of tissues known as glands. Some of these glands are so small that they can only be seen with the help of a microscope ; others, such as the liver and pancreas, are of considerable size.

Each gland contributes in some way to the vital activity of the body. It is not within the scope of this book to mention all the glands in the body and their various functions, but a few examples can be given.

(i) Glands mainly concerned with the removal of waste products, viz., the kidneys and sweat glands.

(ii) Glands producing digestive juices, viz., salivary glands, liver, pancreas, and the small glands in the lining of the stomach and bowels.

(iii) Glands assisting in the working of organs in the body, e.g., glands producing tears to bathe the eyes, wax to protect the ears, and grease to keep the skin soft.

(iv) Glands associated with reproduction, viz., testes (testicles) in the male, and ovaries in the female.

(v) Glands producing milk, viz., the Mammary Glands (breasts).

Most of the glands have tubes, which are known as " ducts " leading from them. These tubes carry away the secretions from the glands to the surface of the body or into stomach, bowels or other organs.

One other important type of glands must be mentioned, the *Ductless glands*, so called because they have no ducts, as have those mentioned above. These glands are situated in different parts of the body, the thyroid gland in the neck is an example of one, and each produces a special kind of fluid which is known as a hormone. These hormones are carried to all parts of the body by the blood stream as it flows through the glands, and play a vital part in the growth and activities of the tissues of all the systems throughout the body. So long as a balance is maintained between the manufacture and output of these different hormones all will be well in the body, but should this balance be upset by one or more of the ductless glands not functioning properly the whole condition of the body may be changed with very serious results. We all at some time must have seen a stunted idiot child who seems hardly human, and is known as a cretin, but how many realise that this is caused by a disease of the thyroid gland, referred to above, which is thereby unable to produce the hormone necessary to maintain the proper balance between it and the other hormones? Giants and dwarfs are other examples of the failure of certain ductless glands to produce the hormones necessary for proper development and growth. It will thus be seen that whereas glands with ducts produce and discharge their fluid through these ducts into special parts of the body the ductless glands discharge their fluid into the body as a whole, using the blood stream for this purpose.

(*i*) *The Lymphatic System*

The lymphatic system is concerned with the actual nourishment and drainage of the tissue cells throughout the body.

BLOOD PLASMA, LYMPHATICS, LYMPH

As blood circulates through the capillaries, part of its liquid portion (plasma) (See Chapter VI) is constantly passing through the thin porous walls of these blood vessels and being absorbed by the tissue cells, just as water is absorbed by a sponge. This liquid contains the necessary materials for nourishing the tissue cells, i.e., oxygen, from the red blood corpuscles (which remain in the blood vessels and do not leave them), and food materials from the alimentary (food) system. When the tissues have been thoroughly bathed with this liquid and

have taken all the nourishment they require from it, they fill it up with their waste products (of which the most important is carbon dioxide), and return it to the blood stream again through the walls of the capillaries. All the liquid, however, is not returned to the blood and a certain amount remains over in the tissues. This excess fluid which is known as " lymph " is drained off by minute vessels, which resemble capillaries but do not contain blood, and moreover are provided with valves so that the lymph can flow in one direction only. These vessels or channels are called " lymphatics " or " lymphatic vessels," and from small beginnings become larger and larger, and join together until they form two large ducts or canals (thoracic ducts) which pass up through the belly and chest and finally open into a large vein on each side of the neck (subclavian vein). Thus it will be seen that this lymph which is derived from the blood plasma in the capillaries is again returned to the blood in the veins. When first drained off from the tissues lymph is a clear colourless or slightly yellow liquid (resembling that found in a blister), but as it takes up food materials, notably fats, from the intestines, it changes its colour and by the time it reaches the two main ducts looks like watery milk.

LYMPHATIC NODES AND LYMPHATIC GLANDS

Mention must be made of these as they are of interest to first aid workers, as are also the lymphatic vessels, owing to their connection with disease germs which enter the body through wounds and cause infection (See page 47).

Along the course of the lymphatic vessels as they pass through the tissues are numerous small bodies, varying in size from that of the head of a small pin to that of a broad bean about ½ inch long ; they also frequently resemble this in shape. The small bodies are known as " lymphatic nodes, or nodules " and the larger as " lymphatic glands."

These nodes and glands play an important part as sieves or filters to keep back poisonous materials, such as germs which, but for the presence of these filters, would be carried on through the lymphatics into the blood stream.

Lymphatic glands are found in large numbers in the region of the intestines and along the course of the big blood vessels in the belly, chest and neck ; also in the armpits and groins. A few occur in the arm as far down as the bend of the elbow. When poisonous material from, say, a festering wound on the foot is carried in the lymphatics up the leg, these lymphatics can frequently be seen as dusky red tracks beneath the skin leading up the limb from the foot. If the poison reaches the lymphatic glands, in this case those in the groin, they become enlarged, tender and inflamed, showing that they are engaging the germs in a fight to destroy them so that they cannot pass on into the blood. These lymphatic glands are capable of producing certain of the white blood corpuscles which are referred to in Chapter V.

(j) The Nervous System

A structure such as a living body consisting of many different working parts requires some arrangement by which the action of these various parts can be regulated and co-ordinated.

Two systems of nerves which are called the *Cerebro-Spinal* and the *Sympathetic* regulate and control the movements and functions of the human body. Voluntary movement is controlled by the cerebro-spinal system, involuntary movement and the vital activities of the organs and tissues by the sympathetic system.

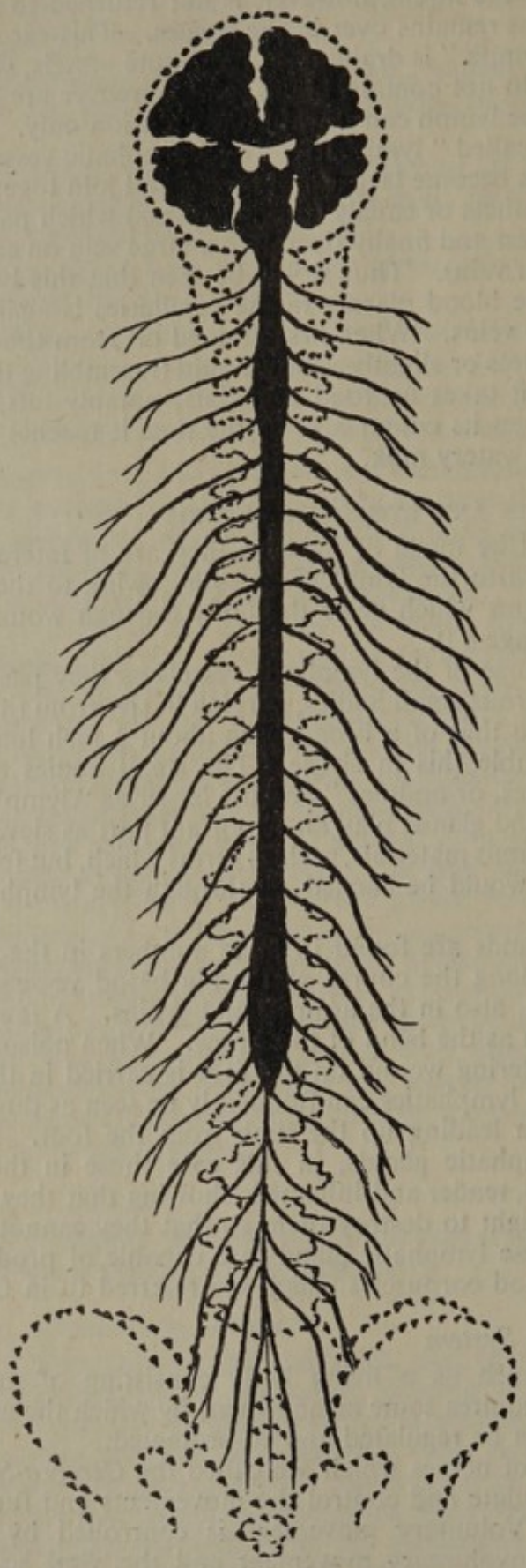

Fig. 3—Diagrammatic View of the Central Nervous System

THE CEREBRO-SPINAL SYSTEM

The Cerebro-Spinal system is made up of the brain, the spinal cord, and nerves which are given off from both of these.

(i) *The Brain* which is situated within the cranium (skull) is the receiving, transmitting and recording centre for all in-coming and out-going messages. It may thus be likened to a large Central Telephone Exchange containing an innumerable number of wires. It is the seat of the intellect, the emotions and the will.

The brain is a large greyish white organ, weighing about three pounds in a normal adult, and from its shape and wrinkled surface may be said to resemble a gigantic walnut. It consists of a mass of nerve cells and fibres bound together by a connecting tissue called neuroglia. The nerve cells do the actual work but the fibres connect them to each other and carry messages to and from the different parts of the body. Nerve fibres therefore can be compared to telephone wires. Bundles of them are grouped together to form nerves, and the largest of these form trunks which can be regarded as telephone cables.

(ii) *The Spinal Cord.*—The Spinal Cord, which may be considered as the central cable of the telephone system of the body, is an extension of the brain which, as a cylinder of nervous tissue about 18 inches long in a normal adult, leaves the skull through a hole on its under surface and runs down the inside of the Back-bone as far as the small of the back. (See Chapter IX (I)—The Bones of the Cranium). Thirty-one Nerve Cords are given off from each side of the Spinal Cord and pass outwards between the bones forming the Back-bone (See Chapter IX) —The Back-bone), to divide and sub-divide into branches and twigs which go to every part of the body. Each Nerve Cord consists of two sets of Nerve Fibres united to form the one Cord (See Fig. 3).

(*a*) Sensory Nerve fibres through which sensations or impulses from the skin, the muscles, or Organs of Special Sense, e.g., sight and taste, pass *to* the Brain.

(*b*) Motor Nerve fibres which carry impulses to the muscles *from* the Brain.

The endings of the nerve branches and twigs in the tissues can be imagined to represent actual telephone instruments through which messages are sent and received. As a simple example—if a pin sticks into a foot the sensation caused is picked up by the Nerve Endings in the foot and passed along through the nerves and Spinal Cord to the Brain. The Brain registers the sensation as one of pain and sends out a message through the Spinal Cord and nerves to the muscles in the leg and foot to contract and pull the foot away from the pin. This is called *Voluntary Action.*

Reflex Action

In some cases a message which reaches the Spinal Cord through a Sensory nerve is passed directly across to a Motor nerve without going to the Brain. The Motor nerve then takes action on its own and causes movement to take place. This is called *Reflex Action.* As an example—If a person or animal is hungry and sees or expects an appetising meal, saliva will pour into his mouth to aid digestion of the meal when he takes it. The difference, thus, between *Voluntary Action* and *Reflex Action* is that in the former a person is conscious of wishing to perform a movement, whereas, in the latter, the movement takes place spontaneously.

(iii) *The Sympathetic System.*—This system consists of a number of small gland-like knots of nerve cells known as ganglia which are connected together by a network of nerve fibres to form a pair of beaded cords (the sympathetic chains). These run down on each side of the back-bone and communicate freely with the spinal nerves. Similar ganglia are found in other parts of the body, but in certain areas they are more concentrated. A collection of these ganglia which is situated in the upper part of the belly behind the stomach is an example of this concentration and is known as the " Solar Plexus." When a person receives a blow in the solar plexus, as sometimes happens in boxing or football, he may become severely collapsed.

The nerve cells in the sympathetic ganglia control the movement of involuntary muscle and the vital activities of the organs and tissues. Although they are closely linked with the brain they are not under the direction of the will, but are concerned in the emotions. In addition to supplying involuntary muscles such as are in the heart, the Sympathetic System also sends impulses to the glands and to the walls of blood vessels. Thus, when a person is shocked or frightened his face and body may become pale and cold. This is because the blood vessels are contracting and allowing less blood to reach the surface of the body as a result of action taken by the Sympathetic System of nerves, in response to messages received, although they may have originated in the Central Nervous System.

CHAPTER II

GENERAL PRINCIPLES OF FIRST AID AND THE HANDLING OF CASUALTIES

Teaching in first aid should be largely practical and approached in a commonsense and realistic manner. During air raids sound judgment and quick and accurate decisions are needed, and can only be achieved by good training and a thorough knowledge of first aid as applied to war-time conditions. There are certain fundamental points which must be taught first as the basis of all first aid training. These points are :—

(i) To treat every casualty strictly on its merits.

(ii) To do nothing which might lower further the vitality of a casualty.

(iii) To remember that a badly wounded person will have to travel to a hospital.

(iv) To keep all first aid on the spot as simple as possible.

(v) To deal first with the most urgent cases.

(vi) To handle casualties gently ; to keep them warm ; to reassure them ; and to do anything else which will help to minimise shock.

(vii) To remove casualties from the scene of the incident as quickly as possible to a first aid post or hospital where they can get shelter and skilled medical attention.

The first consideration in dealing with a casualty is to decide whether there is any immediate danger to life, the following being some of the most important indications :—

(*a*) Severe bleeding (hæmorrhage).

(*b*) Shock.

(*c*) Interference with normal breathing (e.g., pressure on the chest by earth or debris as in a collapsed trench or building ; obstruction of the air passages, mouth, windpipe, etc., by false teeth, mud, dust ; or as a result of contact with a live electric wire).

(*d*) Proximity to a source of danger to life (e.g., fire, dangerous masonry, flooding, as may occur when water mains are damaged ; moving machinery ; exposed electric cables ; or escaping coal gas from a damaged gas main.

These conditions must be dealt with at once.—Bleeding must be controlled ; shock must be treated ; obstructions to normal breathing must be cleared ; the source of danger must be removed from the casualty, or the casualty from the source of danger.

It may be necessary to move him in order to prevent further injury, as, for example, if he is found lying on ground contaminated with persistent gas, or to shift him from the neighbourhood of a dangerous wall or building or out of heavy rain or keen wind. A casualty should not be moved unnecessarily, and it must be decided whether treatment is called for prior to moving or not.

A few very simple examples are given on the next page.

A wounded man lying on ground saturated with mustard gas and bleeding from the main artery of the leg, must have the bleeding controlled before he is removed from the liquid gas.

A casualty with a broken leg, found unconscious in a closed room full of gas from a damaged gas pipe, is in immediate danger of death unless he is got out quickly. This must be done and the injured part supported while he is being moved, in spite of the general rule not to move a casualty with a broken bone until this has been attended to.

A wounded man, bleeding profusely and with an apparently broken arm, found lying unconscious across a machine with moving parts which might kill or injure him further must be removed from the machinery (which must be stopped as soon as possible), care being taken to support the fracture, before the bleeding and the broken bone have been dealt with.

Certain general principles of first aid apply in all cases as stated below

(1) The casualty must be removed at once from any source of danger, or the source of danger from the casualty.

(2) First aid should be confined to essentials only.

(3) Severe bleeding must be attended to at the earliest possible moment (See Chapter VIII).

(4) Pain must be relieved by supporting the injured part in the most comfortable position.

(5) If a casualty is found to have difficulty in breathing or to have stopped breathing, the cause of this must be dealt with and artificial respiration, if needed, commenced at once and continued so long as there appears to be any chance of restarting normal breathing. Death is not to be assumed because signs of life are absent. In a case of true suffocation it is better to persist with artificial respiration on a corpse, than to let a man die for lack of doing this. Instances have occurred in which persons have recovered after breathing has stopped for a long time. In cases of doubt a doctor must always be called to decide whether life is extinct or not. (See Chapter XV.)

(6) Shock varies in degree from faintness to extreme and dangerous collapse. It is always present to some extent in every casualty, even affecting those who may be uninjured or only slightly injured. Gentleness and great care in handling and moving shocked casualties is essential, always keeping in mind that shock is responsible for many deaths amongst people injured in air raids. (See Chapter III.)

(7) When a bone or bones are found to be broken, or it is suspected that they are, great care should be taken to immobilise the affected part so that the patient can be moved as quickly as possible, without the danger of the break in the bone becoming worse. Shock will be increased by unnecessary handling of the parts, or by employing elaborate measures to produce immobilisation. Such measures cause pain, in itself one of the primary causes of shock, and in addition they delay the despatch of the casualty to hospital. Special care should be taken when the broken ends of a bone or bones protrude through a wound in the skin. (See Chapter X.)

(8) It must be remembered that a casualty is a human being who has probably had a terrifying experience and suffered a severe shock. He, if conscious, will naturally be anxious not only about his own condition, but also about the fate of relatives and friends who may have been near him at the time. It is the duty of a person who renders first aid to do all in his power to gain the confidence of a casualty by firm but gentle handling, and to relieve his anxiety by sympathy and convincing re-assurance. On no account should the condition of a conscious casualty be discussed with other helpers in his presence, or instructions given in whispers ; this will make the casualty think that something is being said which is not meant for him to hear, and so anxiety will be increased.

After an injury has been attended to, a casualty should not be left alone, but placed with others, under cover, and in charge, if possible, of a member of the Civil Defence Corps, pending their removal.

The majority of air raid casualties are covered with dust and dirt from the debris of damaged buildings. A sound practical rule to follow is to wipe the face of a casualty and clean the eyes, nose, mouth and ears with a handkerchief, triangular bandage or other material, moistened if possible. The patient will be grateful for this and find it a great comfort.

From the above it will be seen that in all cases the first consideration in dealing with casualties at an incident is to save life by correct and prompt action ; the second to deal with shock ; the third to prevent an injury or injuries from becoming worse by injudicious movement or careless handling ; the fourth to arrange for their speedy removal to shelter and skilled care. It must be realised that speed *can* be combined with gentleness and care.

CHAPTER III

SHOCK

The immediate recognition of a condition of shock and its proper treatment are of the greatest importance in first aid, since it is the chief cause of death in cases of accident and injury when the victims are not killed outright. The name is a little misleading for in its technical sense it has no connection with the use of the word " shock " in ordinary conversation. A more accurate description of " shock " would be " a state of prostration resulting from actual injury, or from the pain of injury, or from emotional reaction to the sight of an accident or the receipt of bad news." In the surgical sense there are two kinds of shock which are of interest to first aid workers.

Primary Shock

This starts at the moment of injury and is most probably nervous in origin. Since it is now known that the same mechanism may operate at any period during the existence of what used to be called " secondary," but is now called " surgical " shock, the term " primary " is not entirely satisfactory. The condition is now generally included under the heading " neurogenic " shock.

This form of shock is the result of the actual impact of a blow however caused ; by pain, or by fright, or by a combination of all three. There need be no obvious injury, or indeed any wound at all. The ordinary " faint " is the simplest example of this type. It is shown by a *sudden* fall in blood pressure (producing a rapid, weak pulse) ; pallor ; weakness (loss of muscular tone) ; giddiness and clouding of consciousness (the patient says," What happened ? Where am I ? "). These signs and symptoms may be present in widely different degrees, but the constant feature is the sudden fall of blood pressure. Three things may happen :—

(*a*) Commonly, primary shock, like a faint, passes off within a short time, lasting seconds or even longer, according to the severity of the injury. Where there is an open wound it is a natural protective device, for the fall in blood pressure and the relative immobility of the patient give the blood an increased chance to clot in the wound and so lessen bleeding. The immediate pain is dulled. The weakness and inability to move may prevent an injury from becoming worse, or being increased by attempts to move.

(*b*) Primary shock may be prolonged into the state of secondary shock without any period of recovery. This is not common but when it occurs the outlook is grave.

(*c*) The shock may be so severe that the patient looks as if he might die within a few minutes ; all possible steps must be taken immediately to lessen the gravity of the condition, otherwise he *will* die.

Surgical Shock

Also known as " secondary " shock. This results from serious injuries causing loss of blood, from crushing injuries—whether fractures are present or not ; from fractures of large bones, such as the thigh bone or the back-bone (spinal column) ; from comminuted

fractures and from fracture dislocations (See Chapters X and XI); from injuries to the external sex organs, etc. Extensive burns also cause shock, especially if the face and chest are scalded or burnt. This serious condition should be anticipated in all cases of severe injury and its onset *prevented*. When primary shock has already appeared, treatment must be immediate. Except when primary shock has been prolonged into the state of secondary shock, *the onset is from one to ten hours or more after the injury*, and is characterised by a relatively slow drop in blood pressure and by a reduction of the amount of circulating blood. The latter is produced by some of the liquid part of the blood (plasma) oozing out through the thin walls of the capillaries (See "capillaries," page 59). The red cells in any given volume of blood, however, remain in the circulating blood, and are further increased in number; thus bringing about a thickening of the blood in circulation, and, in consequence, the flow of blood through the capillaries becomes difficult. In addition, blood vessels in the muscles and perhaps in the large organs contained in the belly (e.g., liver and spleen) become wider and so they hold more blood than usual and this "held" blood is effectively out of the circulation; it is not, in fact, doing its job of carrying oxygen. The fall of blood pressure decreases the output of the heart (See "The Heart," etc., Chapter VI) and in turn the lessened blood volume tends to lower the blood pressure. This is an example of a "vicious circle."

Remembering then that the two chief features of surgical shock are a fall of blood pressure and a reduction of circulating blood volume, the *signs* (i.e., unusual features found in a patient on examination) and *symptoms* (unusual sensations felt by a patient and complained about) which will be found are easily understood, especially when it is remembered that the chief duty of the blood is to carry oxygen. Without oxygen none of the organs or tissues of the body can do their work properly.

Signs and Symptoms

(1) The pulse must be the first-aid worker's chief guide. If within an hour after injury the pulse rate is 100, this is a danger sign. If it tends steadily to increase, even slightly, it is so much the worse. A pulse rate of 120 is a grave sign and means that shock is already present, or the patient is bleeding, or both. The pulse force is weak, and the artery is difficult to feel. (Frequent practice on feeling normal pulses is important so that anything abnormal can be quickly recognised). In advanced cases it may not be possible to detect it at the wrist, but it can generally be felt at the temple or in the neck and the apex beat of the heart may be felt or heard in the space between the fifth and sixth ribs, below and just inside the left nipple.

(2) The Skin is pale because of the fall in blood pressure and contraction of the skin blood vessels. Because of the lessened oxygen supply the blood is more venous or dark in colour, so the skin tends to be blueish or grey (in advanced cases, of a leaden hue). This blue tinge first appears in the lobes of the ears and the lips.

(3) The Skin is cold because the temperature falls owing to the diminished circulation and decreased oxygen usage, and is often clammy or moist to the touch. Normal body temperature is kept up by oxidation of food, i.e., "burning up" oxygen. The more the supply of oxygen is interfered with, the more the body temperature will drop.

(4) Breathing may be shallow and sighing. In advanced cases, air hunger appears, though this is more marked when the shock is complicated by severe bleeding. (See " Symptoms and Signs of Bleeding," paragraph 7, page 70). It is a grave sign.

(5) The Eyes have a glassy or vacant stare, and the pupils are wide. The more dilated the pupils are, the more serious is the case.

(6) The muscular system is weak because the muscles are not receiving sufficient oxygen.

(7) There is a feeling of faintness, weakness, sometimes dizziness, and often nausea. There are changes in the mental state owing to interference of the circulation of blood through the brain. At first the patient is alert and apprehensive but as his condition gets worse he may become duller, confused, and fail to reply to other than the simplest questions. As the condition progresses, stupor and unconsciousness follow.

It will be seen that severe bleeding whether external or internal will increase the tendency for all these signs and symptoms to become more pronounced. Indeed, it must be emphasised that bleeding alone will cause shock if the blood loss is sufficient. The amount varies in different people but a loss of two to four pints will bring about a state of surgical shock.

The tendency to shock and its intensity are increased if at the time of the injury the patient is *tired*, *cold*, *hungry* and *afraid*. Obviously, if these conditions continue after the injury it is so much worse for the patient, and they provide a clue to the prevention and treatment of shock.

Treatment of Shock

(1) The patient should be laid on his back with his head low and turned to one side, and his feet raised, *unless* he has an injury to his head or chest, in which case his head and shoulders should be raised and supported. The utmost care in moving him is essential.

(2) Any bleeding which can be seen must be stopped.

(3) Pain must be relieved by support of the injured part, and placing it in the most comfortable position.

(4) Warmth should be applied by blanketing, by hot bottles, which must not be too hot (covered so as not to burn the skin) placed between the feet, knees, and at the sides of the patient ; by warm drinks and, where time and circumstances permit, by rubbing the limbs upwards towards the heart. This latter action also tends to help the circulation. To produce a greater effect in assisting the return of blood to the heart and brain, the foot of the stretcher or bed upon which the patient is placed should be raised about 9 inches. This is important and should only be omitted in serious wounds of the chest and head. A doctor may bandage the legs tightly from the feet upwards for the same reason.

It is *essential* that the patient is not overwarmed so as to cause sweating, which would reduce further the fluid in his body and so increase shock. Shocked patients have, in fact, been killed by too efficient heat treatment. This point serves to emphasise again that the shocked patient must be kept under continual observation.

(5) Food should be given as a liquid, but never to an unconscious patient or one in whom an internal injury is suspected. Hot drinks

of well sweetened tea, coffee or cocoa, are usually the most convenient. Sugar or boiled sweets can be given to suck as a substitute, though warm drinks are much to be preferred. *On no account must the patient be given any alcohol.*

(6) Mental treatment is fully as important as physical treatment. The patient must be reassured and cheered up. Success depends on the personality, calmness and self-confidence of the first aid worker. The patient's condition should never be discussed in his hearing, which is often unusually sharp in injured persons. If a raid is in progress, every effort should be made to take him to a place of greater safety or, if this is impossible, to give him some illusion of security. At the worst, sheltering behind a sheet of corrugated iron or other object, though quite inadequate to give any real protection, undoubtedly helps the patient. If possible he should be put where he will not be disturbed ; out of the way, for example, of other stretchers being carried past.

If a patient's injuries permit, it is often a good plan to place him on his face, with his head turned to one side, especially if he is stuporous or unconscious, since, if this position is properly arranged, the air-way is less likely to be obstructed by his tongue falling back, or from other causes.

Above all, the casualty who is in a severely shocked condition and therefore in danger of his life, should receive treatment in a hospital as soon as possible. This treatment, which includes blood transfusions, is too complicated to be effectively applied, save in a hospital.

It cannot be emphasised too often that the keynote of successful prevention and treatment of shock is gentle and careful handling of the patient, who is already apprehensive and suffering physical pain. (See " General principles of First Aid and the Handling of Casualties," Chapter II.)

CHAPTER IV

PRINCIPLES OF BANDAGING

Bandages are made by cutting pieces of material to a desired length, shape and size for use in first aid work and surgical practice ; the material is usually unbleached calico but may be gauze, linen or flannel. Bandages can be improvised from such things as cotton sheets, handkerchiefs and shirts.

They are used to keep dressings in position ; to give support to injured parts, as arm slings ; to secure a broken bone in a limb to its fellow or to the trunk in the case of an upper limb ; to fix splints and retain them in position ; to make pressure, to stop bleeding, and to reduce or prevent swelling in a joint (as in a sprained ankle).

There are two varieties of bandage in common use :—

(i) The Triangular Bandage

Triangular bandages are most useful articles of first aid equipment and are issued to rescue parties for use at incidents. They will also form part of the equipment of static first aid posts, mobile first aid units, and hospitals.

Triangular bandages consist of pieces of calico or linen, usually 40 inches square, cut across the centre from one corner to another. Each half forms a triangular bandage. The longest edge is called the lower border, the two others the side borders. The upper corner opposite the lower border is called the point, the other two corners are called the ends.

To fold a triangular bandage for packing :—

Fold it vertically down the middle, placing the ends of its lower border together. Bring the point, and the two ends, to the middle of the lower border. This forms a square. Fold the square in half from right to left and again in half twice.

Triangular bandages can be used in the following ways :—

As a " whole-cloth," i.e., unfolded, the triangle being spread out to its full extent.

As a " broad-fold " bandage. Carry the point (the angle opposite the longest edge) to the middle of the longest edge opposite, and then fold the bandage again in the same direction.

As a " narrow-fold " bandage. Fold a broad-fold once, long edge to long edge. (See Figs. 4-7.)

Bandages can be secured by tying (using a reef knot) or in certain cases by pinning.

Triangular bandages should be secured by reef knots. Granny knots are to be avoided.

To tie a reef knot, take one end of the bandage in each hand, pass the end in the right hand over that in the left and tie a single knot, then pass the end in the left hand over that in the right and complete the knot. The ends when pulled tight will be parallel with the turns of the bandage. The rule for tying a reef knot is " Right over left, left over right."

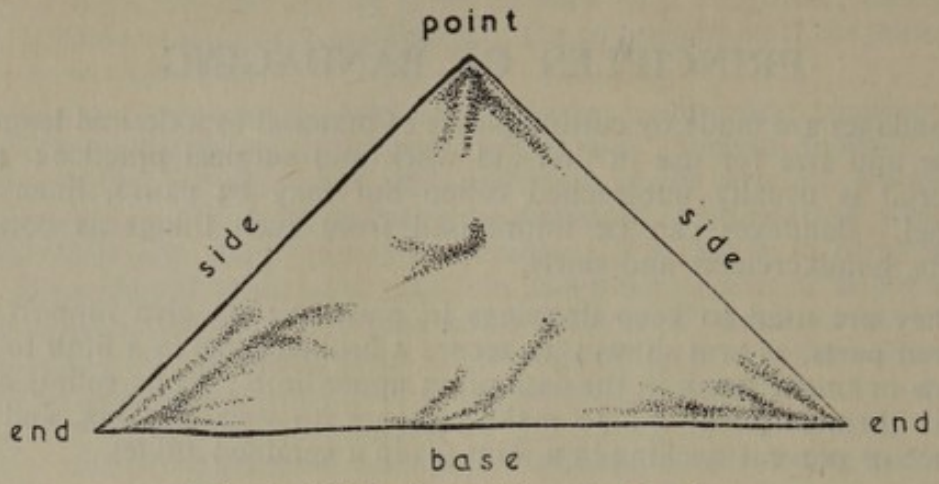

Fig. 4—Whole-cloth Triangular Bandage

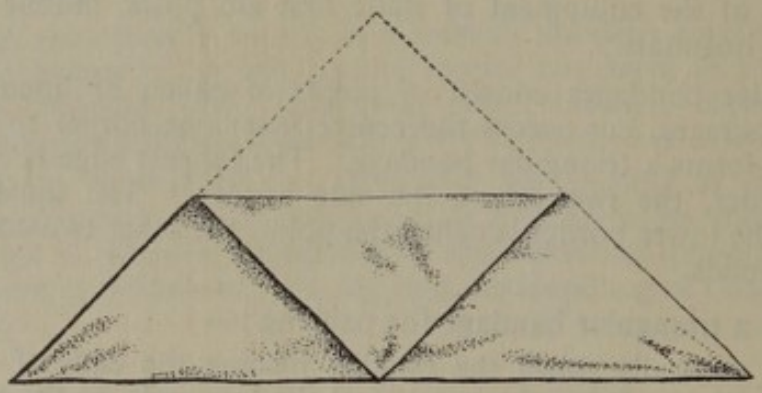

Fig. 5—Once Folded Bandage

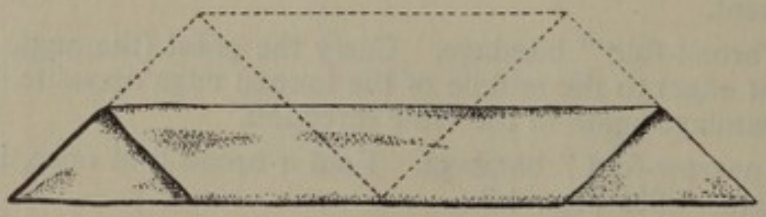

Fig. 6—Broad-Fold Bandage

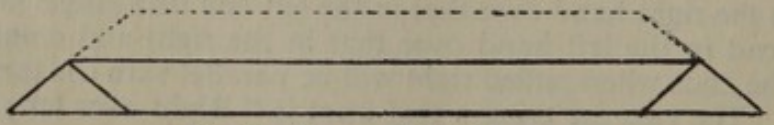

Fig. 7—Narrow-Fold Bandage

For securing splints the triangular bandage may be used broad or narrow fold as convenient. Either of the following methods may be used :—

After adjusting the splints to the limb, place the centre of the bandage over the outer splint, then pass the ends round the limb, cross them on the inside and tie on the outside, over the splint.

Double the bandage lengthways on itself. Place the loop upon the outer splint, carry the ends round the limb from without inwards, and pass both ends through the loop in opposite directions. Tighten the bandage by drawing on the two ends, and tie over splint.

As improvisations in place of triangular bandages, scarves (e.g., Boy Scouts' scarves) or pieces of cloth can be used ; and ties, braces, straps or belts can be used to secure splints or dressings or as improvised tourniquets.

SLINGS

The Large Arm Sling (to support forearm and hand).—Spread out a triangular bandage, put one end over the shoulder on the sound side, pass it round the neck so that it appears over the shoulder of the injured side, and let the other end hang down in front of the chest. Carry the point behind the elbow of the injured limb, and place the forearm over the middle of the bandage ; then carry the second end up to the first and tie them. Bring the point forward and secure to front of the bandage with two pins. (See Figs. 8 and 9.)

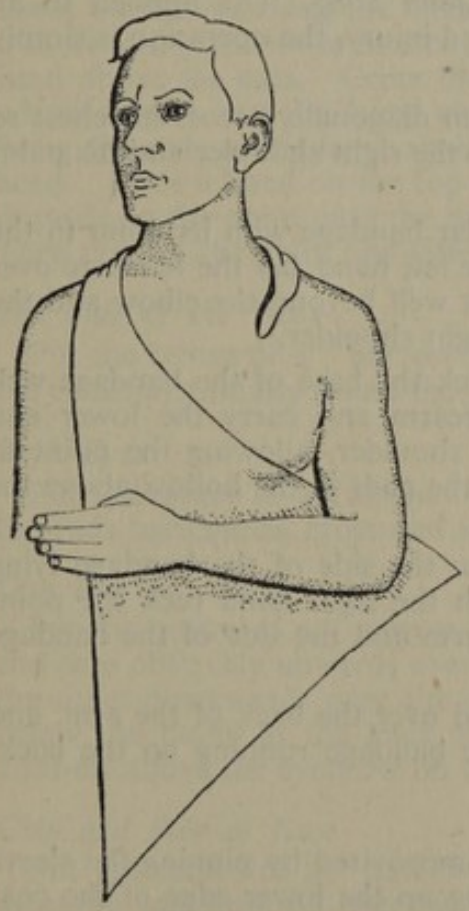

Fig. 8—Application of Large Arm Sling (First Stage)

Fig. 9—Application of Large Arm Sling (Completed)

The Small Arm Sling (supporting wrist and hand, but leaving elbow to hand free). Place one end of a broad bandage over the shoulder of the sound side, pass it round the neck so that it appears over the shoulder of the injured side ; place the wrist over the middle of the bandage so that the front edge covers the base of the little finger. Bring up the second end to the first and tie them. (See Fig. 10.)

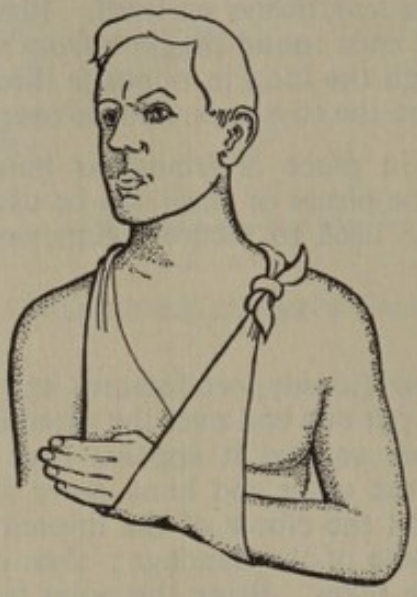

Fig. 10—Application of Small Arm Sling

The "Hand-raised" Sling or St. John Sling. (As applied to an injury on the left side ; for a right-sided injury, the operation is simply reversed.)

(*a*) Place the patient's left forearm diagonally across his chest so that his fingers point towards the right shoulder and his palm rests on his breastbone.

(*b*) Holding an unfolded triangular bandage with its point in the right hand and one end in the left hand, lay the bandage over the left forearm with the point well beyond the elbow and the end in the left hand on the right shoulder.

(*c*) Supporting the left elbow, tuck the base of the bandage well under the left hand and forearm and carry the lower end across the back to the right shoulder, allowing the point to hang loosely outwards. Tie the ends in the hollow above the right collar bone.

(*d*) With the left hand hold open the side of the bandage lying on the left forearm, and with the right hand tuck the point well in between the left forearm and the side of the bandage which is being held open.

(*e*) Carry the resulting fold round over the back of the arm, and firmly pin it to a part of the bandage running up the back. (See Figs. 11 and 12.)

Improvised Slings.—Slings may be improvised by pinning the sleeve of the coat to the garment, by turning up the lower edge of the coat and pinning it, by passing the hand inside the coat or waistcoat and buttoning it, or by using scarves, ties, or belts.

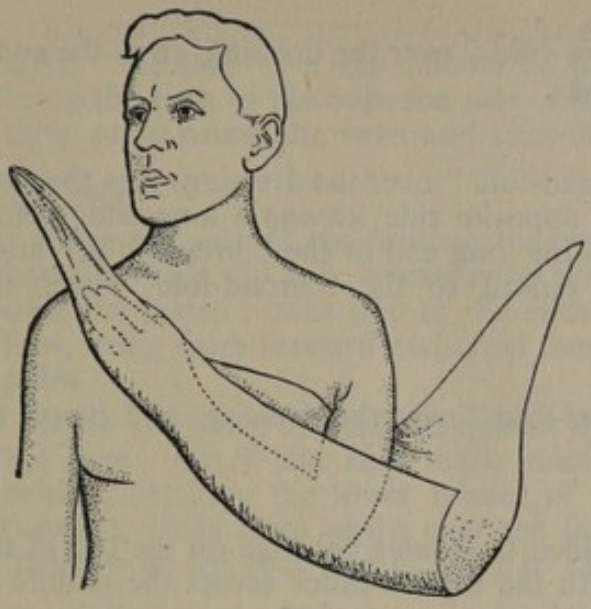

Fig. 11—Application of St. John Sling (First Stage)

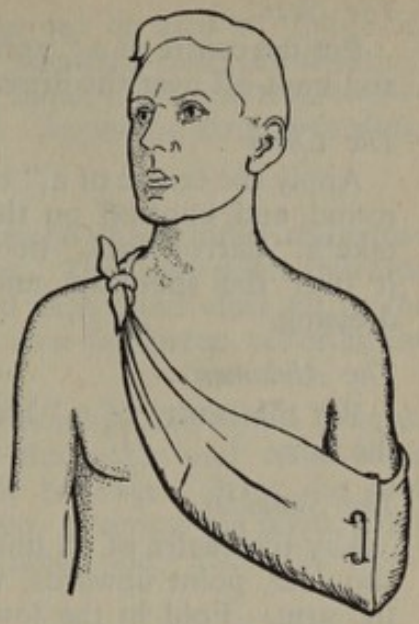

Fig. 12—Application of St. John Sling (Completed)

TO APPLY TRIANGULAR BANDAGES TO SPECIAL PARTS OF THE BODY (e.g., TO SECURE DRESSINGS) :—

The Top of the Head

Take an unfolded triangular bandage and lay its centre on the top of the head, so that its point is towards the back of the head and its lower border lies along the forehead just clear of the eyebrows. Make a short fold in the lower border and pass the ends round the back of the head above the ears. Cross the ends over the point of the bandage, which should here be lying vertically over the crown of the head ; bring the ends to the front again and tie off in the middle of the forehead. Place a hand on the top of the head to steady the dressing and draw down the point until the bandage is taut over the top of the head. Then turn up the point and pin-off on the top of the head.

The Side of the Head

Put the centre of a " narrow-fold " bandage over the dressing, pass the ends horizontally round the head, cross and knot over the dressing.

Both Eyes

Put the centre of a " broad-fold " bandage between the eyes, carry the ends backwards, cross and knot-off in front.

One Eye

Put the centre of a " narrow-fold " over the affected eye. Let one end pass obliquely upwards over the opposite side of the forehead, and the other downwards over the ear of the same side. Cross the ends below the bump at the back of the head, bring them forwards, and knot-off above the eyebrow on the affected side.

Chin and Side of Face

Put the centre of a " narrow-fold " under the chin, pass the ends upwards, and knot-off over the top of the head. Tuck in the ends.

The Lower Jaw (See Chapter XI page 121)

The Neck

Put the centre of a " narrow-fold " over the dressing, cross the ends, and knot-off over the dressing.

The Chest

Apply the centre of a " broad-fold " over the dressing, pass the ends round, and knot-off on the opposite side leaving a long end. Now take a " narrow-fold," tie to the long end of the " broad-fold," bring it over the shoulder, and pin-off to the " broad-fold " over the dressing.

The Abdomen

Put the centre of a " broad-fold " over the dressing, and tie-off on the side.

The Shoulder

Lay the centre of an unfolded triangular bandage on the top of the shoulder, point upwards, with the lower border across the middle of the arm. Fold in the lower border, carry the ends round the arm, cross them, and knot-off on the outer side. Apply the small arm sling, draw the point of the first bandage under the arm sling, fold it back on itself, and pin over the shoulder. (See Fig. 13.)

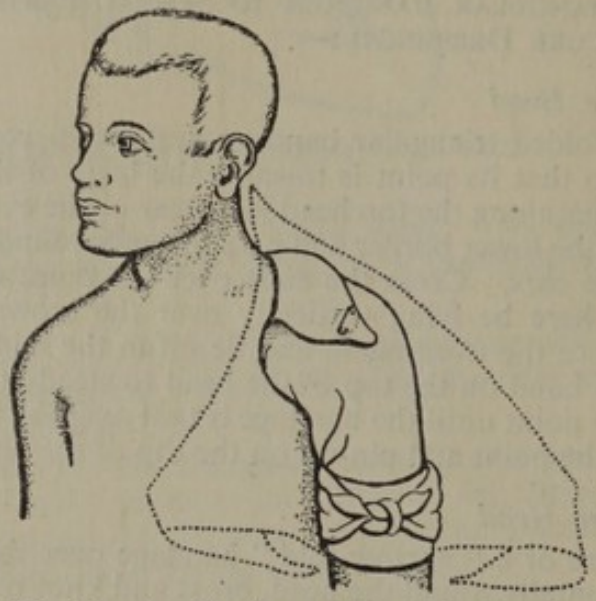

Fig. 13—Application of Shoulder Bandage

The Elbow

Place the centre of an unfolded triangular bandage over the back of the bent elbow, point upwards, turn in the lower border, pass the ends round the forearm, cross them in front, pass up round the arm, cross behind, and knot-off in front. Tighten the bandage by gently drawing in the point, which is then brought down and pinned-off. Apply the large arm sling.

The Hand

Place the hand, palm down, in the centre of an unfolded triangular bandage,with the fingers towards the point of the bandage. Bring the point over the back of the hand to the wrist, pass the ends round it, crossing them over the point. Then fold the point towards the fingers and cover it by another turn of the bandage round the wrist. Knot-off the ends in front of the wrist.

Alternatively, a " narrow-fold " bandage can be used in " figure-of-eight " fashion. Put the middle of the bandage over the dressing, bring the ends to the opposite side of the hand, cross and take two or three turns round the wrist and knot-off. Apply the large arm sling.

The Foot

Place the sole of the foot on the centre of an unfolded triangular bandage with the toes towards the point. Turn the point upwards over the instep ; take one of the ends in each hand close up to the foot, bring them forward and cross them over the instep, covering the point.

Draw the point upwards to tighten the bandage and fold it towards the toes. Carry the ends back round the ankle and cross them behind, catching the lower border of the bandage. Bring the ends forward, cross them again over the instep, covering the point, carry them under the foot and knot-off to the inner side. (See Fig. 14.)

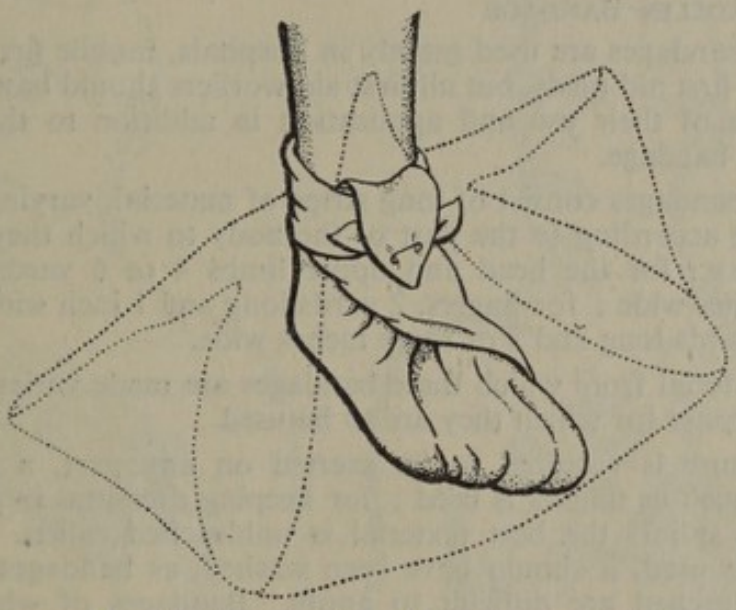

Fig. 14—Application of Bandage to Foot

The Hip

Pass a " narrow-fold " round the waist and knot-off in front. Then take an unfolded triangular bandage, put its centre over the hip, point

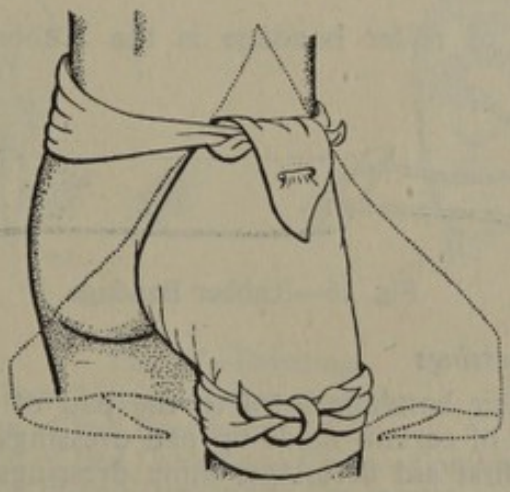

Fig. 15—Application of Bandage to Hip

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upwards, with its lower border folded in and lying across the thigh. Pass the ends round the thigh and knot-off on the outer side. Draw the point upwards under the bandage round the waist, turn it down and pin-off. (See Fig. 15.)

The Knee

Keeping the leg straight, apply a " broad-fold " bandage, cross it behind and knot-off in front below the knee-cap. (See Fig. 6.)

Between the Legs and Lower Part of the Abdomen

Pass a " narrow-fold " bandage round the waist and tie-off. Pass the end of a second " narrow-fold " bandage under the first (waist) bandage at the middle at the back. Fold it over and secure it with a safety pin. Bring the other end forward between the thighs up to the waist-bandage in front ; pass it under ; turn over and secure with a safety pin.

(ii) The Roller Bandage

Roller bandages are used mainly in hospitals, mobile first aid units and static first aid posts, but all first aid workers should have a general knowledge of their use and application in addition to those of the triangular bandage.

Roller bandages consist of long strips of material, varying in length and width according to the part of the body to which they are to be applied, e.g., for the head and upper limbs 4 to 6 yards long and 2 to 3 inches wide ; for fingers, 2 yards long and 1 inch wide ; for the trunk, 6 yards long and 3 or more inches wide.

The material from which these bandages are made varies according to the purpose for which they are to be used.

If pressure is required to be exerted on any part, a stretchable material such as flannel is used ; for keeping dressings in position or for fixing splints the best material is unbleached calico. Whatever material is used, it should have been washed, as bandages which are stiff or starched are difficult to apply. Bandages of whatever size required are issued rolled and ready for use ; when a portion is unrolled the free end is called the tail and the portion still unwound is known as the head. When possible bandages which have been used should be boiled, washed and used again.

Rubber Bandage

Another form of roller bandage is the Rubber Bandage. (See Fig. 16.)

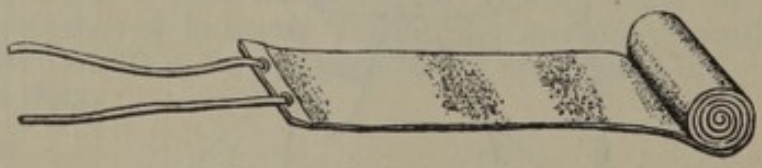

Fig. 16—Rubber Bandage

Made-up Pad Dressings

Lengths of roller bandage sewn to the pad of the dressing form component parts of certain made-up pad dressings used by the Civil Defence Corps (first aid dressings, mine dressings, burns dressings) and the first field dressing carried by the Army. (See Fig. 17.)

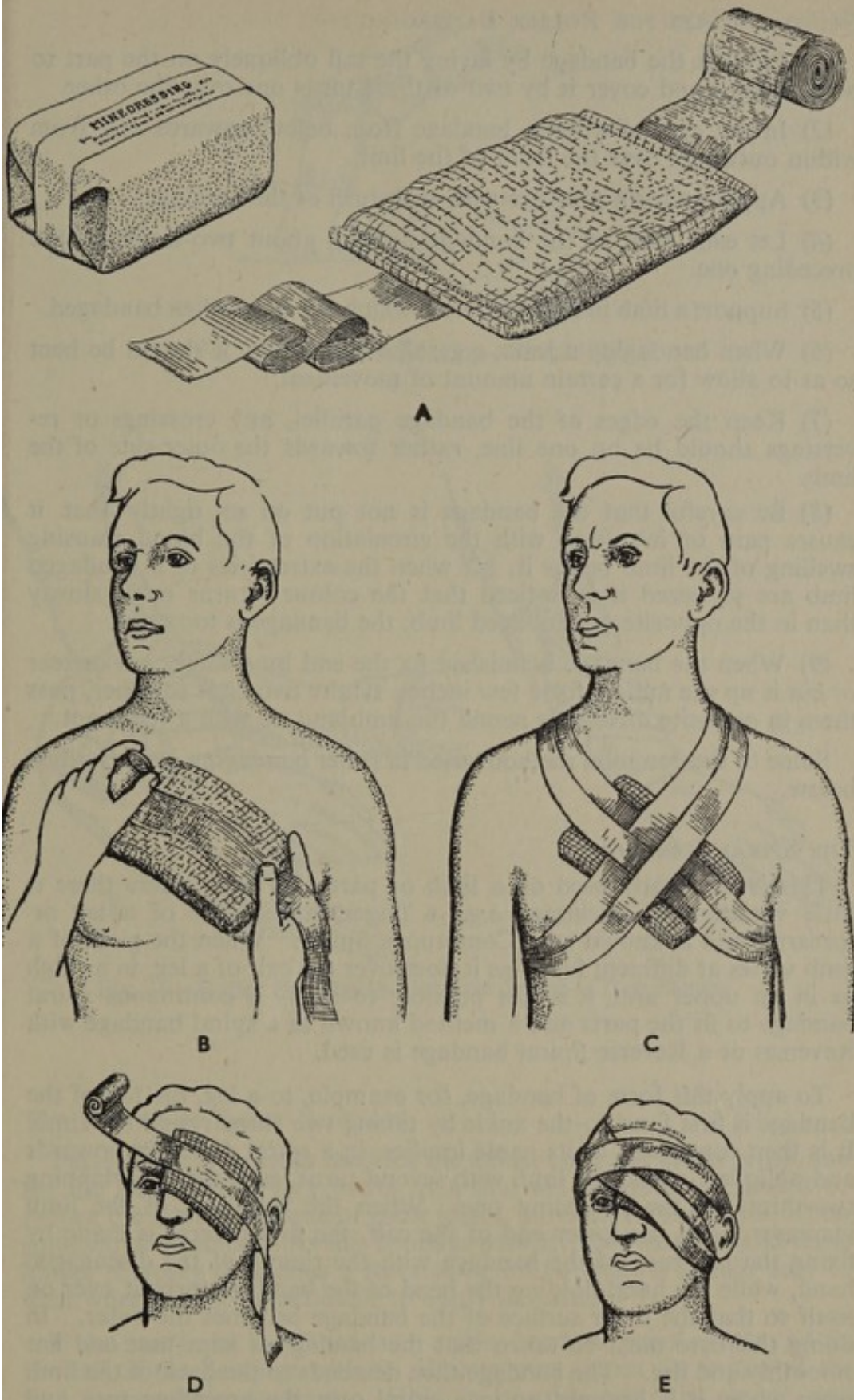

Fig. 17—Dressings

A—Made-up Pad Dressing—Mine Dressing
B—Application of Pad Dressing to Chest
C—Application of Pad Dressing to Chest—Completed
D—Application of Pad Dressing to Eye Injury
E—Application of Pad Dressing to Eye Injury—Completed

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General Rules for Roller Bandaging :—

(1) First fix the bandage by laying the tail obliquely on the part to be bandaged and cover it by two or three turns one over the other.

(2) In the case of a limb, bandage from below upwards and from within outwards over the front of the limb.

(3) Apply uniform pressure with each turn of the bandage.

(4) Let each turn of the bandage overlap about two-thirds of the preceding one.

(5) Support a limb in the position in which it is to be when bandaged.

(6) When bandaging a joint, e.g., elbow or ankle, it should be bent so as to allow for a certain amount of movement.

(7) Keep the edges of the bandage parallel, any crossings or reversings should be on one line, rather towards the outer side of the limb.

(8) Be careful that the bandage is not put on so tightly that it causes pain or interferes with the circulation of the blood, causing swelling of the limb below it. If when the extremities of a bandaged limb are squeezed it is noticed that the colour returns more slowly than in the opposite unbandaged limb, the bandage is too tight.

(9) When the bandage is finished fix the end by a safety pin or tear or cut it up the middle for a few inches, tie the two ends together, pass them in opposite directions round the limb and tie with a reef knot.

Some of the common methods used in roller bandaging are described below.

The Spiral Bandage

This is frequently used on a limb or part of a limb where there is little variation in thickness, e.g., a finger, lower part of a leg or forearm, and is known as a Continuous Spiral. When the girth of a limb varies at different levels as it does over the calf of a leg, in a thigh or in an upper arm, it is not possible to apply a continuous spiral bandage to fit the parts and a method known as a spiral bandage with Reverses or a Reverse Spiral bandage is used.

To apply this form of bandage, for example, to a leg, the tail of the bandage is first fixed to the ankle by taking two turns round the limb. It is then continued, as its name implies, in a spiral direction upwards and obliquely round the limb with several turns, each turn overlapping two-thirds of the preceding one. When the thickness of the limb increases, as at the lower end of the calf, the first reverse is made by fixing the last turn of the bandage with the thumb of the disengaged hand, while the hand holding the head of the bandage turns it over on itself so that the inner surface of the bandage becomes the outer. In doing this care must be taken that the bandage is kept taut and lies smoothly and flat. The bandage then descends to the back of the limb from where it is brought up in a spiral over the preceding turn and again reversed, the process being carried up the length of the limb. A reverse spiral bandage if properly applied should have all its reverses in the same line. A reverse should never be made over a bone, e.g., the shin bone, as this is liable to cause chafing and soreness of the skin. (See Figs. 18 and 19.)

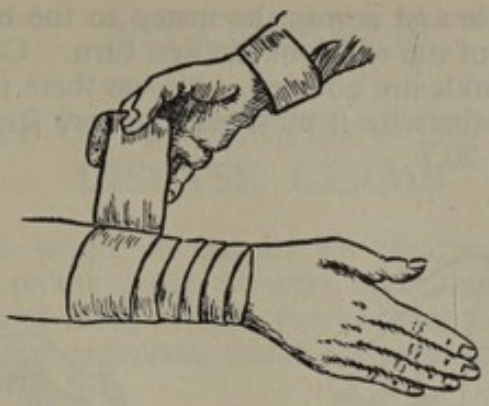


Fig. 18—Roller Bandaging—Simple Spiral

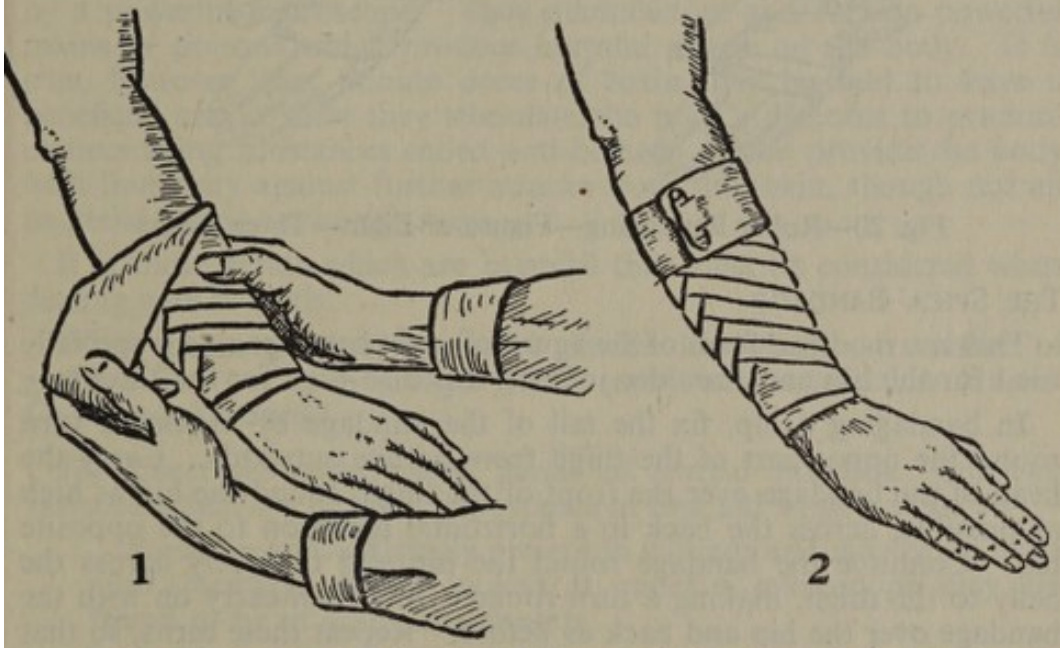


Fig. 19—Roller Bandaging—Reverse Spiral— Two Stages

The Figure-of-Eight Bandage

This is most frequently used for the ankle, knee and elbow joints and for the hand. It is very useful as a first aid measure to prevent or reduce the swelling of one of these joints, particularly the ankle, when sprained or strained. As this bandage uses up more material and takes longer to apply than does a Reverse Spiral bandage it should only be used when it is not practicable to apply the latter.

If the part to be bandaged is an ankle, bend the joint a little and fix the tail of the bandage with an oblique turn across the instep of the foot from within outwards. Hold in position with the thumb and fingers of one hand while the head of the bandage is carried with the other hand under the sole at the base of the little toe and up across the instep, crossing the previous turn and going behind the ankle low down on the heel. Carry the bandage again over the instep and down towards the little toe, covering two-thirds of the width of the first turn ;

pass it under the sole and across the instep to the back of the ankle, covering two-thirds of the width of the first turn. Continue to do this until the foot and ankle are covered. Unless there is a wound on the heel leave it bare, otherwise it may become sore from chafing by the bandage. (See Fig. 20.)

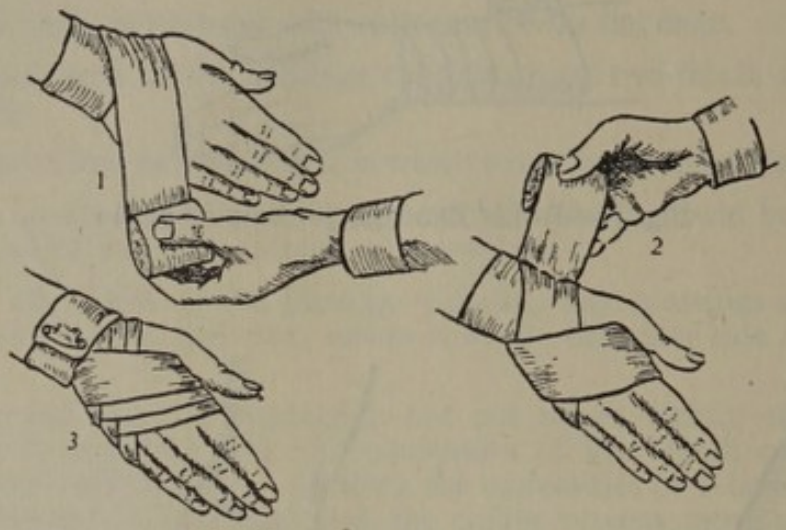


Fig. 20—Roller Bandaging—Figure-of-Eight—Three Stages

THE SPICA BANDAGE

This is a modified form of the figure-of-eight bandage and is specially used for the hip and shoulder joints ; it is also used for the thumb.

In bandaging a hip, fix the tail of the bandage by making a turn round the upper part of the thigh from within outwards. Carry the head of the bandage over the front of the thigh, round the hip as high as possible, across the back in a horizontal direction to the opposite hip. Continue the bandage round the hip and obliquely across the belly to the thigh, making a turn round it, and then carry on with the bandage over the hip and back as before. Repeat these turns, so that each overlaps the preceding one by two-thirds of its width and the turns cross one another on the outside of the hip.

CHAPTER V

PREVENTION OF INFECTION OF WOUNDS BY DISEASE GERMS

Throughout the world, in the air we breathe, on our skins and within our bodies, on the clothes we wear, in the things we eat and drink, in the soil, dust and mud, in fact, everywhere, there is an enormous number of tiny living organisms which are capable of multiplying very rapidly.

Many of these are essential to us in order to maintain our health, others may cause disease or may bring disease into the body if they gain an entrance from outside. These organisms are called germs or bacteria, and are so small that they can only be seen when magnified by a powerful microscope. They manufacture and contain powerful toxins or poisons which produce harmful effects on the body. It is true, however, that minute doses of toxin may be said to have a beneficial action since they stimulate the body's defences to produce counteracting substances called anti-bodies. These provide the body with immunity against further attacks from the toxin, though not all bacterial toxins act in this way.

It is those germs which are harmful that must be considered when dealing with wounds.

While germs which are harmful can be divided into a number of groups, the two main groups which cause wound infection are the *Cocci* and the *Bacilli.*

The Cocci are small round germs of several varieties. The two varieties which are of most importance in first aid work are the :—

Staphylococci.—Usually present in wounds and may cause boils and abscesses. When looked at under a microscope they are found to be in grape-like clusters.

Streptococci.—Similar in shape to the above, but generally formed into chains. Many serious diseases are caused by different varieties of these germs.

The Bacilli are rod-shaped germs which are usually separate from one another and are capable of independent movement. There are many varieties which produce various diseases, e.g., diphtheria, typhoid fever, etc. One variety to be specially guarded against in first aid work is that which causes lockjaw (tetanus).

When the blood stream is invaded by any one variety of these germs the condition it causes is called blood-poisoning or septicæmia.

Infection

When a wound occurs in any part of the body, unless prompt and efficient measures are taken, germs of disease will be carried into the wound from the clothing or skin of the patient, from the ground, from the hands of persons who may touch the wound, and many other sources too numerous to mention. When harmful germs get into a wound it is said to be infected. The result of such infection will depend on the extent of the wound, the action taken to limit or check the spread of the germs throughout the body, the state of health of the injured

person at the time of wounding, and particularly on the nature of the germs. Some such as staphylococci cause local poisoning (suppuration) with the formation of pus, while others, such as gas gangrene organisms or tetanus bacilli, cause much more serious and generalised effects.

Infection may be divided into :—

(*a*) Local.—This occurs when germs have entered a wound and affect a limited part of the body only. In this case a wound is said to be poisoned or septic.

(*b*) General.—This is a more serious condition, which results from the germs passing from the wound into the blood stream and spreading all over the body causing general blood-poisoning.

Defence Measures against Germs

Germs can be destroyed or their activities limited by two main methods :—

(*a*) Those adopted by nature.

(*b*) By the use of heat and by certain chemicals, known as antiseptics or disinfectants, and by agents which prevent germs from multiplying. These are known as bacteriostatic agents, of which sulphanilamide is a good example (See page 50).

(*a*) Nature's Method

The body possesses numerous defence measures against injury and disease, a well known example of one being the clotting of the blood as a defence against bleeding caused by an injury.

By far the most important is that of the power of the blood and lymph to destroy germs of disease when they invade the body.

A reference to Blood (Chapter VI) will show that blood consists of a liquid in which floats a large number of red and white corpuscles. The white corpuscles (leucocytes) which may be described as the body's " Home Guard," destroy germs by taking them up and eating them ; the liquid part of the blood (plasma) contains substances which neutralise the action of the poisons or toxins produced by the germs. These substances are called anti-toxins or anti-bodies (the prefix anti meaning against). Each variety of germ produces its own special toxin, and when this enters the body the blood is stimulated to make an anti-toxin which renders that particular toxin harmless, or destroys it. There are thus two forces which defend the body against germ invasion, one composed of the leucocytes, and a second, the anti-toxins.

As disease germs exist everywhere we are always liable to be attacked, and the germs may enter the body in various ways. For example, the germs of pneumonia, diphtheria, influenza and many others, can enter the body when fine drops of liquid, mucus, etc., loaded with these germs, are expelled from the nose and mouth of an infected person when he sneezes or breathes into the face of another person. This process is known as a " droplet infection." Normal blood contains substances (anti-bodies) which destroy these germs or prevent them from acting, thus maintaining a balance so that no ill effects occur. When, however, an individual becomes " run down " the power to manufacture these substances is diminished and unless more can be made in sufficient quantity as a reinforcement, and called up in time, the disease germs gain the upper hand and illness results.

When a wound in a healthy person becomes infected by germs the defence organisation comes into action and the conflict between the germs and the body causes inflammation. In this the small blood vessels in the affected area dilate, so that blood circulates more quickly and in a larger quantity than before, causing heat and redness in the injured part. Soon the blood vessels contract, the circulation slows, and the white corpuscles tend to stick to the walls of the capillaries. Later, these corpuscles, together with a large quantity of the liquid part of the blood and a few red corpuscles, force their way through the thin walls of the capillaries and smaller veins and attack the germs in the surrounding tissues. The increase of fluid produces the *swelling* which, with *heat*, *redness* and *pain* form the four characteristic signs of inflammation. The liquid part of the blood in the meantime is making anti-toxins to neutralise the toxins which the germs are passing into the blood and tissues.

If the defence area of white corpuscles and anti-toxins resists the attack, destroying the invading germs, then the inflammation is limited and healing takes place, though pus (or matter) is often formed by the process. Pus is a yellowish or white (sometimes brown or green) creamy material composed of the dead white corpuscles, tissue cells and germs. All the germs, however, may not be killed so pus can carry infection and is thus dangerous to those who come into contact with it. If, on the other hand, the defence fails, the germs may enter the general circulation and cause serious trouble.

The lymphatic system forms a second line of defence. It is composed of a network of lymphatic vessels like capillaries and veins through which a clear fluid, lymph, flows. Along the course of these channels lymph glands are found, often in groups as in the groin and armpit. The main purpose of this system is to act as a filter which removes toxins and the dead corpuscles which have become casualties in the war against the invading germs. The signs of involvement of the lymphatic system are described earlier (See Chapter I).

Prevention of Infection

It must always be remembered that any wound, especially one which occurs in an air raid, is certain to be infected by the clothing of a casualty or by dirt, mud or dust carried into the wound, therefore:—

Do not add to the infection by touching the wound with your hands or by attempting to cleanse it at an incident but :—

Remove any obvious loose foreign bodies (e.g., splinters of glass, pieces of rubble, clothing, etc.) which are lying upon or near the wound.

Do Not attempt to remove any foreign bodies which may be embedded in the wound, as by doing so you may start bleeding and will certainly infect the wound with your fingers. A "Built-up" dressing, composed of several sterilised pad dressings, forming a mound placed round the wound with a dressing over it may be all that is necessary (See Fig. 21), but in the case of bleeding which cannot be stopped by this method a rubber bandage should in addition be applied above the wound (i.e., between the wound and the heart) at the nearest point where the bleeding can be controlled.

Cover the wound as quickly as possible with a clean, dry dressing and bandage, after removing only sufficient clothing to lay it bare. In very exceptional cases where there is extensive damage and shock

is very marked, a dressing may be applied without removing any clothing as the removal of clothing tends to increase shock. This dressing will prevent further germs from entering the wound and will ease pain. In the case of multiple wounds, only those which are an immediate danger to life should be attended to, so as not to delay the removal of the patient to hospital. A dressing usually consists of layers of lint or gauze, on top of which is a thick pad of cotton wool and a bandage ; the lint or gauze is placed next to the wound and the dressing kept in position by the bandage. Certain types of made-up pad dressings previously sterilised and wrapped in packets, are issued for use by the appropriate Civil Defence Sections (e.g., large and medium first aid dressings, and mine dressings). If no proper dressings are available, a clean freshly unfolded handkerchief, or clean triangular bandage, used as a pad (both with their inner surfaces next to the wound), a piece of clean unprinted paper or an envelope opened up with its inner clean surface next to the wound, may be used as a purely temporary measure.

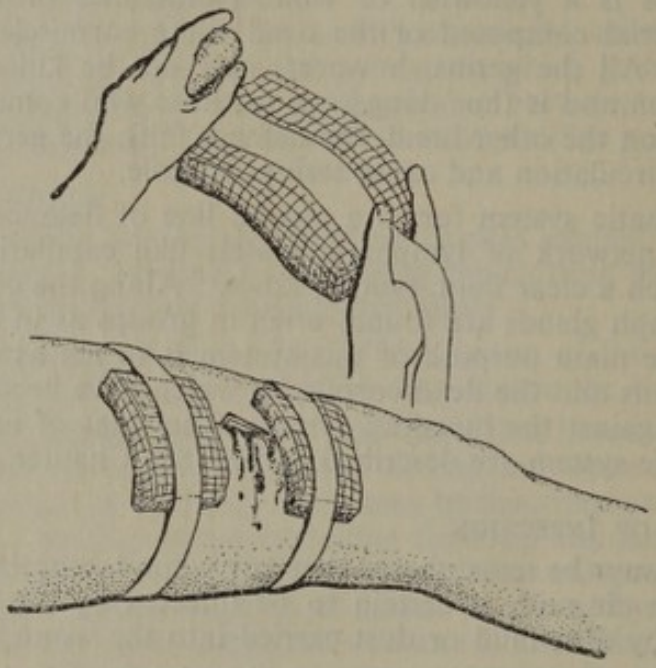


Fig. 21—Application of " Built Up " Dressing

It is of the utmost importance that a casualty with a wound should be sent to a hospital, to a mobile first aid unit or to a static first aid post as soon as possible after the wound has been dressed and he has been treated for shock at the incident. The reason for this is twofold. Anything which tends to make the general condition of the casualty worse (e.g., shock, rough handling, bleeding, delay, etc.) will favour the growth of infection and the occurrence of blood poisoning. It is at hospitals and first aid posts that skilled surgical aid, together with appliances and nursing facilities, are available to deal with wounds and prevent them from becoming poisoned (septic) ; here also the injection of anti-tetanic serum is given as a protective measure against lock-jaw (tetanus). At hospitals the modern complicated anti-shock measures which are impossible at a first aid post can be carried out, therefore, all severe cases should be sent to hospital.

It cannot be stressed too often that persons dealing with casualties must refrain from touching wounds and must keep their hands as clean as possible when handling dressings.

(*b*) By the use of heat or by chemical antiseptics—

There are two well known artificial, as opposed to natural, methods of preventing infection in wounds. One is called Aseptic treatment and the other Antiseptic treatment.

(i) *Aseptic Treatment.*—This method is concerned with the prevention of sepsis in a clean wound, such as an operation wound, by the use of heat and is described below. The principle of this method is to free from germs by means of sterilization everything which might be brought into contact with a wound.

Modern surgery is primarily concerned with the exclusion of sources of infection, and its method is a combination of the aseptic and antiseptic principles.

There are three normal methods of destroying germs by heat, i.e., by boiling, by using steam under pressure (steaming), or by actual burning. It is obvious that this method cannot be employed against living germs within the body or in wounds ; it can, however, be used to kill germs in materials, such as dressings, clothing, etc., in all instruments and appliances and in liquids, before they are allowed to come into contact with wounds. Some types of germs are more resistant to heat than others, and consequently require a higher temperature and for a longer period than those which are more easily killed by lower temperatures. The process of destroying germs, whether by heat or by chemicals, is known as " sterilisation " ; articles in which germs have ceased to exist after sterilisation are said to be " sterile." Materials used for covering wounds cannot, of course, be sterilised at incidents, so dressings such as those already referred to (first aid, mine dressings, etc.) are used. Where facilities are available (e.g., at hospitals, first aid posts, etc.) dressings can be sterilised as required, and applied to wounds which have previously been cleansed. In an emergency, when no sterile dressings are available, it is possible rapidly to sterilise a piece of lint or other form of dressing by holding it before a gas or electric fire until it just begins to scorch. The scorched side can be considered sterile.

(ii) *Antiseptic Treatment.*—This method of treating wounds is intended to prevent the development of germs or to destroy them by the use of certain chemical substances known as antiseptics or disinfectants. These substances, which are mostly dangerous poisons, may be either liquid or solid. Antiseptics are usually employed for cleansing wounds and for use as dressings in the form of solutions known as " lotions." They are made up by dissolving a measured amount of the antiseptic in a suitable liquid, generally sterilised water, so as to form a lotion of a known strength sufficient to prevent the growth of germs or to destroy them. Thus, a lotion whose strength is 1 in 20 means that 1 part of the antiseptic (e.g., teaspoonful) is contained in 19 parts (teaspoonfuls) of water or other liquid. If antiseptics are used it is essential to know the appropriate strength in which to apply the antiseptic concerned, and instructions will normally be found on a label on the bottle. Dilution of these chemicals is necessary when they are used for wounds as many of them are so strong that they will, if undiluted, not only destroy germs but also the tissues and protective white corpuscles. Stronger solutions than those used for wounds can be employed to sterilise instruments, dressings, etc.

A few examples of the methods used to destroy germs or to prevent their growth are given below.

BY HEAT

All instruments (with the exception of sharp cutting instruments, such as knives, scissors, razors, needles, etc., which will be blunted if they are boiled) can be sterilised by boiling in water or a 1 per cent. solution of bicarbonate of soda (baking soda) for 30 minutes. For the sterilisation of sharp cutting instruments the best solution is a mixture of borax and formaldehyde as contained in the liquor sterilisans.

Dressings, bandages, swabs, etc., are best sterilised in a high pressure steam boiler known as an " Autoclave." The articles for sterilisation are loosely packed in perforated drums so that the steam when generated and compressed at a high temperature can circulate through and thoroughly penetrate them. At a temperature of 266 degrees to 293 degrees F. all germs are destroyed by exposure to the action of the steam for 15 minutes ; where only a temperature of 212 degrees F. can be obtained, three-quarters of an hour are necessary before the germs are killed.

A quick method of sterilising bowls, trays, etc., is to pour a small quantity of methylated spirit into them and then set it alight ; the heat produced is sufficient to destroy any germs which are present. Boiling for 20 minutes will produce a similar result.

BY ANTISEPTICS

Proflavine and Euflavine are valuable antiseptics which destroy germs in a wound without damaging the tissues. *They should never be used in a strength greater than* 1 *in* 1,000 (i.e., 10 drops to a pint). Some forms of prepared dressings after being sterilised are soaked in a solution of this antiseptic before being dried and packed. Euflavine will be issued to Civil Defence first aid posts. There are also a number of proprietary antiseptics which are entirely satisfactory, though the liquor antisepticus which will be used at Civil Defence mobile first aid units and static first aid posts contains somewhat similar elements and is an excellent lotion for cleansing wounds, sterilising instruments, dressings, etc. It is used in a strength of half a teaspoonful to a pint of boiled water.

Hydrogen Peroxide.—Is a colourless fluid which is specially used for cleansing wounds when infection has occurred and pus has formed. It contains either 10 or 20 times its volume of free oxygen and hence is said to have a strength of either 10 or 20 volumes.

Sulphanilamide.—Is one of a group of compounds known as the Sulphonamides used extensively in the treatment of wounds, and is of great value. The action of Sulphonamides is mainly to prevent the multiplication of germs in wounds and hold them in check until the defence mechanism of the body can destroy them. Sulphonamides do not neutralise the toxins of germs to any extent of practical importance. Sulphanilamide is chosen as a local application for wounds on account of its ready solubility, but it can also be given in the form of tablets by the mouth and is rapidly absorbed into the blood stream, penetrating throughout the whole body.

Sulphanilamide powder will be issued with dredgers to Civil Defence mobile first aid units for use when there is likely to be a delay in getting a casualty to a hospital. The powder is shaken over the wound so

that a thin uniform coating is spread over its surface, after which a dressing is applied. When this powder is used in quantity for large wounds, e.g., burns, etc., or for prolonged periods, its effects must be frequently checked by examining the blood of the patient. This must be done in a hospital.

Penicillin.—The comparatively recent discovery of this product of a plant mould has shown that it is a powerful agent in destroying or preventing the growth of certain germs which infect wounds, e.g., staphylococci and streptococci being the most common. Penicillin is combined with various chemical salts before it is suitable for internal or external administration. There are many types of germs upon which penicillin has little or no effect, consequently in some conditions a bacteriological examination of the site of infection must be made to determine the nature of the germ before penicillin can be used with any hope of success. At first aid posts penicillin can be applied to certain types of wounds, under medical supervision, in the form of an ointment or cream spread upon sterilised lint. It may also be used as a fine powder shaken out of a dredger or sprayed over a wound before a dressing is applied.

CHAPTER VI

THE HEART, BLOOD VESSELS AND CIRCULATION OF THE BLOOD

A brief account of the circulatory (blood) system has been given in Chapter I. Before dealing with bleeding and its first aid treatment it is necessary to give a more detailed account of the structure of the heart, the blood vessels and the blood together with their functions, followed by a description of the method by which the circulation of the blood is carried out.

The Heart

Is a strong hollow muscular organ which acts as an automatic pump and maintains the circulation of the blood throughout the body. It is about the shape and size of an adult closed fist and weighs normally about 8-10 ounces. Roughly conical it is situated within the chest behind the breast bone and between the two lungs with its base or broader part facing upwards towards the neck, and its apex or point projecting downwards and inclined somewhat to the left. It is this apex which is seen and felt to beat against the chest wall below and slightly internal to the left nipple which constitutes the " apex beat."

A partition which extends down the centre of the heart from base to apex divides it into two halves and allows no communication between them.

In each half there are two cavities or compartments communicating with one another by a large circular orifice. The upper cavity is called the " auricle or atrium " and the lower the " ventricle." The cavities on each side of the heart are known respectively as the right and left auricles or atria and the right and left ventricles.

Into the right auricle open two large veins through which blood pours into the heart from all parts of the body, except from the lungs. The upper of these two veins carries blood from the head, neck and chest with the exception of the lungs and the upper extranities (superior Vena Cava) ; the lower from the trunk and lower limbs (Inferior Vena Cava).

Blood is brought from the lungs to the left auricle in four large veins (pulmonary), two from each lung. These veins can be considered as the suction feed pipes of the pump. The communicating orifice between the auricle and ventricle is guarded by a valve which opens and closes to allow blood to pass only from auricle to ventricle. Out of each ventricle a large tube leads off, that from the right ventricle is called the " pulmonary artery " and that from the left the " Aorta." These correspond to the hosepipes of a pump as they carry blood away from the heart, by the pulmonary artery to the lungs only, by the aorta to all other parts of the body. Just as the opening between auricle and ventricle is provided with a valve so there is a valve placed at the root of each of these large arteries as they leave the heart to allow the blood to travel away from the ventricle only, and permit of no back wash.

The heart is composed of a special type of involuntary muscle which has the power of being able to contract and relax the auricles and ventricles alternately with a regular rhythm and so produce the action of an automatic pump. As in all forms of pump, fluid has to be fed *to* the pump through one pipe or set of pipes before it can be forced *out* through another pipe, so in this case fluid in the form of blood is fed *to* the heart through veins and pumped *out* again through arteries.

If the diagrams (Figs. 22 and 23) are studied, some idea can be obtained of what happens when the heart is in action as a pump.

The whole heart is assumed to be relaxed and flabby for a moment. Blood is pouring into each auricle through the veins gradually distending it, and some flows through the connecting orifice into the corresponding ventricle. When the auricle is fully distended it contracts and drives its blood into the ventricle after which it relaxes. The valve between the auricle and ventricle begins to close as the ventricle then contracts forcibly and drives the blood out through the large artery, the valve guarding the orifice of the artery then closes so that no blood can flow back to the heart.

When the ventricle is empty it again relaxes and becomes flabby until a further supply of blood is forced into it from its auricle when it recommences its pumping. It must be realised that this takes place at the same time on each half of the heart. In a normal adult the heart beats, i.e., contracts and relaxes about 72 times every minute.

As the ventricles of the heart have heavier work to do than have the auricles, their muscular walls are considerably thicker than those of the auricles. Since the left ventricle has to pump blood further than has the right ventricle, its walls are thicker than those of the right ventricle.

In order that the heart can continue to work as an automatic pump, minute by minute, day by day, and year by year, without cessation, its tissues are richly supplied with nourishment brought to it by its own blood vessels. It is enclosed in a strong fibrous bag known as the "pericardium", within which it moves freely with a minimum of friction, as the outer surface of the heart and the inner surface of this bag are both covered with a smooth shining membrane and lubricated by a special fluid obtained from the blood.

Blood Vessels

These are the tubes through which blood circulates to every part of all the tissues of the body after it has been pumped out of the heart, and also through which it is returned again to the heart.

The three types of blood vessels are known as "Arteries", "Capillaries" and "Veins".

(*a*) *Arteries*

These are the tubes through which blood passes *from* the heart to all parts of the body. Arteries may be likened to rubber tubing, as their walls contain elastic and muscle tissues, which render them capable of dilating and relaxing in the same way as rubber tubing does when fluid is forced through it under pressure.

Because of their elasticity the blood which is pumped into each artery with every beat of the heart, is carried on as a fluid wave which distends the vessels throughout the arterial system, the wave becoming less noticeable as the arteries grow smaller and the pressure in them less. This wave or impulse only occurs in the arteries and is known

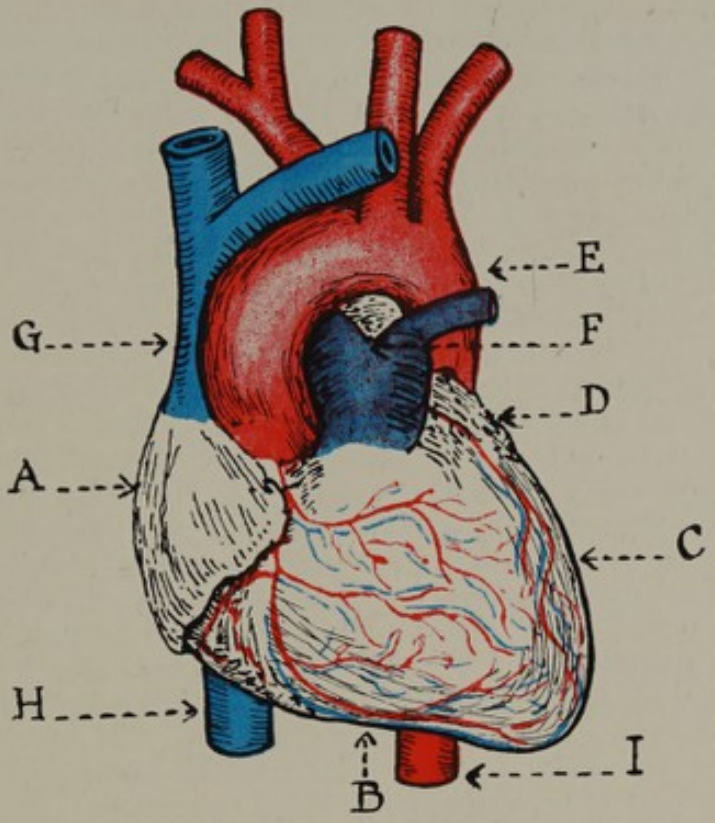


Fig. 22—Heart, Front View

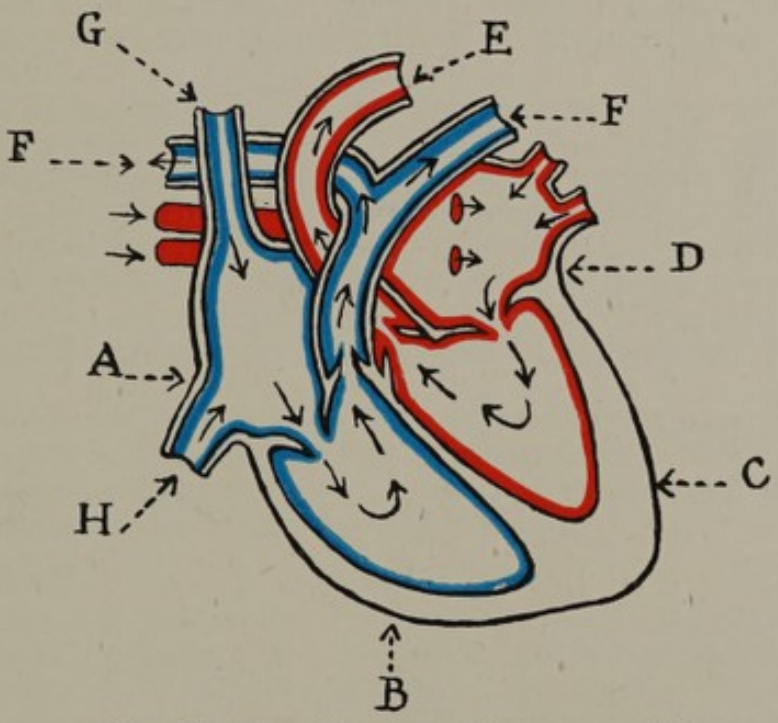


Fig. 23—Heart Cut Open (Diagrammatic)

A—Right Auricle
B—Right Ventricle
C—Left Ventricle
D—Left Auricle
E—Aorta
F—Pulmonary Artery
G & H—Superior and Inferior Vena Cava
I—Thoracic Aorta

as the " pulse." Each beat of the pulse corresponds to a contraction of the left ventricle of the heart and the consequent distension of the aorta with blood (see below). Most arteries lie deeply in the body beneath muscle and other forms of tissue, but in some parts they lie near the surface and can be seen and felt to pulsate. The easiest way in which the pulse can be felt is by placing a finger on the front of a forearm about one inch above the bend of the wrist, and about half an inch to the inner side of the edge of the bone on the outer side of the forearm when the palm is uppermost. This pulse is from an artery (known as the " radial ") which lies near the surface and upon one of the bones of the forearm (radius) (See page 99). The pulse can also be seen and felt in other parts of the body, e.g. by placing a finger on either temple in line with the front of the ear an artery called the " temporal " can be felt : likewise, a pulsating artery called the " carotid " can be felt by placing a finger on either side of the " Adam's apple " in the neck. At certain points in the body arteries which lie close to or upon bones and near the surface can be pressed down upon the bones by one or more fingers, or other means, so that blood cannot pass beyond the point of pressure. These points which are known as " pressure points " are used to stop bleeding which has occurred when an artery has been wounded. Every first aid worker must be familiar with these pressure points which are described on page 82-86. The *aorta*, which is the largest artery in the body, opens out of the left ventricle and at its commencement has an internal diameter of about one inch in a normal adult person. The total length of this artery in an adult is about eighteen inches. After leaving the heart it gives off branches before dividing into smaller branches carrying blood to every part of the body, with the exception of the lungs.

It must be realised that these branches become smaller and smaller as do the branches of a tree until they finally end as minute twigs. The smallest branches, or twigs, of arteries are known as " arterioles " (little arteries). Muscle tissue as well as elastic tissue is found in the arterioles, as in the arteries. This by its contraction causes a diminution in the calibre of the tubes and so controls the amount of blood which can pass along them to supply the needs of the tissues. If a tissue needs more blood the muscle relaxes ; if it needs less the muscle contracts.

The Pulmonary, which is the other main artery, opens out of the right ventricle and shortly after its commencement divides into two large branches, a right and a left, which again divide and subdivide, carrying blood to the right and to the left lungs.

(*b*) *Capillaries*

These are the continuations of arterioles which, as they become merged into capillaries, lose the characteristic muscle and elastic tissue in their walls. Capillaries form a mesh-work of minute blood vessels throughout the body. The walls of these tiny tubes are different in composition from those of both arteries and veins as they are made up of an extremely fine transparent membrane through which oxygen and certain soluble substances absorbed by the blood from food can pass to the tissues as nourishment. At the same time carbon dioxide and various waste products are absorbed into the capillaries to be carried on by the blood stream and got rid of. The capillaries gradually increase in size from the smallest tubes, which can only be seen through a microscope, to larger ones which are known as " venules " (little

veins). The walls of these contain some elastic as well as muscle tissue and are joined by other venules and larger tributary veins on their way back to the heart to form " veins." It will thus be seen that capillaries are the minute blood vessels which unite the ends of the arteries to the beginnings of the veins.

(*c*) *Veins*

These are the tubes through which blood is carried back to the heart from the tissues throughout the body. They differ somewhat in structure from arteries as they are not called upon to undertake such heavy work or to withstand the variations in pressure which occur in the arteries. For this reason they have thinner walls containing less elastic and muscle tissue than have the arteries ; their calibre (or internal diameter), however, is usually greater than that of the corresponding arteries.

As will be seen from the description of the circulation of the blood, the force of the pumping action which originates from the heart becomes less as it passes through the arteries and capillaries into the veins. This force constitutes what is called the " blood pressure." This is maintained by the heart beat, by the volume of blood pumped out by the heart, by the elastic walls of the arteries, and by the resistance to the onward flow of the blood through the blood vessels. In consequence, the blood pressure is highest in the arteries but falls considerably in the veins, until, in the main veins near the heart it has fallen to zero, or even to a minus pressure. The blood in the veins is drawn back to the right side of the heart by the suction action of the alternately contracting and relaxing right auricle, and this is further assisted by respiration. During each inspiration blood is drawn into the chest by suction ; during each expiration blood is driven up from the abdomen by pressure on the veins. Thus a kind of subsidiary pumping action occurs, and this has been called the " respiratory pump." Another important factor in the return of blood to the heart is muscular action. This compresses the blood vessels in the muscles themselves and squeezes the blood towards the heart ; thus, more blood goes to the heart, and the action of the respiratory pump is increased when a person takes exercise, than when he and his muscles are at rest. As there is little force behind the flow of blood in the veins, and also on account of gravity, there is a tendency for the blood to flow back the wrong way ; this is specially marked in the limbs. To prevent this back-flow, valves are placed at regular intervals along the course of the larger veins, particularly those in the limbs. These valves are designed to allow the blood to flow only towards the heart and not away from it. Few valves exist in the veins of internal organs. " Varicose veins " as they are called, and with which everyone is familiar, occur when for one reason or another the valves have ceased to work efficiently, thus allowing the blood to flow back away from the heart. The commonest place for this condition to occur is in the legs, especially in persons who have to stand for long periods, or who compress the veins by wearing tight garters above the knees. As a result the veins become enlarged, visible, tortuous and knotted. Unlike the arteries, many quite large veins lie just beneath the skin, particularly in the limbs.

BLOOD

Blood is a fluid tissue consisting of a liquid called " plasma " in which floats a vast number of minute solid bodies called " corpuscles."

The two main kinds of these corpuscles are the " red " and the " white." There are also other small bodies which are known as " blood platelets," which are concerned with the clotting of the blood. The red corpuscles are of a round biscuit shape slightly hollowed out on both sides, are soft and elastic, and contain a substance called " hæmoglobin " which gives them a yellowish red-colour. The white corpuscles are far fewer in number than the red corpuscles but are larger and have varying shapes. Some idea of the size of the red corpuscles can be obtained when it is realised that there are many millions in a single drop of normal human blood The colour of the blood is bright red in the left side of the heart (i.e., in the left auricle and left ventricle) and in the arteries, but changes to a bluish red in the capillaries, in the veins and in the right side of the heart (i.e., in the right auricle and right ventricle). This is due to the fact that blood which is pumped from the left side of the heart into the arteries contains oxygen brought to it from the lungs and for this reason is called " purified " blood, while that in the veins has got rid of its oxygen to the tissues and as " impure " blood, as it is sometimes called, reaches the right side of the heart. If the plasma is separated from the corpuscles it is found to be a straw-coloured liquid which contains about 85 per cent. of water with certain complex substances dissolved in it. Plasma is the medium for carrying nourishment obtained from the food to the tissues and for carrying away waste products, including carbon dioxide, from the tissues to be removed by the lungs and the kidneys. It also contains substances which can combine with the blood platelets referred to above and cause the blood to clot. The function of the red corpuscles is to carry oxygen to all the tissues. This is obtained from the air by the hæmoglobin in the red corpuscles, which possesses the power of combining with oxygen as the blood circulates through the lungs. The white corpuscles have been described as the " Home Guard " of the body (See page 46) as their main functions are to destroy all forms of disease-producing germs which invade the body, to absorb foreign bodies, and to aid in the repair of wounded tissues.

The total quantity of blood contained in the human body is about one-eleventh of its total weight ; thus the amount of blood in a man of 11 stones weight will be about 14 lb. (approximately 11 pints).

The functions of the blood can be summarised as follows :—

(i) To carry oxygen from the air in the lungs *to* the tissues, and to remove carbon dioxide *from* the tissues to the lungs.

(ii) To carry nourishment obtained from the food to the tissues.

(iii) To remove waste products *from* the tissues *to* organs which get rid of them, e.g., the kidneys and sweat glands.

(iv) By means of the white corpuscles to destroy disease germs which invade the body, and to repair injured tissues.

(v) To arrest bleeding by clotting.

(vi) To distribute and maintain an even temperature throughout the body.

Circulation of the Blood

In order to understand this, it must be realised that there are two lines or traffic systems along which blood passes throughout the body. These two systems are called the " General " and the " Pulmonary "

circulations. The general circulation is the larger and more extensive as blood has to pass along it from the heart to all parts of the body, with the exception of the lungs, and back again to the heart. The pulmonary circulation is only concerned with the flow of blood from the heart to the lungs and back again to the heart, after circulating through the lungs.

To deal with the *general circulation* first, and commence at the left ventricle of the heart. Blood is pumped out of this into the arteries through the aorta and its branches, reaches the capillaries where its rate of flow is slowed down ; then on into the veins where it returns to the heart and is collected by two large veins which open into the right auricle. It will thus be seen, and a reference to the diagram will make this clear, that the blood has travelled from one side of the heart right round the body and returned to the other side of the heart. At this point the general circulation is completed and the blood is now carried on through the *pulmonary circulation.*

This commences after the right auricle has driven the blood it contains into the right ventricle and this in turn forces the blood through the pulmonary artery and its branches into the lungs. Here it circulates through capillaries as in other parts of the body and also through special air cells and is finally brought back by veins to the left auricle. The left auricle now filled with blood is ready to pump its contents into the left ventricle and start the general circulation again on another round of the body.

CHAPTER VII

BLEEDING (HÆMORRHAGE)

Bleeding may be described as an escape of blood from any kind of blood vessel as the result of an injury or disease which causes a break in its wall.

Bleeding is classified as :—

Arterial
Capillary
Venous

according to the type of blood vessel from which it comes.

Much has been written and taught about the distinction between these three types of hæmorrhage. In war injuries, however, there seems to be little point in describing separately the signs and symptoms of these three types, since in an extensive wound all three are present at the same time. It is sufficient to say that if an artery is damaged, the blood spurts out in jets, each jet corresponding to a beat of the heart, and is bright red in colour, while in the case of capillaries and veins the blood oozes or pours from a wound in a steady continuous stream, and is darker in colour than the blood from an artery. If a large artery is cut, spurting may be seen for the first few moments only, owing to the rapid fall in blood pressure.

The fact that blood is bright red and is spurting may be useful in deciding the severity and treatment of a wound in daylight, but, in darkness or by artificial light the only guide will be the speed and force with which blood is flowing from a wound. The most serious kind of bleeding is that which takes place from a large artery and unless the bleeding is checked within a very short space of time the injured person will die from loss of blood. Fortunately, this type of bleeding is rare. It must be remembered that any form of bleeding, even capillary, may be capable of assuming alarming proportions, and this is particularly the case when muscle tissue has been lacerated, as by fragments of H.E. bombs.

Bleeding may also be divided into three stages :—

(*a*) Primary
(*b*) Reactionary
(*c*) Secondary

according to the time when it occurs.

(*a*) *Primary Hæmorrhage*

This occurs at the time of an injury. It may also occur when the wall of a blood vessel is perforated or eaten away by some form of disease. This sometimes happens in cases of Tuberculosis of the lungs, stomach ulcer, and in many other conditions.

(*b*) *Reactionary Hæmorrhage*

This is bleeding which recurs some time after the primary bleeding has stopped, and generally within 24 hours. In some cases, wounds may bleed little when they are first caused, but later a considerable amount of blood may be lost by this form of hæmorrhage.

The reason for this is that as a result of the shock caused by the injury the blood pressure is lowered, the action of the heart is weakened and the volume of blood going to it lessened, so there is a tendency for the flow of blood from a wound to be diminished or even stopped. When recovery from the shock takes place, the blood pressure is raised and bleeding recommences.

It is particularly important to remember the possibility of reactionary hæmorrhage occurring in severely injured persons who may have to travel a long distance before reaching a hospital. Inadequate first aid treatment at the time of the injury, together with careless or rough handling, may have fatal results if bleeding should recur, and not be noticed, on the way to the hospital. All first aid workers and ambulance attendants in particular should, therefore, be instructed to keep a good look-out for such cases.

(*c*) *Secondary Hæmorrhage*

Fortunately this seldom occurs. It means that bleeding has started again at a later date, seldom earlier than a week after the initial injury.

This type of bleeding, which gives rise to a very urgent and grave condition, is generally due to infection of the wound by germs.

These cause the breaking down and dislodgment of the blood clot which has plugged the hole in a blood vessel and so bleeding recommences. This breaking down of the blood clot by germs is one of the features of the condition known as " Sepsis " (See Chapter V).

This is not the type of bleeding with which first aid workers are likely to come into contact, but in cases where it may be necessary for casualties to be evacuated for long distances in hospital trains or ships, attendants should be advised that there is a possibility of secondary hæmorrhage occurring.

Any of the above types of bleeding may occur as :—

External Hæmorrhage, or
Internal Hæmorrhage

External Hæmorrhage

Occurs when blood escapes from an open wound and can be seen.

Internal Hæmorrhage

Means bleeding which comes from some internal organ or structure within the body and not from its surface.

This may be sub-divided into :—

Visible Internal Hæmorrhage

This means that bleeding is taking place in some structure and the blood reaches the exterior of the body in the process of vomiting, coughing, or, to take a familiar example, in nose bleeding.

Concealed Internal Hæmorrhage

Is bleeding from some structure within the body from which the blood does not reach the outside of the body and therefore cannot be seen. When this occurs, the characteristic signs and symptons are those which are present in all forms of hæmorrhage, and will provide the clues that bleeding is taking place within the body.

Examples of this form of hæmorrhage occur when the kidneys, liver or spleen are injured and bleeding takes place into the cavity of the belly. Bleeding may also occur within the brain, inside the skull, as the result of an injury, or of disease (Apoplexy).

Internal Hæmorrhage into the Tissues

This results from a blow or crushing injury, and a bruise may be produced or in some cases a swelling filled with blood which is known as a " Blood tumour." Bruises are injuries of the deeper parts of the skin and underlying tissues accompanied by bleeding from damaged blood vessels, but without any corresponding open wound.

General Effects of Hæmorrhage

The effects of bleeding depend on its severity, the amount of blood lost, the rate of loss, and the time which elapses before it ceases or is checked.

The immediate effects are those of shock (See Chapter III) ; coupled with other factors which may perhaps also exert their influence, such as the general health of a patient, his age, the amount of pain associated with the injury, the extent of exposure and the degree of mental anxiety.

Thus, an infirm elderly man is more likely to suffer from the immediate effects of shock from bleeding than a young and healthy man ; similarly a comparatively small amount of bleeding may cause a severe degree of shock in a child. Exposure to unfavourable climatic conditions such as cold winds or rain tends to favour the rapid onset of shock and to increase it.

Symptoms and Signs of Bleeding

When *external* bleeding takes place, the signs are obvious but certain general symptoms and signs also occur in a person as the result of the loss of blood.

These are progressive and increase in intensity according to the amount of blood lost and the rate at which this loss occurs. They are the same for all the varieties of bleeding already described, but it is of vital importance for a first aid worker to be able to recognise them in cases where internal bleeding has occurred, especially when the blood remains concealed within the body cavity. Only by the proper recognition of a steadily increasing intensity of these symptoms and signs can a diagnosis of internal bleeding be made and a distinction drawn between this and shock. Failure to appreciate this difference in a case of severe internal bleeding will most probably cost the patient his life, and in any case will seriously reduce his chance of ultimate recovery even if the bleeding should cease.

(1) Pain. At the site of an injury or in cases of disease at the site where the bleeding has started.

(2) Faintness, Nausea and a Feeling of Coldness. These may occur in the early stages of bleeding and the patient may actually faint or vomit if this is severe.

(3) Pallor of the face and body. This becomes more marked if the bleeding continues.

(4) Pulse. This is rapid and is not easily felt ; the more the bleeding goes on the more rapid and weak the pulse becomes until it may be impossible to feel it at the wrist. It may be said that a pulse rate of 100 beats per minute, half an hour or more after an injury is a sign of danger, and especially so if the rate tends to increase.

(5) Cold, clammy and sweaty skin ; subnormal temperature (i.e., less than 98.4 degrees F.).

(6) Thirst. The patient complains of thirst which is the result of loss of fluid in the body.

(7) Air hunger, Restlessness ; Anxious Expression on the face. Due to a feeling of impending suffocation a patient becomes extremely restless and anxious. This anxious expression is very characteristic, and the restlessness is often shown by the patient plucking at his clothing or other objects in an endeavour to obtain more air. " Air hunger " as it is called, is due to actual lack of oxygen which results from the loss of the red corpuscles which carry this vital gas.

(8) Dilated Pupils of the Eyes. Widely dilated pupils form a grave sign.

(9) Dimness of Vision, Noises in the Ears. As less and less blood goes to the brain the patient's sight becomes dimmed, his mind confused and he finally passes into a state of collapse and complete unconsciousness.

Nature's Methods of Dealing with Hæmorrhage

Unless a large blood vessel has been opened, hæmorrhage is for various reasons seldom immediately fatal. This is because the normal reactions of the body tend to stop or limit the bleeding without the assistance of any treatment.

In every case of hæmorrhage there is a tendency for this to diminish, but in the case of a sudden and severe hæmorrhage the rapid loss of blood may be sufficient to endanger a person's life before it can be checked by natural means. It is for these cases that first aid treatment, if applied in time, is of the greatest value.

The three main methods which nature employs for the arrest of hæmorrhage are :—

Lowered Blood Pressure and Diminished Volume of the Blood.—As a result of the sudden fall in blood pressure and weakening of the heart's action, combined with shock, an injured person who is bleeding may become collapsed or faint. Should this happen it will prove a valuable safeguard for the patient, and a powerful factor in diminishing the flow of blood, as he will be lying still and keeping quiet, thereby reducing the strain on the heart and circulation to a minimum and favouring the clotting of the blood (see below).

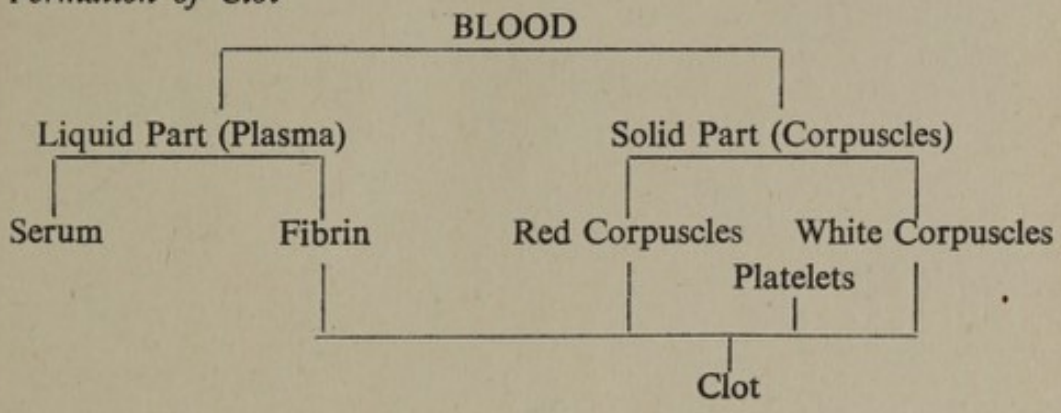
Contraction of Blood Vessels.—When a blood vessel, especially an artery, is completely cut across, as frequently happens in an incised wound, the muscular fibres in its walls contract and bring them closer together so that the opening in the blood vessel becomes reduced in size. At the same time the cut ends of the elastic fibres become retracted and curl inwards upon themselves, still further reducing the size of the opening. In the lumen of the vessel thus narrowed a blood clot begins to form and blocks the open end (see below.) When a blood vessel is only partially severed, contraction and retraction of its walls cannot take place ; consequently bleeding is likely to be more serious than when a blood vessel is completely cut across.

Clotting of the Blood.—While blood is in the blood vessels it remains liquid but rapidly becomes solid or clotted when it is shed. Blood which is clotting loses its liquid character and after a short time sets

into a jelly-like mass which gradually becomes firmer until it is comparatively solid. This mass which is of a dark red colour is known as a " Blood Clot."

After a while this clot starts to shrink and squeezes out a yellow clear fluid from the jelly-like substance. This is known as " serum " ; thereafter, the clot remains smaller and more solid. This blood clot is made up of large numbers of blood corpuscles and blood platelets (See *Blood*, Chapter VI) which are entangled, as in a net, by a delicate mesh-work of fibres composed of a substance known as " fibrin."

Formation of Clot



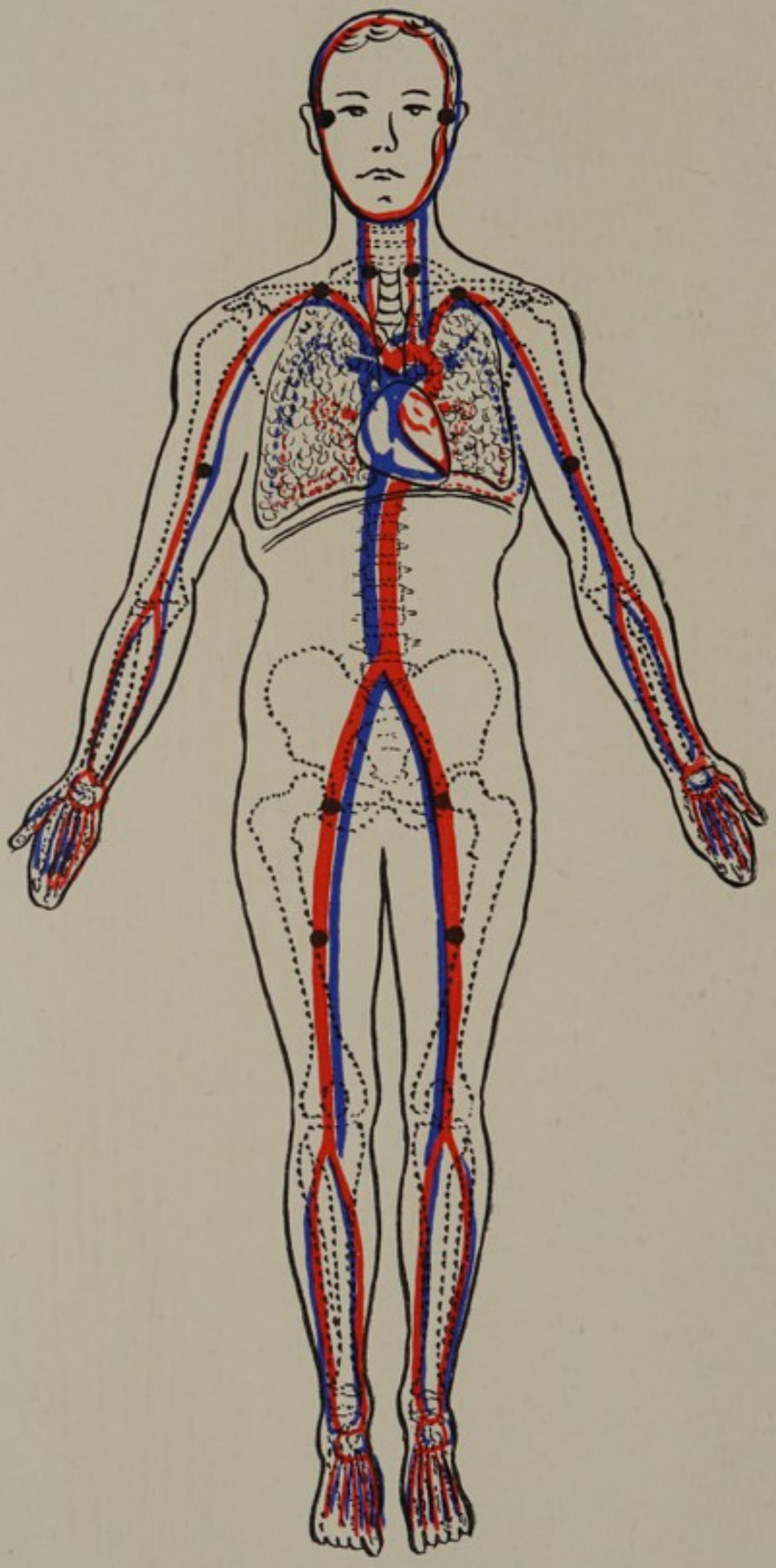


Fig. 24—Circulation of Blood and Arterial Pressure Points

CHAPTER VIII

FIRST AID TREATMENT OF BLEEDING

External Hæmorrhage

The immediate object of first aid is to stop the bleeding, and this can best be done by the application of pressure to the bleeding spot. Unless this is done as quickly as possible, a person's life will be endangered if the bleeding is severe ; even continued oozing of blood from a large area may lead to a high degree of shock, collapse, and death, if it is not treated properly.

With the above in mind, a definite line of action should be followed so that bleeding can be stopped with the least possible interference to other tissues.

The following procedure should be adopted :—

(a) Position of the Patient

Lay the injured person down. The heart beats with less strength when a person is lying down, and so blood will escape with less force from the injured blood vessels.

If bleeding comes from the head, or from a limb, this should be raised so that blood will have to be pumped " uphill " from the heart, and will therefore flow less forcibly from the wound. In cases where bleeding is accompanied by a break in the bone of a limb, the affected limb should not be raised.

(b) Expose the Bleeding Point

Open or cut off clothing but do not needlessly expose the patient or remove or destroy more clothing than is necessary.

(c) Direct Digital Pressure

Apply pressure with the fingers or thumb directly on the bleeding point. If a dressing or a clean handkerchief is immediately available place this on the wound and press upon it, but remember that speed in stopping the bleeding is the great necessity and no time should be wasted. Do not apply pressure if a bone is broken at the site of bleeding or if there are any substances, such as splinters of glass or metal in the wound ; in such cases, apply indirect pressure (see below), place a dressing over the wound and bandage lightly. Unless the bleeding is severe, as from a large artery or vein, it can generally be stopped by the application of a bandage firmly tied over the dressing, after keeping the fingers or thumb in position for a minute or two while the bandage and dressing are being got ready. The first aid dressings which are carried by Rescue Parties each consist of a sterilised pad dressing and bandage and are designed for easy application at incidents. If a dressing becomes soaked with blood it should not be removed but a second, or third applied on top and bandaged even more firmly. If, after this, blood again comes through then try indirect digital pressure.

(d) Indirect Digital Pressure

Apply pressure with the fingers or thumb on the nearest " Arterial Pressure Point " if the blood is coming from an artery (See Fig. 24). This should be done when the wound is large or if there is a broken

bone or foreign body in it. A few minutes of this pressure may be enough to let the blood clot in the damaged vessel and stop the bleeding, after which a pad dressing and tight bandage will prevent its recurrence. If, however, all these measures fail, the application of a tourniquet will be needed.

A Tourniquet

This is an appliance for compressing an artery in a limb so that no blood will pass through it.

Any form of tourniquet *must* be regarded as a dangerous instrument and only to be used as a last resort. A patient may lose a limb if proper precautions are not taken. By entirely stopping the circulation of blood through a limb, death of the part which is deprived of its blood supply will occur if the tourniquet is left on too long. The condition thus produced is known as " Gangrene". If not properly applied, a tourniquet may only stop the circulation of blood through the veins, and will cause great swelling of a limb and increased bleeding by the blood reaching it through the arteries and being unable to return to the heart through the veins. This condition is known as " Venous Congestion " (N.B.—A patient may bleed to death, if there is a wound in a big vein, particularly if varicose, as a result of this.) A tourniquet may cause crushing of tissue such as muscle, thereby increasing shock, or whilst pressing an artery against a bone may severely damage nerves in the same area.

The two types of Tourniquets in use are :—

(i) The Improvised.

(ii) The Rubber Bandage.

If it is decided that a tourniquet must be used the type which will probably be the most readily available is :—

(i) The Improvised Tourniquet.

A narrow-fold triangular bandage can be used for this, and it may be sufficient to tie it round a limb immediately above the site of the hæmorrhage (i.e., between the wound and the heart) sufficiently firmly to just stop the bleeding, or below the wound in cases where it is suspected that blood is coming from a large vein (e.g., a varicose vein in a leg). When bleeding occurs from a large artery, such as the femoral, this treatment will not be found sufficient, and a pad sufficiently large to actually press upon the artery will be necessary. This can be improvised by tying a knot in the centre of the bandage to enclose a hard smooth substance such as a pebble or piece of wood, but it must be realized that unless this is about the diameter of a tennis ball it will probably slip off the artery or miss it altogether, and may do damage to other tissues surrounding the artery without compressing it. For small arteries it may be enough to tie two or three knots in the handkerchief to make one large knot, and a cork or similar article enclosed in the knot will be found useful. An ideal pad for size and shape is an unopened first aid or mine dressing packet, as carried by members of the Rescue Section. The packet if placed accurately on an arterial pressure point along the line of the artery and bound firmly in position with a narrow fold bandage will stop bleeding from the largest artery in a limb. Whatever form of pressure is used care must be taken to see that it is applied accurately on the pressure point before it is fixed in position. When it is necessary to keep the tourniquet

from slipping, as when a casualty is on a stretcher or on his way to hospital in an ambulance, a piece of cane or stick is pushed through the last tied knot to act as a twister. This is then twisted just enough to stop the bleeding and secured to the limb by the free ends of the bandage or by another bandage to prevent it from untwisting. Pieces of cane for use with improvised tourniquets are carried by Rescue Parties.

(ii) The Rubber Bandage.

This is a length of elastic about four feet long and two-and-a-half inches wide which is a most efficient form of tourniquet and should be used wherever necessary. At one end two tapes are sewn on to the bandage for tying it. The bandage, which must always be applied above the wound (also between the wound and the heart) is wound firmly round a limb with even pressure, and with each turn placed immediately over the preceding one. The tapes are then tied securely round the limb over the turns of the bandage, care being taken that they do not slip while the knot is being tied. This rubber bandage is carried by the Rescue Section, but may be improvised by a strip of rubber from an inner tube of a tyre.

Rules to be strictly observed when a tourniquet is used :—

(1) A tourniquet must only be used as a last resort to arrest serious bleeding from an artery in a limb.

(2) *Never* put on a tourniquet under dressings or clothing where it will not be seen. It must be applied over a thick layer of material, e.g., a dressing or folded triangular bandage, so that it will not pinch up the skin.

(3) A tourniquet, other than in the case of a stump wound (see below), must always be placed above a wound, i.e., between the wound and the heart.

(4) Tourniquets *must only* be applied by a skilled person, who has had plenty of practice in putting them on, and knows the exact position of the pressure point. If such a person is not immediately available, a tourniquet should not be applied, but an attempt made to control the bleeding with a pad and firm bandage directly over the wound, pending the arrival of skilled assistance.

(5) In some cases a limb may be completely torn off or left hanging by pieces of muscle and skin. On account of the shock and contraction of the arteries there may be little or no bleeding at first, but this is bound to come on later. A tourniquet *must* be applied to *prevent* the onset of bleeding, and the rubber bandage is the best kind to use. It should be applied as near the raw end of the stump as possible, without the risk of its slipping off. A tourniquet imperils the vitality of the parts beyond it, and the loss even of half an inch of stump length might seriously increase the disablement. This tourniquet must *not* be loosened until the patient is in the hands of a surgeon. (See Fig. 25.)

(6) A tourniquet *must never* be left in position for more than 15 minutes (the only exception being that mentioned above at (5)). At the end of this time it should be loosened and tightened up again if bleeding restarts. If it is found that bleeding can be

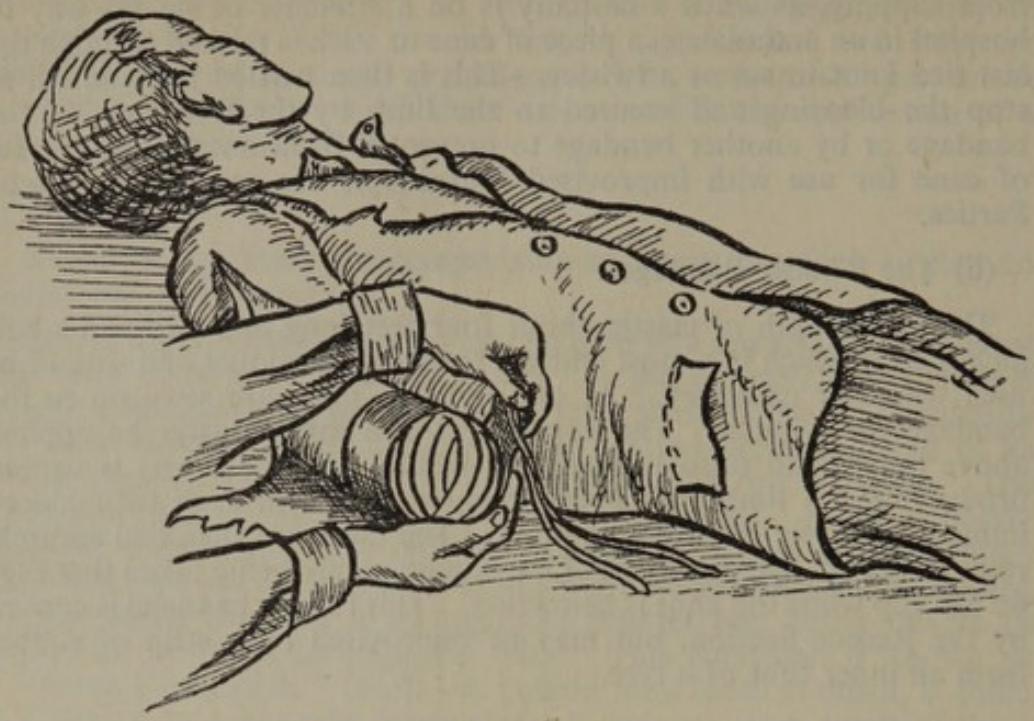


Fig. 25—Rubber Bandage Applied as Tourniquet to Stump

controlled by a pad dressing and firm bandage, the tourniquet should not be tightened, but left loose in position so that it can be readjusted at once if bleeding starts again. A constant watch for this must be kept.

(7) When tourniquet cases are being carried in ambulances to hospital the ambulance attendant *must* be told, and strict instructions given to her in regard to the points at (5) and (6) above.

(8) At an incident a tie-on label with the symbols HT on it should be fixed to the patient's clothing, or failing this, a piece of paper attached to a button or pinned to the clothing. The time of application of the tourniquet and its subsequent releases and re-applications should be indicated on the label. The same symbols HT should also be marked on the forehead of the patient with an indelible pencil. (H=hæmorrhage ; T=tourniquet.)

Internal Hæmorrhage

The most dangerous type of internal hæmorrhage is " *Concealed Internal Hæmorrhage* " which is referred to on page 68. As no blood can be seen, it is of extreme importance that a first aid worker should be able to realise from the signs and symptoms which are present, that a person is bleeding into some part of his body, and that unless prompt and efficient action is taken his life will be gravely endangered and death may occur very soon.

The signs and symptoms of " internal hæmorrhage " are the same as those of severe or prolonged hæmorrhage elsewhere. It is the duty, therefore, of a first aid worker to interpret these signs and symptoms correctly when they occur in a person who is obviously very ill and gradually or rapidly becoming worse.

A small penetrating wound in the belly or chest which appears of little consequence in itself and causes little or no external bleeding may be the cause of severe concealed internal hæmorrhage, and this may be overlooked if attention is focussed only on the small wound which can be seen. Crushing injuries of the body may cause concealed internal hæmorrhage even though there may be only signs of bruising on the surface. Concealed internal hæmorrhage may occur as the result of blast from exploded H.E. bombs when there may be no signs of any external injury.

Concealed internal hæmorrhage due to disease is frequently sudden and may occur without warning. The bursting of a diseased blood vessel in the brain (apoplexy) or in one of the larger arteries elsewhere in the body (aneurysm) provides examples of this.

In " *visible internal hæmorrhage* " it is easier to locate the site of the hæmorrhage since blood may be coughed up, vomited, or passed in the urine or stools, in which case it will be realised that injury or disease have caused bleeding from the lungs, stomach, kidneys or bowels. When concealed internal hæmorrhage takes place as the result of an injury it is always associated with some degree of primary shock. It is essential, therefore, that a distinction should be recognised between a patient who is suffering from shock only and one who is suffering from internal hæmorrhage in addition ; this may be the deciding factor as to whether the patient will survive or die.

A reference to the signs and symptoms of shock in Chapter III, and those of hæmorrhage in Chapter VII will show that they are similar in many respects. Concealed internal hæmorrhage combined with shock should, however, be suspected if the pulse rate tends steadily to increase and the pulse itself becomes less easily felt ; if a patient becomes more and more restless with signs of increasing air hunger ; if he complains bitterly of thirst and perhaps of severe pain in some part of his body, which may be that from which the bleeding is coming.

Treatment of Concealed Internal Hæmorrhage

Surgical treatment is essential and must be prompt. As soon as it is decided that the casualty is probably bleeding internally, he must be sent to hospital at once. A stretcher must be used, and gentle handling is imperative. *Nothing* may be given to drink even though the patient is very thirsty. Every minute saved before he reaches the hospital is of vital importance to his later progress. If transported in an ambulance the ambulance attendant must be informed of the nature of the injury and instructed to report to the hospital authorities immediately on arrival there. At an incident a label bearing the symbol X should be tied in a prominent position on the patient's clothing to denote that he needs priority of examination at the hospital. This symbol should also be marked with indelible pencil on the forehead of the casualty. (X=internal hæmorrhage and priority.)

Treatment of Visible Internal Hæmorrhage

(*a*) *In the Lungs*

As a result of damage to the lungs by injury (e.g. broken ribs, crushing of the chest, direct blows on the chest by missiles, effects of blast from H.E. bombs) or by disease (e.g. Tuberculosis of the lungs) a patient may spit up or cough up blood which is usually bright red and frothy.

First Aid Treatment

The spitting up or coughing up of blood, especially in large quantities, generally causes great alarm to a patient and he will suffer severely from shock.

The first aid worker must, therefore, do all in his power to reassure him and cheer him up, at the same time lay him down inclining towards the side from which the blood appears to be coming and with his head and shoulders slightly raised.

Treatment for shock must be given and any injuries attended to. No stimulants should be given but if the patient complains very much of thirst his mouth and lips may be moistened with a damp cloth, or handkerchief. Blood should be sponged away from the mouth with a piece of moistened cotton wool or a triangular bandage used as a towel. The patient must be sent as soon as possible as a stretcher case to hospital, and the ambulance attendant instructed how to act on the journey and to notify the hospital authorities immediately on arrival. Instructions should also be given to the ambulance driver to drive carefully. If at an incident, a label on which the symbols HX are marked should be tied on the patient's clothing and similar symbols marked with an indelible pencil on his forehead.

(*b*) *In the Stomach*

This should be understood to refer to the part of the digestive system described at (*e*) on page 4 and not to the belly as a whole. Hæmorrhage from the stomach occurs most commonly as the result of *disease* (e.g. ulcer and cancer of the stomach) which eats through the walls of blood vessels allowing the blood to escape into the cavity of the stomach. When a large amount of blood has leaked into the stomach and is vomited up, it is dark red in colour, often mixed with undigested food, or in large clots like pieces of liver. Blood may also collect in the stomach from hæmorrhage which has occurred elsewhere, and passed into it through the gullet (e.g. in cases of nose bleeding, in a broken jaw where there is a wound inside the mouth, or when blood from the lungs has been coughed up into the mouth and swallowed). In these cases the blood accumulates less rapidly and becomes altered in colour so that when it is vomited it is a dark brown colour and is frequently described as " coffee-grounds " vomit. Blood which has collected in the stomach and not vomited may be passed out of the body through the bowels and in the stools.

Hæmorrhage in the stomach may result from an *injury* caused by fragments of bomb splinters, with an external penetrating wound, or even by the effects of blast from H.E. bombs which may cause extensive bruising or rupture of its walls. Blood from such cases may be vomited or passed in the stools. It may also leak into the cavity of the belly and become concealed internal hæmorrhage as there will be no outward signs of it.

First Aid Treatment

This is essentially the same as that for hæmorrhage from the lungs and *on no account* should the patient be given anything to drink.

Arterial Pressure Points

An arterial pressure point is a part of the body where an artery lies directly upon a bone, and is sufficiently near the surface to be felt by

the fingers if they are placed upon the right spot. Every first aid worker must know where such points are, so that by pressing an artery against a bone he can prevent any blood from passing through it, in the same way as fluid can be prevented from flowing through a piece of elastic tubing, or a hose-pipe, by compressing it against something hard. It is useless to press an artery against soft tissues such as fat or muscle. When a first aid worker wishes to stop bleeding from an artery, and all other measures have failed, he will have to use pressure directly on the artery from which the blood is coming. As blood is pumped away from the heart into the arteries, pressure must always be applied between the heart and the bleeding point (a first aid worker will know at once if he is successfully compressing the artery as, if he is, the bleeding will either stop completely or appreciably diminish).

There are many arterial pressure points in the body (See Fig. 24, which shows the main arteries and their chief pressure points), but it is only necessary for a first aid worker to know those described below.

(a) The Common Carotid Arteries

These are two large arteries which run up the neck in the hollows on each side of the windpipe. They pass upwards from where the collar-bone meets the breast bone to the angle of the jaw on each side of the neck, and can be felt beating by placing a finger against the windpipe along this line. Through these two arteries all the blood for the neck, head and face passes, so that by compressing one of them any bleeding which is coming from these parts on one side is controlled. *On no account* must both carotid arteries be compressed at the same time, nor a tourniquet of any kind be applied, as if this is done, the blood supply to the brain will be cut off and the patient will die.

To Compress the Common Carotid Artery

If possible, lay the patient down and raise his head and shoulders off the ground, supporting them on a pillow or bundle of clothing. Kneel by the injured side of the patient facing his head. If the injury is on the left side take hold of his wrist with the left hand and support his left arm across his chest. Grasp the nape of his neck with the fingers of the right hand at the back, and the thumb in front on the line of the artery. When the artery can be felt beating, press it backwards and inwards with the thumb, taking care not to press upon the windpipe ; the artery will then be compressed against part of the bony spine in the neck and bleeding will cease. If the injury is on the right side, kneel on that side and use the right hand to support the patient's

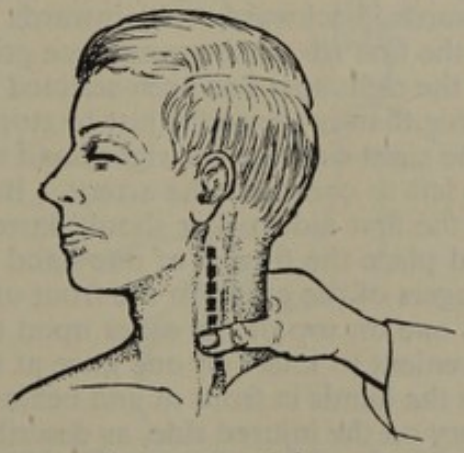


Fig. 26—Compression of Carotid Artery

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arm, and the left to compress the artery. It may be necessary for relays of helpers to keep up the pressure before the patient can reach hospital, as it is very tiring for one person to maintain the pressure for any length of time. When one helper takes over from another he must use the utmost care to press upon the right place at once and not to let further bleeding occur ; it is also very important that the change-over should be done very gently so as not to alarm the patient and increase his shock. Only use such pressure as will just stop the bleeding ; too much force may cause serious damage to nerves and blood vessels. (See Fig. 26.)

(*b*) *The Subclavian Artery*

(So called because it lies beneath the collar bone) is a large artery through which blood passes to the upper limbs. As it passes through the armpit it is called the " axillary " artery ; beyond this point it continues down the arm as the " brachial " artery, as far as the bend of the elbow, where it divides into two branches the " radial " and " ulnar " arteries (See Fig. 24).

The subclavian artery runs upwards from the chest then turns outwards forming a curve between the centre of the collar-bone and the first rib, upon which it lies. It can be felt beating in the hollow above the collar-bone, close to the outer border of the prominent muscle (sterno-mastoid) where it is inserted into the collar bone.

Although compression of the subclavian artery will stop all bleeding from the upper limb, it is difficult to maintain pressure upon it for any length of time. In consequence, unless there is severe bleeding from the shoulder or armpit, which can only be checked by compressing the subclavian artery, it is more convenient and less tiring to compress the brachial artery (see below) for severe bleeding from an artery in the arm or hand, which cannot be controlled by other means. Furthermore, a tourniquet can be applied over the brachial, if necessary, whereas it cannot be over the subclavian artery.

To Compress the Subclavian Artery

Lay the patient down and, as in the case of the common carotid artery, kneel by the injured shoulder facing his head. If the injury is on the left side place the left hand on the patient's head and gently pull it down so as to relax the muscles of the neck. Place the right palm over the shoulder with the fingers behind and the thumb in the hollow above the left collar-bone, and parallel to it ; press downwards gently and the artery will be felt beating beneath the thumb. Increase the pressure downwards, backwards and inwards until the artery is compressed against the first rib, at the same time gripping the shoulder with the fingers ; if the right spot has been selected bleeding will cease. Do not use more force than is necessary just to stop the flow of blood. If the injury is on the right side use the right hand to pull the patient's head down, and the left to compress the artery. Both thumbs may be used, in which case the first aid worker should kneel at the side of the injured shoulder and place the fingers of one hand on the back of the shoulder, and the fingers of the other on the front of the chest, with the two thumbs pressed one on top of the other upon the artery. It may be found more convenient to kneel on one knee at the shoulder on the sound side, and pass the hands in front of and behind the patient's head to compress the artery on the injured side, as described above, supporting the patient's head against the body. As with the carotid artery,

the same precautions must be observed, and relays of helpers may be necessary to keep up continuous pressure until the patient can reach hospital (See Fig. 27).

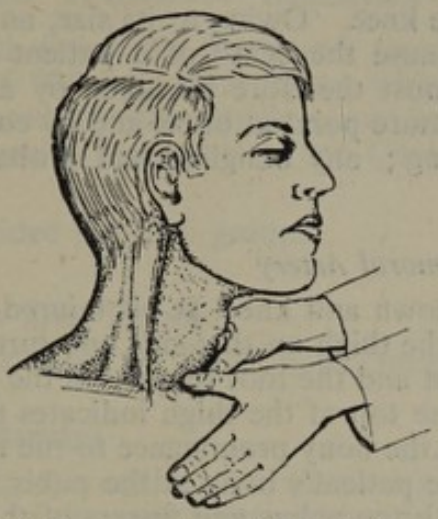

Fig. 27—Compression of Subclavian Artery

(c) *The Brachial Artery*

As described above, this artery extends from the armpit to the bend of the elbow ; the course roughly corresponds to the line of the inner seam of the coat sleeve above the elbow. At its commencement the artery lies in the groove on the inner side of the biceps muscle. It is easily felt if the biceps is made prominent by bending the arm and forcibly clenching the fist.

To Compress the Brachial Artery

Make the patient sit or lie down and kneel behind him at the side from which the blood is coming. If the injury is on the left side, grasp the patient's left wrist with the left hand and partially bend the elbow joint. Pass the fingers of the right hand round the under side of the middle of the upper arm with the fingers inside and the thumb outside. Feel for the artery in the groove on the inner side of the biceps muscle and press it outwards (i.e. towards you) against the bone of the upper arm (humerus). If the injury is on the right side kneel on that side and use the right hand to hold the patient's wrist, and the left to compress the artery. (See Fig. 28.)

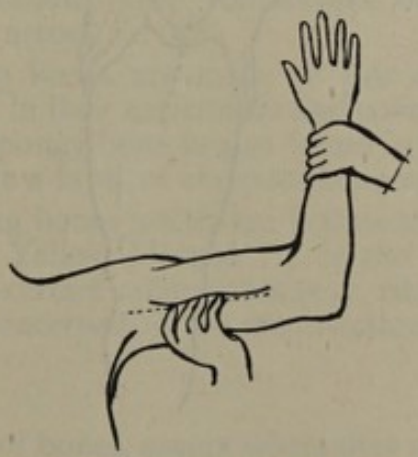

Fig. 28—Compression of Brachial Artery

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(d) The Femoral Artery

This is a large artery which comes from the interior of the belly, and runs down the thigh from the middle of the fold of the groin to the inner side of the knee. Owing to its size, an injury to this artery may very quickly cause the death of a patient from loss of blood. Immediate action must therefore be taken by a first aid worker to find the correct pressure point at once, and by compressing the artery to check the bleeding; any bungling will probably cost the patient his life.

To Compress the Femoral Artery

Lay the patient down and kneel at his injured side facing his head or his feet. Raise the thigh on that side and turn it outwards so that the knee will be bent and the foot remain on the ground. The crease in the clothing at the top of the thigh indicates the line of the groin, which extends from the bony prominence to the front of the hip-bone to the middle of the patient's body at the pubis. Encircle the upper end of the thigh with the palms and fingers of the two hands, so that the thumbs are on the front of the thigh. With one thumb feel for the beating of the artery in the centre of the fold of the groin. As soon as it is felt place the other thumb on top of the first and press the artery downwards against the bony edge of the hip-bone with both thumbs, using only enough pressure to just stop the bleeding.

As it is very tiring to keep up the pressure in this situation and it may be some time before medical aid can be obtained, relays of helpers should be employed to take their turn at maintaining the pressure until the patient can reach hospital. Care must be taken that each helper places his thumbs in the right place above those of the person he relieves so that no blood can escape during the change-over.

If the bleeding cannot be checked by the above means, and helpers are not available, the application of a tourniquet must be considered. This cannot be applied over the centre of the fold of the groin, but at a point four fingers' breadth below this spot in the centre of the thigh. Here the artery can be distinctly felt. (See Fig. 29.)

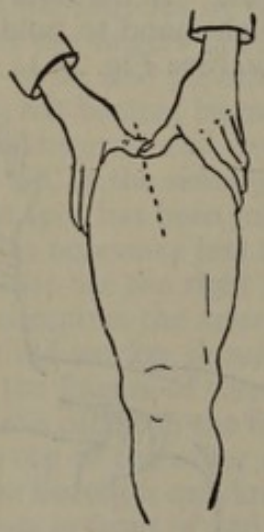

Fig. 29—Compression of Femoral Artery

CHAPTER IX

THE HUMAN SKELETON

The skeleton which forms the framework upon which the body is built is made up of 206 individual bones which are reinforced in certain regions by pieces of gristle (cartilage) and held together by hands of fibrous tissue known as ligaments. (See Chapter I, and Figs. 30 and 31.)

The bones are divided into two groups.

Bones of the Head and Trunk

The skull, the back-bone, the breast-bone (sternum) and the ribs.

Bones of the Extremities

In the upper limb, the collar bone (Clavicle), the shoulder blade (Scapula), the bones of the arm, wrist and hand.

In the lower limb, the hip bone (Os Innominatum) and bones of the leg, ankle and foot.

As the body is symmetrical in shape most of the bones are in pairs, as in the limbs ; single bones, however, occur among those of the head and trunk. Examples of these are the lower jaw and the bones which form the back-bone.

Composition and Structure of Bone

Bone is an extremely hard substance, but it is also somewhat tough and elastic. It is composed partly of fibrous tissue and partly of the chemical salts of lime (phosphate and carbonate) intimately mixed together and called " bone-earth." The colour of bone when fresh is pinkish white on the surface and deep red inside. The bones of a child contain a higher proportion of fibrous tissue than bone-earth, while those of older people contain more bone-earth than fibrous tissue ; as a result of this the bones of children are inclined to be tough and elastic while those of older people, especially the aged, are more brittle and less elastic. It will be seen later how this may affect fractures of bones when they occur among children and older people.

There are two types of bone, one very hard and dense like ivory, known as " Compact " or " Dense bone " and the other softer called " Spongy " or " Cancellous bone " on account of its resemblance to a sponge when it is cut across.

The shafts of long bones are made of this compact bone while spongy bone is found in their extremities and covered with a thin layer of compact bone. Spongy bone is also found in the interior of short bones which also have a layer of compact bone on their surfaces.

In the shafts of long bones which are hollow there is a yellow fatty material known as " Yellow Marrow " ; in the ends of long bones, in short bones and in certain other bones (e.g., ribs) the marrow is red. This red marrow is concerned in the manufacture of red corpuscles.

The Periosteum

The outer surfaces of bones, except where they are covered by gristle are wrapped in a fibrous membrane known as " periosteum." In this

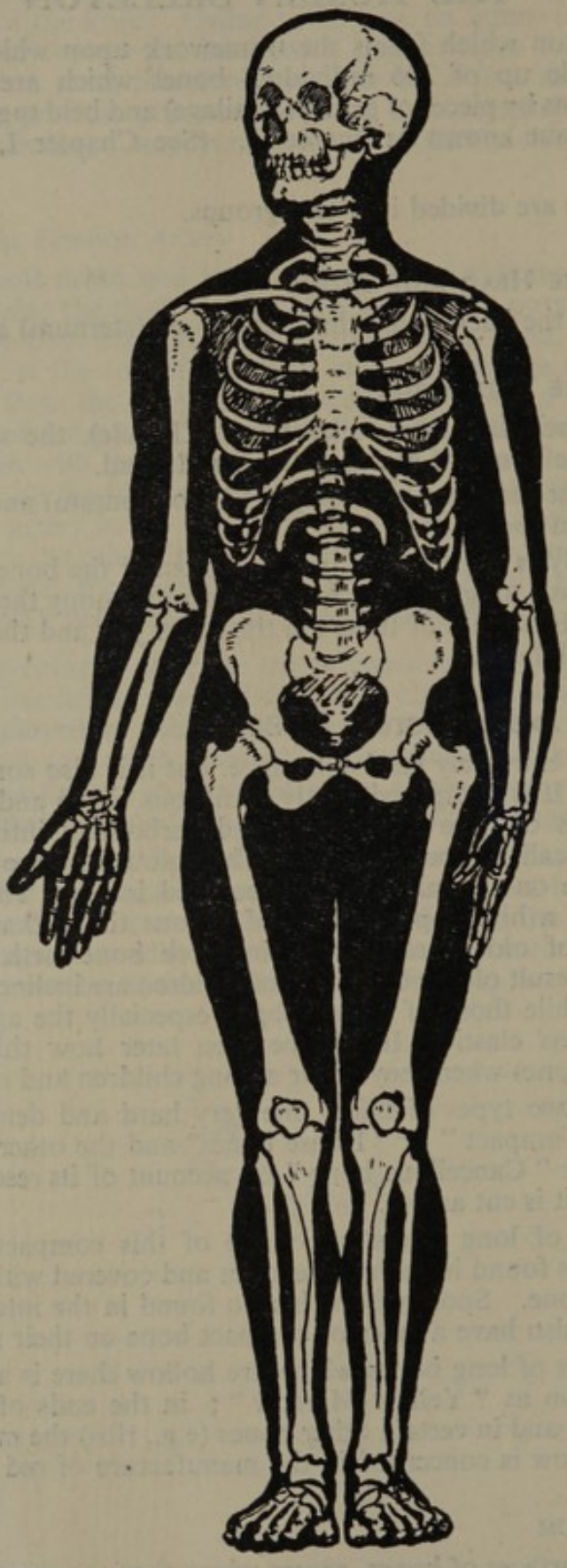

Fig. 30—Skeleton—Front View

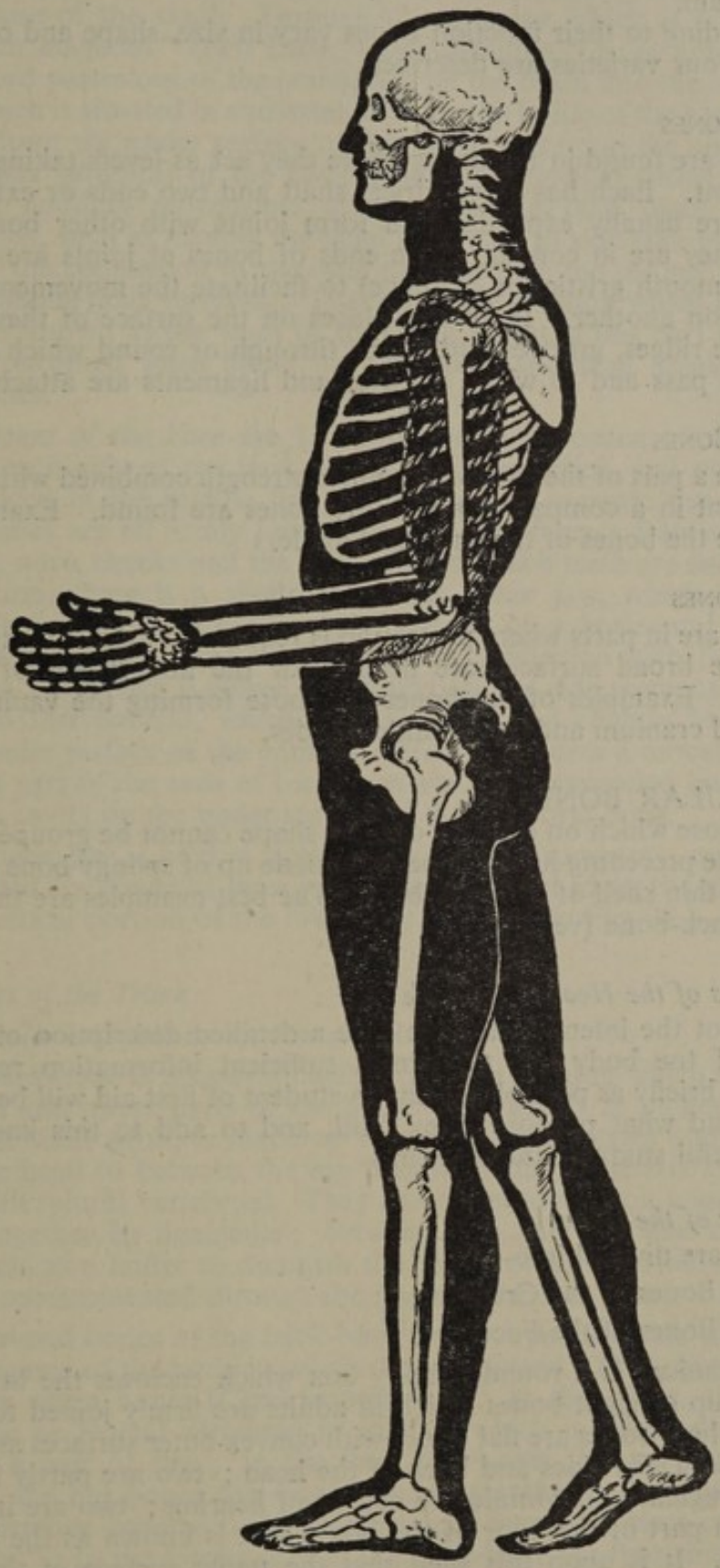

Fig. 31—Skeleton—Side View

are many blood vessels and nerves which pass from it into the substance of bone for its nourishment and growth. When a bone is broken it bleeds from the damaged blood vessels which pass to it from the periosteum.

According to their function bones vary in size, shape and construction. Four varieties are described.

Long Bones

These are found in the limbs where they act as levers taking part in movement. Each has a cylindrical shaft and two ends or extremities which are usually expanded and form joints with other bones with which they are in contact. The ends of bones at joints are covered with a smooth gristle (or cartilage) to facilitate the movement of one bone upon another. In certain places on the surface of these bones there are ridges, grooves and knobs through or round which tendons (leaders) pass and to which muscles and ligaments are attached.

Short Bones

Where a part of the skeleton requires strength combined with limited movement in a compact space, short bones are found. Examples of these are the bones of the wrist and ankle.

Flat Bones

These are in parts where protection is required for delicate structures or where broad surfaces are needed for the attachment of certain muscles. Examples of flat bones are those forming the vault of the skull and cranium and the shoulder blades.

IRREGULAR BONES

Are those which on account of their shape cannot be grouped under any of the preceding heads. They are made up of spongy bone encased within a thin shell of compact bone. Tne best examples are the bones of the back-bone (vertebræ).

(*a*) *Bones of the Head and Trunk*

It is not the intention to give here a detailed description of all the bones of tne body but to furnish sufficient information regarding them, as briefly as possible, so that a student of first aid will be able to understand what purposes they fulfil, and to add to this knowledge by a careful study of the diagrams.

(i) *Bones of the Head*

These are divided into—

The Bones of the Cranium.

The Bones of the Face.

The cranium is a rounded bony box which encloses the brain. It is made up of eight bones which in adults are firmly joined together. Four of these bones are flat bones with convex outer surfaces and form the forehead, the sides and back of the head ; two are partly flat and partly irregular and contain the organs of hearing ; two are irregular and form part of the floor of the box which is known as the base of the skull. It is upon this shelf that the under surface of the brain rests, and it is this part which is referred to when " a fracture of the base " occurs as the result of an injury. The bones forming the base

of the skull are perforated by many holes of various sizes through which blood vessels and nerves pass to and from the brain. Of these holes, the largest is an opening in the flat bone forming the back part of the base of the skull. Through this opening which is called the " foramen magnum " (two Latin words meaning " large hole "), the spinal cord passes out of the cranium from the brain into the vertebral canal which is situated in and extends down the inside of the back-bone. At this point the under surface of this bone rests upon the uppermost bone (atlas vertebra) of the back-bone with which it forms a joint, allowing nodding movements of the head to take place ; other movements, such as turning the head from side to side take place as a result of the connection of the occiptal bone with the second bone of the back-bone (axis vertebra). The top of the cranium which is dome-shaped is known as the vault of the skull, and it is this part which is chiefly concerned when blows on the top of the head break one or more bones.

The Bones of the Face are 13 in numoer and consist of six pairs, one for each side of the face, as this is symmetrical, and one single bone placed in the middle line of the nose to separate the nostrils. These bones are all firmly joined together and form a framework for the eyes, nose, cheeks and the upper jaw in which teeth are embedded. In addition, there is a single bone, the lower jaw, which is freely moveable in certain directions. It consists of a horizontal portion which contains the lower teeth, and is in apposition with the upper jaw when the mouth is closed ; two vertical flat side portions at right angles to this portion, which pass upwards and slightly backwards to the under surface of the cranium. Here they form a movable joint, in which part of the ends of the bones which are expanded into knobs fit into a cavity on the under surface of the temporal bone.

The lower jaw is held in position by strong ligaments ; movement is provided by powerful muscles which are attached to the skull and to the vertical portion of the lower jaw bone. (See Fig. 32.)

(ii) *Bones of the Trunk*

The Back-bone (Spine or Vertebral Column)

The back-bone is a central flexible pillar or column which supports the head and upper parts of the body. It is about 28 inches long in a normal sized adult, is made up originally of 33 bones and extends from the head to between the hip bones. Each of these is known as a vertebra (plural vertebrae). They are placed one upon another and joined together by ligaments ; between each pair is a disc of gristle which acts as a buffer to diminish the effects of jars and blows which may be communicated through the head or the feet.

The several bones of the back-bone are grouped together according to the regions of the body in which they are found. Thus, in the neck, there are seven bones (Cervical vertebræ) ; in the chest, 12 bones (Thoracic or Dorsal vertebræ) to each of which is attached the rear ends of a pair of ribs ; in the loin, five bones (lumbar vertebræ) ; between the hip bones five bones (sacral vertebræ). In adults these sacral vertebræ become fused together into one solid piece called the " Sacrum ". In the lowest part of the back-bone are four small bones similarly fused together into one piece to form the " Coccyx ". Thus, in adults after fusion is complete there are only 26 separate bones. Although the bones in each of the above regions have distinctive

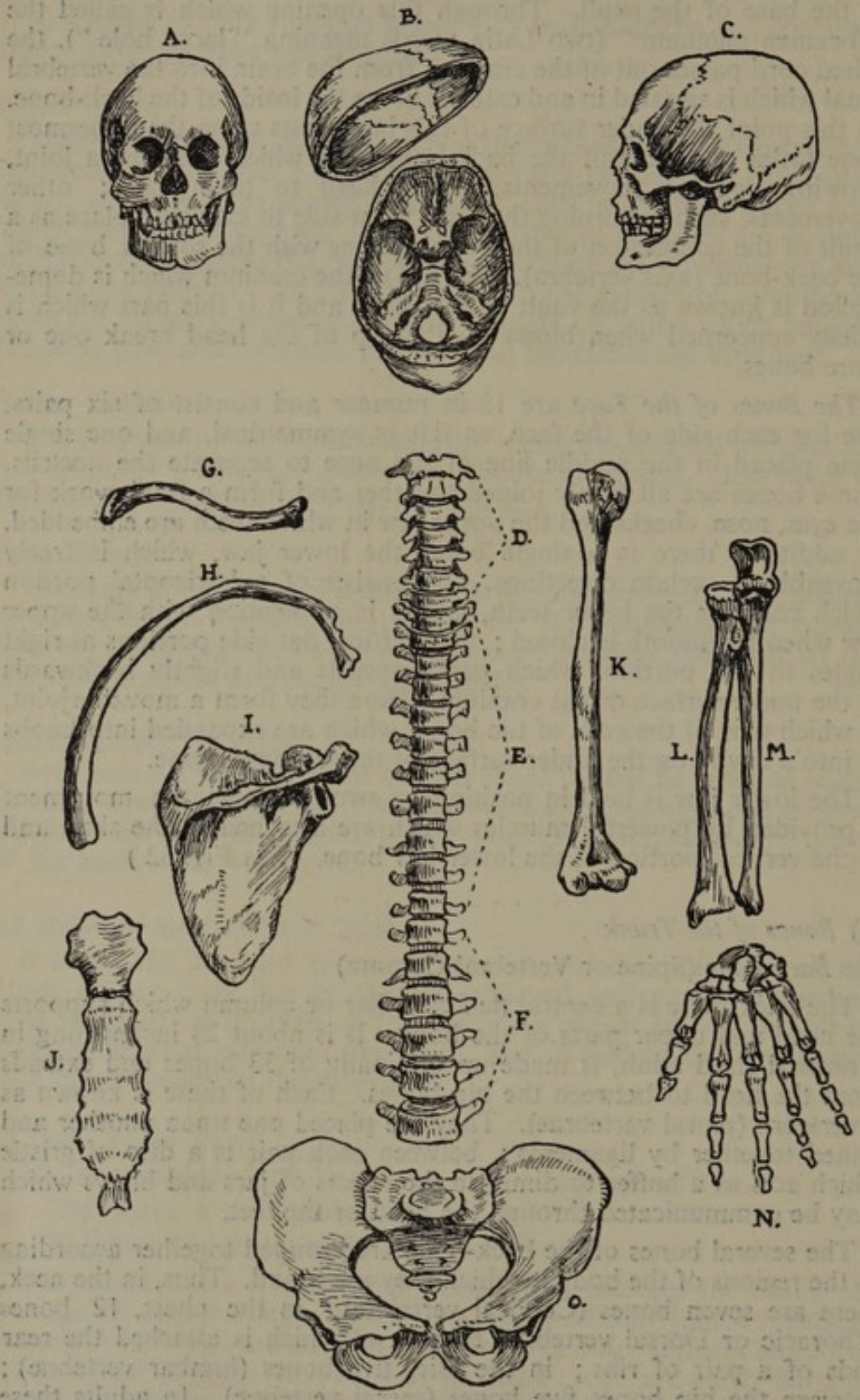

Fig 32—Individual Bones of the Skeleton.

A—Skull (Front View) ; B—Skull (Top Removed) ; C—Skull (Side View) ; D, E, F—Cervical, Thoracic and Lumbar Regions of Spine (Front View) ; G—Collar Bone ; H—Rib ; I—Scapula ; J—Breast Bone ; K—Humerus ; L & M—Radius and Ulna ; N—Hand ; O—Hip Bone.

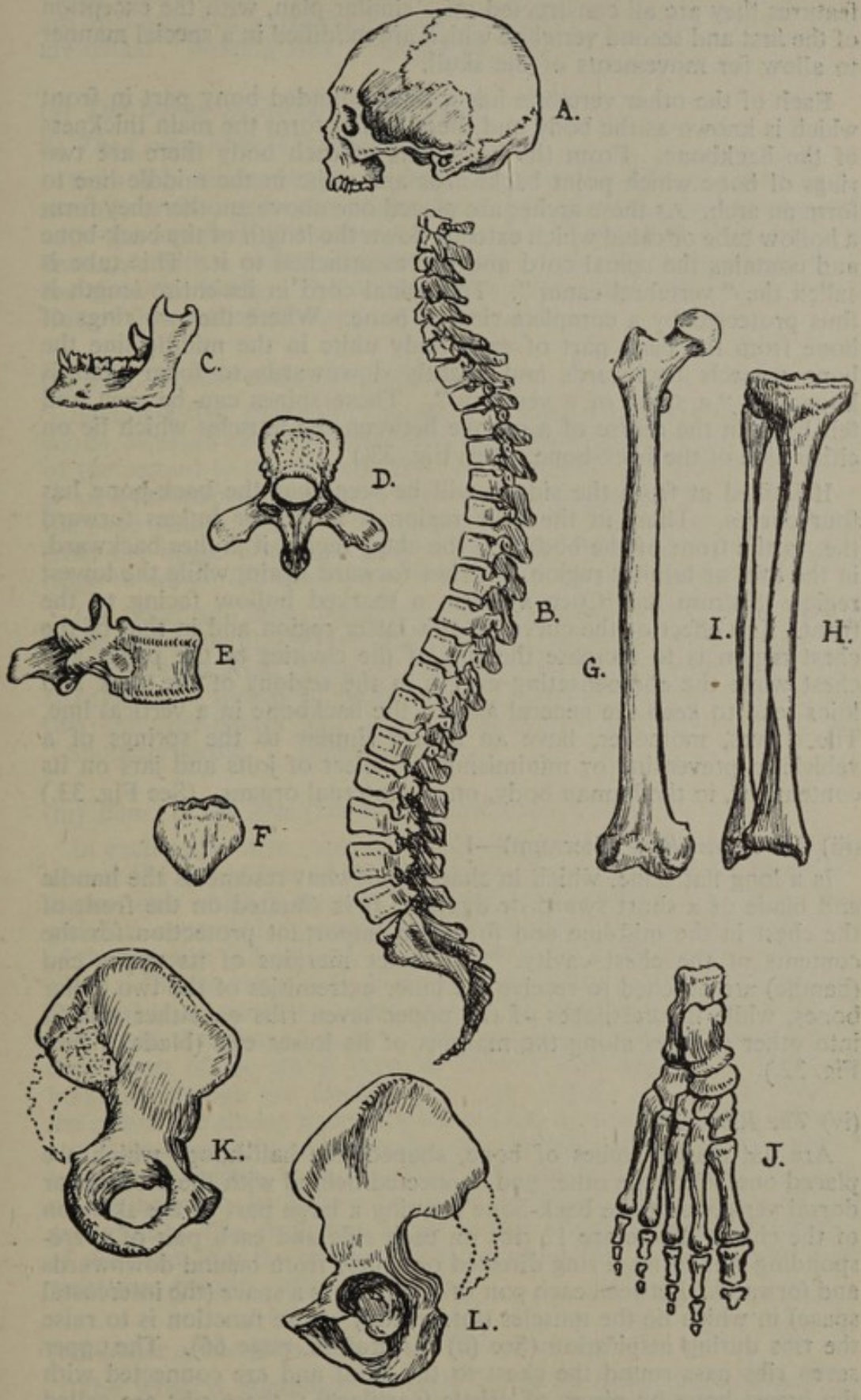

Fig. 33—Individual Bones of the Skeleton

A—Skull (Side View); B—Spine (Side View); C—Jawbone; D & E—Vertebrae; F—Knee Cap; G—Femur; H & I—Tibia and Fibula; J—Foot; K & L—Hip Bone (Side View).

features they are all constructed on a similar plan, with the exception of the first and second vertebræ which are modified in a special manner to allow for movements of the skull.

Each of the other vertebræ has a thick rounded bony part in front which is known as the body and these bodies form the main thickness of the backbone. From the back part of each body there are two rings of bone which point backwards and unite in the middle line to form an arch. As these arches are placed one above another they form a hollow tube or canal which extends down the length of the back-bone and contains the spinal cord and nerves attached to it. This tube is called the " vertebral canal ". The spinal cord in its entire length is thus protected by a complete ring of bone. Where the two rings of bone from the back part of each body unite in the middle line the bone projects backwards and slightly downwards to form what is known as " a spine of a vertebra ". These spines can be seen and felt lying in the centre of a groove between the muscles which lie on either side of the back-bone. (See Fig. 33.)

If looked at from the side it will be seen that the back-bone has four curves. Thus, in the neck region it arches or bulges forward (i.e. to the front of the body), in the chest region it arches backward, in the loin or lumbar region it arches forward again, while the lowest region (Sacrum and Coccyx) form a marked hollow facing to the front. The effect of the curves in this latter region and in that of the chest region is to increase the size of the cavities of the pelvis and chest while the compensating curves in the regions of the neck and loins tend to keep the general axis of the backbone in a vertical line. The curves, moreover, have an action similar to the springs of a vehicle in preventing or minimising the effect of jolts and jars on its contents or, in the human body, on the internal organs. (See Fig. 33.)

(iii) *The Breast Bone* (Sternum)—1

Is a long flat bone, which in shape somewhat resembles the handle and blade of a short sword or dagger. It is situated on the front of the chest in the mid-line and forms an important protection for the contents of the chest cavity. The outer margins of its upper end (handle) are notched to receive the inner extremities of the two collar bones, while the cartilages of the upper seven ribs on either side fit into other notches along the margins of its lower end (blade). (See Fig. 32.)

(iv) *The Ribs*—24

Are flat elastic arches of bone, shaped like half-hoops which are placed one below the other and connected behind with the thoracic or dorsal vertebræ of the back-bone forming a large part of the skeleton of the chest. There are 12 ribs on each side and each pair of corresponding ribs forms a ring directed obliquely from behind downwards and forwards. Between each pair of ribs there is a space (the intercostal space) in which lie the muscles (intercostal) whose function is to raise the ribs during inspiration (See (*a*) Inspiration, page 66). The upper seven ribs pass round the chest to the front and are connected with the breast bone by pieces of gristle (cartilage) ; these ribs are called " true ribs ". The remaining five ribs which also pass round the chest are called " false ribs " ; of these, the pieces of cartilage at the ends of the eighth, ninth and tenth are each joined to the cartilage of the rib immediately above , thus, these ribs do not come into

direct contact with the breast-bone. The eleventh and twelfth ribs are only attached to the back-bone behind but are free in front. These are called " floating ribs ". (See Fig. 32.)

(*b*) The Bones of the Upper Extremity

(i) *The Collar-bone* (Clavicle)—2.

Each is a slender long bone bent like the italic letter *f*, placed horizontally at the upper part of the chest wall, connected by its inner end with the top part of the breast bone and by its outer end, which is flattened, with a prominent portion which juts out from the back of the shoulder blade. The collar-bone can be seen and felt on either side of the root of the neck. (See Fig. 30.)

(ii) *The Shoulder-blade* (*Scapula*)—2

Each is a flat, triangular shaped bone with its apex pointing downwards, situated on either side of the back-bone and lying over a portion of the second to the seventh ribs. At its upper and outer angle there is an oval-shaped depression into which the upper end, or head, of the bone of the upper arm (humerus) fits and forms a joint. Protruding from the upper and back part of the shoulder-blade is a prominent ridge to which the outer end of the collar-bone is connected.

The outer and inner surfaces of this bone are covered with muscles of the trunk and upper arm which are attached to it ; these in addition to affording a wide range of movement of the bone also add to its strength as a means of protection for part of the chest wall. The two shoulder-blades and collar-bone form what is known as the " Shoulder girdle ". (See Fig. 32.)

(iii) *Bones of the Arm* (*Humerus, Radius and Ulna*)—6

In each upper arm there is a single long bone (*Humerus*). As shown above, the upper end of this bone fits into a cavity in the shoulder-blades with which it forms a joint (ball and socket). The lower end which is expanded, is connected with a long bone on the inner side of the forearm (*Ulna*) with which it forms another type of joint (hinge joint). On the outer side of the forearm there is another long bone (*Radius*) lying parallel to the ulna. The head of this bone which is small and disc-shaped, with a slight depression on its upper surface, forms part of the elbow joint by contact with the lower end of the humerus, though not fixed to it as the ulna is. Below the head of the radius are strong ligaments which bind it to the ulna and humerus and these allow it to rotate on the ulna. In this way a rolling movement takes place, which, as the result of muscular action, enables the palm of the hand to be turned upwards or downwards (supination and pronation). The lower end of the radius is expanded and forms part of the wrist joint by contact with the upper row of the bones of the wrist (see below). (See Fig. 32.)

(iv) *Bones of the Wrist* (*Carpus or Carpal bones*)—16

The wrist is composed of eight small irregular bones which are arranged in two rows of four, upper and lower. The upper row is in contact with the lower end of the radius and the lower row with the five small long bones (Metacarpus or Metacarpal bones—see below) which lie in the palm of the hand and form the knuckles. (See Fig. 32).

(v) *Bones of the Palm* (*Metacarpus or Metacarpal bones*)—10

Each palm contains five long bones which are connected above with the bones of the wrist and below with the first row of the bones of the fingers.

(vi) *Bones of the fingers* (*Phalanges—single Phalanx*)—28

There are 14 small long bones which form the fingers and thumb on each hand, three for each finger and two for each thumb. They are placed end on to one another and to the Metacarpal bones ; joints are formed where they come into contact. (See Fig. 32.)

(c) The Bones of the Lower Extremity

These bones are disposed in a manner similar to those of the upper extremities, and consist of the *hip bone* which corresponds to the shoulder-blade, the *thigh-bone* which corresponds to the humerus ; the *two bones of the leg* which correspond to the radius and ulna, and the *bones of the ankle and foot* which correspond to those of the wrist and fingers. The knee cap (patella) has no counterpart in the upper extremity.

(i) *The Hip-bone* (*os innominatum*)—2

Each is a large flattened, irregularly shaped bone, constricted in the centre and expanded above and below. It consists of three portions which are distinct from each other in the young subject but are united in the adult. One portion (ilium) is the broad flat upper part which supports the flank and is connected behind to the sacrum. A second portion (ischium) forms the lowest part of the hip-bone and supports the weight of the body in the sitting position. A third portion is known as the " pubis " and this is joined to the corresponding bone of the opposite side by a pad of gristle.

In the centre of the outer surface of the hip-bone there is a deep cup-shaped depression into which the rounded head of the thigh-bone fits and forms the hip-joint. It will thus be seen that the two hip-bones together with the sacrum and coccyx form a basin-like cavity which is called the " pelvis ". (See Fig. 33.)

(ii) *The Thigh Bone* (*Femur*)—2

This is the longest and strongest bone in the body. It consists of a rod-shaped shaft and two extremities. The upper extremity which is set obliquely to the upper end of the shaft, is rounded like a knob and fits into the cavity on the hip-bone (see above). The portion between the rounded head of the bone and the shaft is known as the " neck ". The lower extremity is expanded to form two large knobs which rest upon the larger of the two bones of the leg (tibia) and help to form the knee-joint. (See Fig. 33.)

(iii) *The knee-cap* (*patella*)—2

Is a small flattish triangular bone which lies upon the front of the knee-joint and rests upon the lower end of the thigh bone. (See Fig. 33.)

(iv) *The Shin-bone* (*Tibia*)—2

This is a long bone which lies on the inner side of the leg and is roughly triangular in shape if cut across. Its upper extremity is expanded into two oval bosses, whose upper surfaces have saucer-like depressions into which the knobs on the lower end of the thigh-bone

fit. A prominent sharp ridge which runs the whole length of the front of the bone and can be seen and felt immediately under the skin is known as the " shin ". The lower end of the tibia is also expanded and rests upon the upper surface of the talus which is the uppermost of the seven bones forming the ankle (see below). A projecting portion of the lower end of the tibia can be seen and felt as a hard lump on the inner side of the ankle ; this is known as the medial or internal malleolus. (See Fig. 33.)

(v) *The Brooch-bone* (*Fibula*)—2

This is a slender long bone which lies on the outer side of the shin bone and is connected to it at each extremity. Its lower end projects a little below the lower extremity of the shin-bone and is connected with a portion of the talus, thereby assisting in the formation of the ankle joint. The prominence of the lower end of the fibula which can be seen and felt on the outer side of the ankle is known as the lateral or external malleolus. (See Fig. 33.)

(vi) *Bones of the Ankle* (*Tarsus or Tarsal bones*)—14

Each ankle is made up of seven bones which are jointed together to form an arched springy framework for the foot and allow it to support the weight of the body. The two most important of these bones are (*a*) the talus, which takes the weight of the body and transmits it to the foot, (*b*) the calcaneum, or heel-bone upon which the talus rests. The calcaneum is the largest of the tarsal bones and forms the prominence of the heel. (See Fig. 33.)

(vii) *Bones of the Instep* (*Metatarsus or Metatarsal bones*)—10

Each instep is formed by five long bones which are similar in construction to those forming the palm of the hand. They are connected above with the bones of the ankle and below with the first row of the bones of the toes.

(viii) *Bones of the Toes* (*Phalanges*)—28

In each foot there are 14 long bones forming the toes, arranged as in the hand, there being three for each toe except the big toe which has two. These bones are smaller and shorter than the corresponding bones of the hand. (See Fig. 33.)

CHAPTER X

FRACTURES OF BONES

A break in a bone is called a fracture.

Fractures may occur in several ways but the commonest cause is some form of violence.

Three different types of violence which may produce a fracture are described as, direct, indirect and muscular action.

(*a*) Direct Violence

In this case a bone breaks at the site where violence is applied. Thus, a blow on the head from a bomb splinter, a brick, a piece of flying or falling debris may cause a fracture of one or more bones of the skull where these missiles strike ; the wheel of a heavy lorry passing over a leg or a heavy beam falling on it may break a bone or bones at the point of pressure. A further example is provided by the fracture of a bone or bones by a machine-gun or rifle bullet.

Fractures most frequently found in air raids are those resulting from direct violence.

(*b*) Indirect Violence

Here the fracture in a bone is at some distance from the spot where violence has been applied. As an example of this, when a man falls heavily on to his outstretched hand he may break the collar-bone on that side, as a result of the violence being transmitted to it through the arm, without causing any damage to the arm or to the hand. Similarly, a man may break his back if he falls or jumps from a height and lands on his feet with his legs held rigidly.

(*c*) Muscular Action

As the result of a sudden forcible contraction of a muscle, a bone to which it is attached may be broken. When a person jumps off a moving vehicle and straightens his legs on touching the ground, the contraction of some of the powerful muscles in his thigh, which are attached to the knee-cap, may break that bone right across its centre into two or more pieces.

TYPES OF FRACTURES

There are two main kinds of fracture, (*a*) closed or simple, and (*b*) open or compound.

(*a*) Closed or Simple Fracture

Is one in which a bone is broken but there is no wound of the skin over the break which allows any communication between the broken ends of the bone and the outside air. Even though a bone may be broken in several places this type of fracture is never so serious as the open variety. (See Fig. 34.)

(*b*) Open or Compound Fracture

In this fracture there is a wound in the skin which runs down to the fracture allowing air to reach the broken pieces of the bone. The wound in the skin may be the result of violence from without, e.g. a

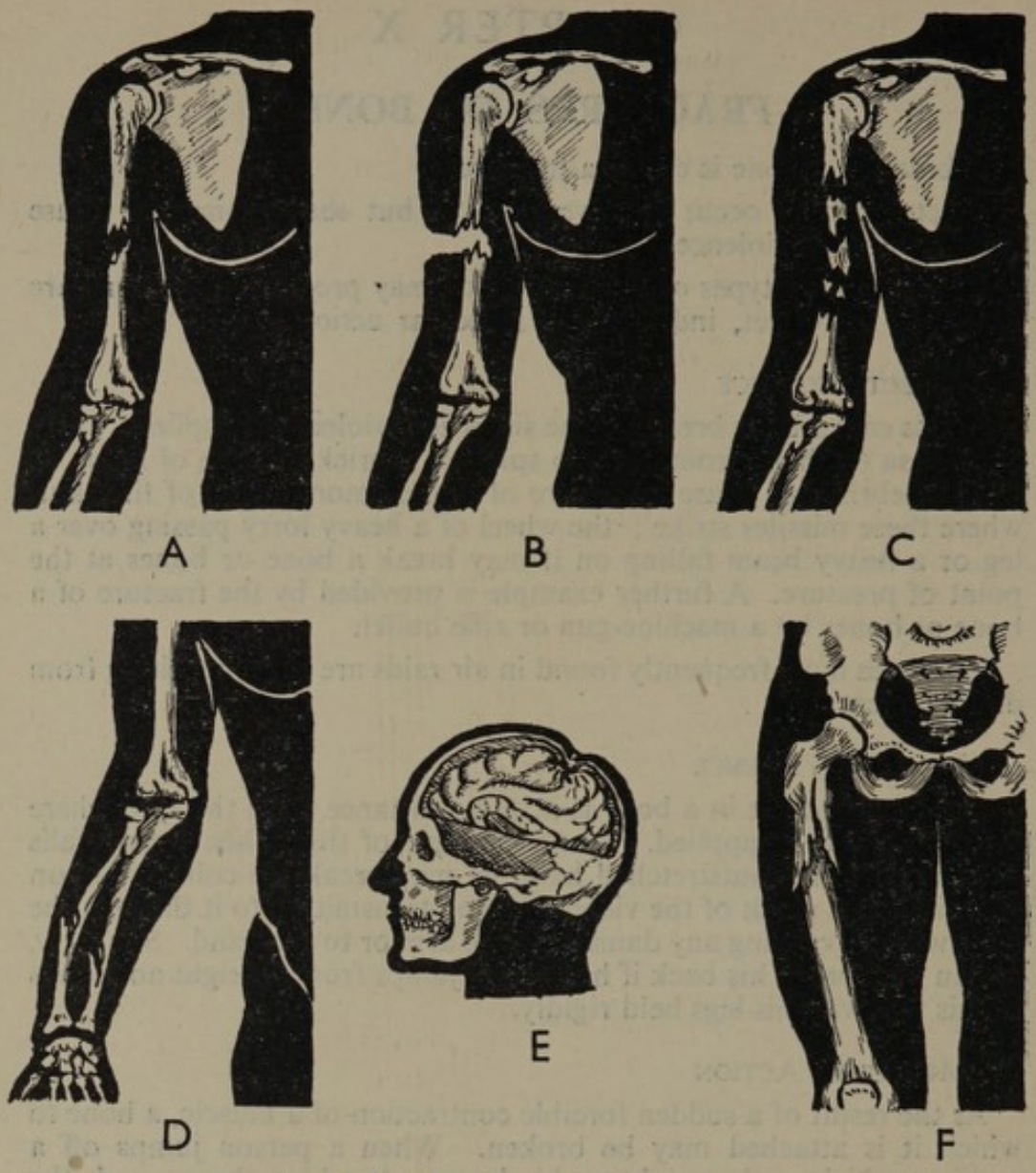

Fig. 34—Types of Fracture

A—Closed ; B—Open ; C—Comminuted ; D—Greenstick ; E—Depressed ; F—Impacted.

bomb splinter, rifle bullet, etc., or more rarely from the broken ends of the bone protruding through the skin from within. It must be realised that although there may be a wound in the skin, it is only when this actually extends down to the broken bone that a fracture can be regarded as open.

A fractured jaw in which the gum may be torn and allow air to reach the fragments of bone, and broken ribs, caused by direct violence, in which parts of the lungs are damaged so that inhaled air can gain access to the broken bones, are examples of an open fracture.

This kind of fracture is more serious than the closed variety as, since air can get to the broken bone, so also can all forms of dirty material (dust, clothing, etc.) laden with disease germs. These may produce a local infection of the wound, known as sepsis, or even a general blood poisoning. (See Fig. 34.)

Either of these types of fracture may be :—

(i) A Complicated Fracture

This is described as any fracture in which damage has been done to important structures such as blood vessels, nerves, and internal organs by the sharp jagged ends of a broken bone. *A depressed fracture* which occurs when the vault of the skull is broken and a piece of bone is pressed down upon the brain may be classed as a variety of a complicated fracture. (See Fig. 34.)

(ii) A Comminuted Fracture

This occurs when a broken bone is splintered into several fragments. It is practically always due to direct violence. (See Fig. 34.)

(iii) An Impacted Fracture

This results when a bone is broken and the end of one fragment is driven into the end of the other fragment and remains tightly wedged in it. It is in long bones, e.g. the thigh bone, that this usually occurs and is often difficult to recognise as some of the ordinary signs of a fracture are absent. (See Fig. 34.)

(iv) A Greenstick Fracture

This is generally found in children under 12 years of age but sometimes in young adults. As the bones of children are more elastic than those of older people, they may not break right across but bend and break incompletely, in the same way as a green twig from a tree does when an attempt is made to break it. Here again some of the usual signs of a fracture are not found. This type is almost invariably of the closed variety. (See Fig. 34.)

In a serious injury, a combination of the above fractures may be met with. For example, a closed or open fracture may be both complicated and comminuted at one and the same time.

Symptons and Signs of a Fracture

(1) Shock. (Coldness, faintness, nausea, etc.) Nearly always found in some degree with any fracture ; may be severe.

(2) Pain at the site of the fracture.

(3) Tenderness over the injured area, generally followed by *swelling*.

(4) Loss of power or function in the affected part.

(5) Irregularity on the surface of the broken bone, a lump may be felt. If the fracture is open the bone may be exposed.

(6) Deformity of the limb. Due to displacement of the broken fragments of bone or by the end of one piece over-riding the other.

(7) Unnatural movement at the site of the fracture so that a limb may be bent in an unnatural manner at a place where there is actually no joint which allows it to bend. (Not found with impacted or greenstick fractures.)

(8) Crepitus. A grating sensation felt when the ends of a broken bone rub together. (Not felt in impacted or greenstick fractures.) A first aid worker should on no account try to obtain this by moving the ends of the bone against one another as he may convert an ordinary closed fracture into a complicated or comminuted one by so doing.

(9) Shortening may be due to the same condition which causes deformity, viz. the over-riding of the ends of a broken bone. This is brought about by the contraction of powerful muscles which pull up the lower fragment over the upper.

Shortening may also be found in the case of an impacted fracture.

Treatment of Fractures

When all the above symptoms and signs are present in a man who has sustained an injury, the diagnosis of a fracture will present little or no difficulty. In many cases, however, a first aid worker will find that he has to base his diagnosis on scraps of evidence picked up from the casualty himself (he may volunteer a statement that he heard a bone snap), or from the bystanders, and a few symptoms and signs which suggest the likelihood of a fracture having occurred. Severe pain and swelling with inability to move a limb, especially if accompanied by shock, should make a first aid worker suspicious. If he is in any doubt as to whether there is a fracture or not, *he must treat the condition as a fracture.*

General Principles of First Aid Treatment

(1) To deal with urgent conditions such as bleeding in the case of an open fracture, and to take steps to minimise primary shock, and prevent the onset of secondary shock.

(2) To immobilise the injured part completely to prevent movement by the casualty, or by improper handling by bystanders, from increasing the damage to the bone and to surrounding structures.

(3) To remove the injured person to a place where more thorough treatment can be carried out, as soon as the above measures have been completed.

Special First Aid Treatment

In all cases of an open fracture there is a certain amount of bleeding but in the majority of instances this is slight, and can be controlled by the application of a clean, dry, sterile dressing bandaged lightly over the wound. This prevents dirt and germs from getting into it, and must be applied in every case of open fracture. If bleeding is excessive it may be necessary to apply indirect pressure also. If these fail, the application of a tourniquet, *as a last resort only*, must be considered.

Shock is always a prominent feature in these cases. It is specially marked in an open fracture of the thigh bone. It can be minimised by careful handling and by the other measures laid down in Chapter III.

In order to prevent further deformity and movement of the fragments of a broken bone, which will increase the already existing damage to structures around it, it is necessary to immobilise (i.e., prevent from moving) the injured part as soon as possible. When a fracture has been discovered, or is suspected, it should be attended to on the spot, unless there is a likelihood of further injury occurring or danger to life by doing so, e.g., a casualty may be found in the middle of a road crowded with traffic, or lying in a damaged building whose walls threaten to fall upon him. In this case he should be moved to a place of safety with the utmost care, and with the injured part properly supported.

The aim of successful first aid is to make the patient as comfortable as possible by keeping the injured part fixed, *and if possible in the position in which it is found*, so that it cannot move.

It cannot be emphasised too often that it is movement which causes pain and increases shock, even more than the actual deformity which the fracture has produced. Careless and rough handling of the casualty must therefore be avoided *at all costs* and he must be moved as little as possible. A first aid worker must remember that it is not his job to try to " set " a fracture. In the case of an open fracture in which one end or ends of the broken bone protrude through the skin, no attempt should be made to replace the protruding fragments in the wound. If this is done, dirt and disease germs will be carried into the wound. If, as in some cases large pieces of bone are sticking out, they may be covered by pieces of clean, dry, sterile dressing before a larger dressing is applied over them.

There may be occasions, however, when on account of gross deformity it is not found possible to fix an injured part, especially a limb, in the position in which it is found. In such a case the help of a doctor should be sought immediately. If this is not available, an attempt must be made to replace the limb in as natural a position as possible with great care and without using force. To do this, one first aid worker should grasp the limb firmly but gently with both hands above the fracture in order to steady it. A second should grasp the limb below the fracture with both hands and slowly and steadily draw it into the position which it should normally occupy, using the other limb as a guide. Without relaxing the grip of the hands the part should then be immobilised by a third first aid worker.

Two methods of immobilising fractures are in force :—

(*a*) By the use of splints (mechanical means).

(*b*) By using the body as a splint (natural means).

(*a*) By the use of Splints (Mechanical means)

A splint is a rigid appliance usually made of wood or metal which is secured to a fractured limb in order to support it and prevent movement of the broken bone. The commonest type is that made from a piece of wood, cut to the required size, which, after being padded, is fixed along the length of a broken bone by bandages or webbing straps with buckles. It should be sufficiently long to keep not only the broken bone but also the joints above and below it from moving, e.g., if a bone in the forearm is fractured the splint should reach above the elbow and extend below the wrist. Bandages or straps should be passed round the limb and splint and fastened firmly but not so tightly as to interfere with the circulation. Knots and buckles should be over the splint. Several types of splints are used for first aid purposes. (See Fig. 35.)

Wooden Splints

Straight pieces of wood of various lengths and widths, which are sometimes made in sections with metal covered ends which fit into one another, in order to suit individual cases. Sets of wooden sectional splints with webbing straps and buckles are carried by Civil Defence Rescue parties. Other types of wooden splints with webbing straps and buckles form part of the equipment of Civil Defence static first aid posts and mobile first aid units. All splints must be padded before application. (See Fig. 35.)

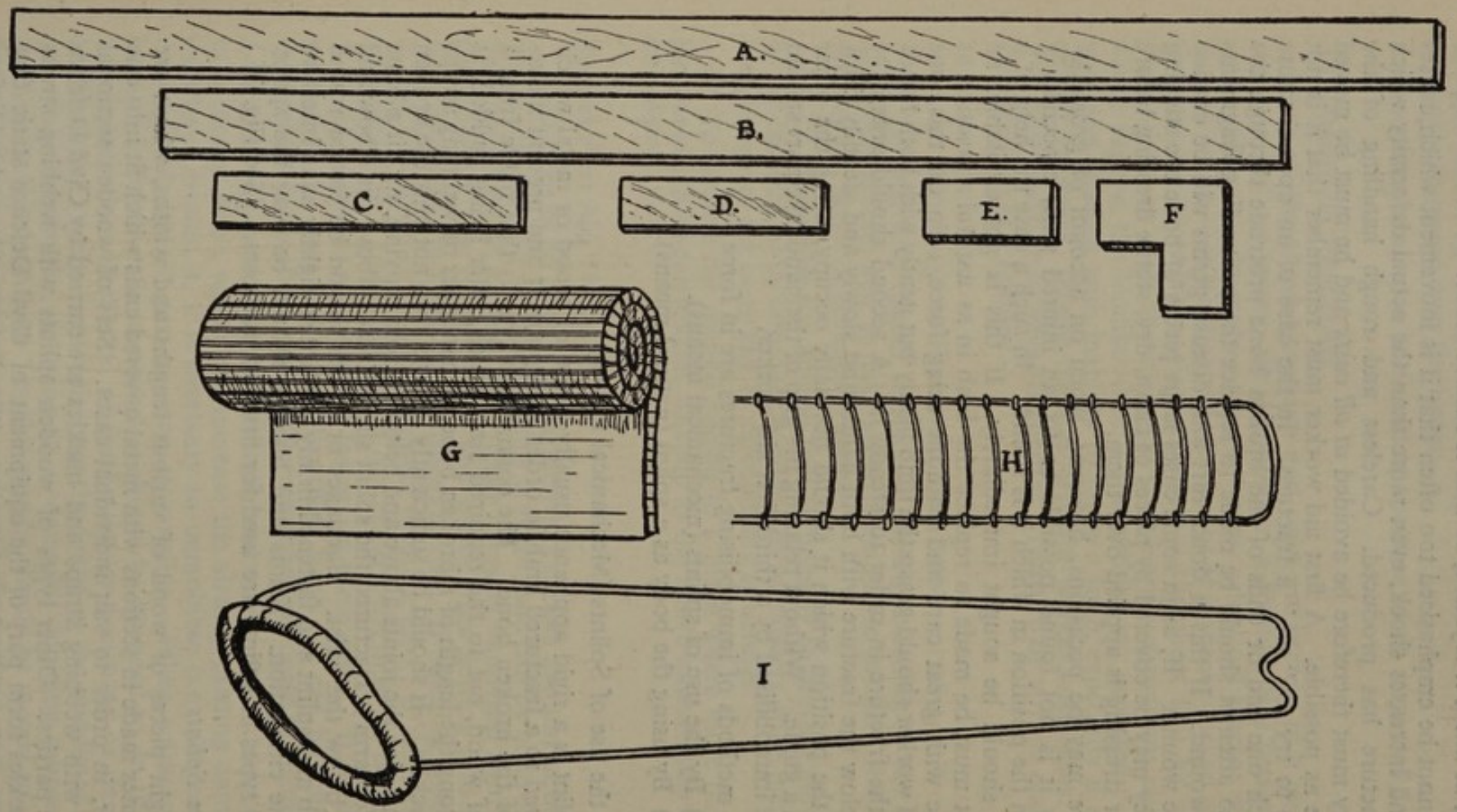

Fig. 35—Types of Splints

A—Thigh Splint ; B—Patella Splint ; C & D—Small Arm or Hand Splints ; E—Straight Metal Joining Piece ; F—Angle Metal Joining Piece ; G—Gooch Splinting ; H—Kramer Wire Splinting ; I—Thomas Leg Splint.

Gooch's Splinting

Consists of narrow, flat laths of wood, side by side, fixed lengthwise on sheets of adhesive plaster. It is usually made into rolls and can be cut to the required length and moulded to a limb.

This splinting is issued to Civil Defence static first aid posts and mobile first aid units. (See Fig. 35.)

Metal Splints

Are usually made of tin or aluminium and may be moulded to fit the shape of a limb. They are generally padded with felt.

Kramer's Splinting

Is made of a framework of stout wire strengthened by wire struts placed across and fastened to it. This is a popular form of splint for first aid use as it can be cut and bent to fit the natural curvatures of any limb. Plenty of padding is, of course, necessary. (See Fig. 35.)

Thomas's Splint

This is a largely used and very valuable splint which was originally designed for fractures of the thigh bone. It may be used as *first aid treatment* for (*a*) all fractures of the thigh bone, except where there is a wound in the upper part of the thigh, groin or buttock, against which the splint will press ; (*b*) all fractures about the knee joint and upper part of the bones of the leg ; (*c*) certain extensive flesh wounds of the thigh or leg. It is seldom used by the Civil Defence Sections at incidents and then *only under the following conditions* :—

When a casualty has to be taken a long distance to hospital.

When a casualty has to be carried a long distance over rough ground.

When it is not possible to send a casualty direct to hospital at once and he may require to be detained at a mobile first aid unit.

A Thomas's Splint consists of a large metal ring, padded and generally covered with leather, which lies obliquely so as to fit over and conform to the shape of the thigh at the groin. Attached to each side of the ring are two long round iron bars of $\frac{3}{8}$-inch gauge, which pass down on either side of a limb converging towards one another as the limb narrows, and terminate at the lower end in a cross-bar about 4 inches long which unites them and has a notch in its centre. The lower end of the splint projects about 6-10 inches beyond the foot of a patient, and as the ring at the upper end is set obliquely the outer side-bar is longer than the inner. This splint can be used for either lower limb provided the longer side-bar is kept on the outer side ; small sizes are made for children. Its object is to fix and support the whole length of the limb in an extended position so that the broken bone or bones cannot be shifted or jolted when the casualty is moved. This is accomplished by passing the padded ring over the foot (the splint being held at first almost vertically) and up over the leg and thigh of a patient until it is wedged against the groin on the inner side and the buttock behind. The foot is then secured to the cross-bar at the far end of the splint and the limb supported on slings fastened between the side bars. The whole apparatus is then slung from a horizontal bar fixed to the poles of a stretcher and called a " suspension bar." The limb is thus lifted a few inches off the surface. A special piece of equipment known as a " stirrup " (foot-piece) which fits on to the side-bars, provides a support for the foot which may be tied to it. (See Fig. 35.)

Method of Application of the Splint

In order to apply this splint efficiently, two at least and if possible three assistants are necessary. If it is a thigh bone which is broken—(1) One assistant supports and keeps up a firm and steady pull on the limb and foot, while another makes a clove hitch knot in a 7 feet long flannel bandage ; a third prepares slings with triangular bandages passed round the inner side-bars and loosely tied round the outer side-bars to form a trough in which the limb will lie. Without relaxing the support and extension of the limb, the clove hitch is slipped round the ankle, over the boot, so that both ends lie on the outer side, one being longer than the other. This longer end is now passed under the instep to the inner side of the ankle where it is threaded under the loop above and then turned down along the inner side of the foot. The two ends will now be in position, one on each side of the ankle, and are known as " extension bands."

(2) With the slings tied loosely to the side-bars the splint is placed in position on the limb, as described above, by the third assistant, the second still supporting and keeping it extended. Both extension bands of the clove hitch are tied round the notched bar at the end of the splint as follows :—

(3) The *outer band* is passed over, then under the bar at the notch, tightened and held over to the opposite side. The inner band is passed in the reverse direction, i.e., under, then over the notched bar crossing the first band at the notch to prevent it from slipping. The two bands are then tied by a half bow and the assistant supporting the limb and foot transfers his hold from them to support the lower end of the splint. While the above has been going on, the third assistant has been busy adjusting the slings on the side-bar to the required tension ; having done this he ties the ends round the outer side-bar. One sling should be under the thigh, another under the knee (which should be slightly bent), a third under the calf, and a fourth under the ankle. To prevent the leg from being raised off the splint, the centre of a narrow-fold bandage is placed on the front of the limb, just below the knee, its ends passed down between the side-bars and the limb, crossed over one another on the back of the limb, then brought up over the side-bars and tied on the front of it.

Under certain conditions, such as when the bone is broken into several fragments, it may be necessary to provide further support by additional splints at the site of the fracture. Gooch's splinting is the most convenient type to use and, if time and circumstances permit, should be applied as follows :—Two pieces of the splinting are placed on the thigh, one over and one under the site of the fracture, care being taken to see that the lower edge of this upper splinting does not press upon the knee-cap ; if there is a wound which has been dressed, they will be over the dressing. The centres of two narrow-fold bandages are placed on the upper piece of splinting, one above and one below the fracture. As in the previous bandage, their ends are passed down between the side-bars and the limb, crossed over one another on the lower piece of splinting, then brought up over the side-bars and tied on the upper piece.

(4) The end of the splint should now be raised off the surface of the stretcher on which the patient is lying, and supported on a roll of blanket, or sandbags, placed across the stretcher, so that the entire limb is suspended between the ring of the splint under the buttock

and the support at the other end of the splint. The foot must not touch this support. Extra padding is placed between the inner surface of the ring and the outer side of the thigh to act as a wedge and to prevent undue movement. (See Fig. 36.)

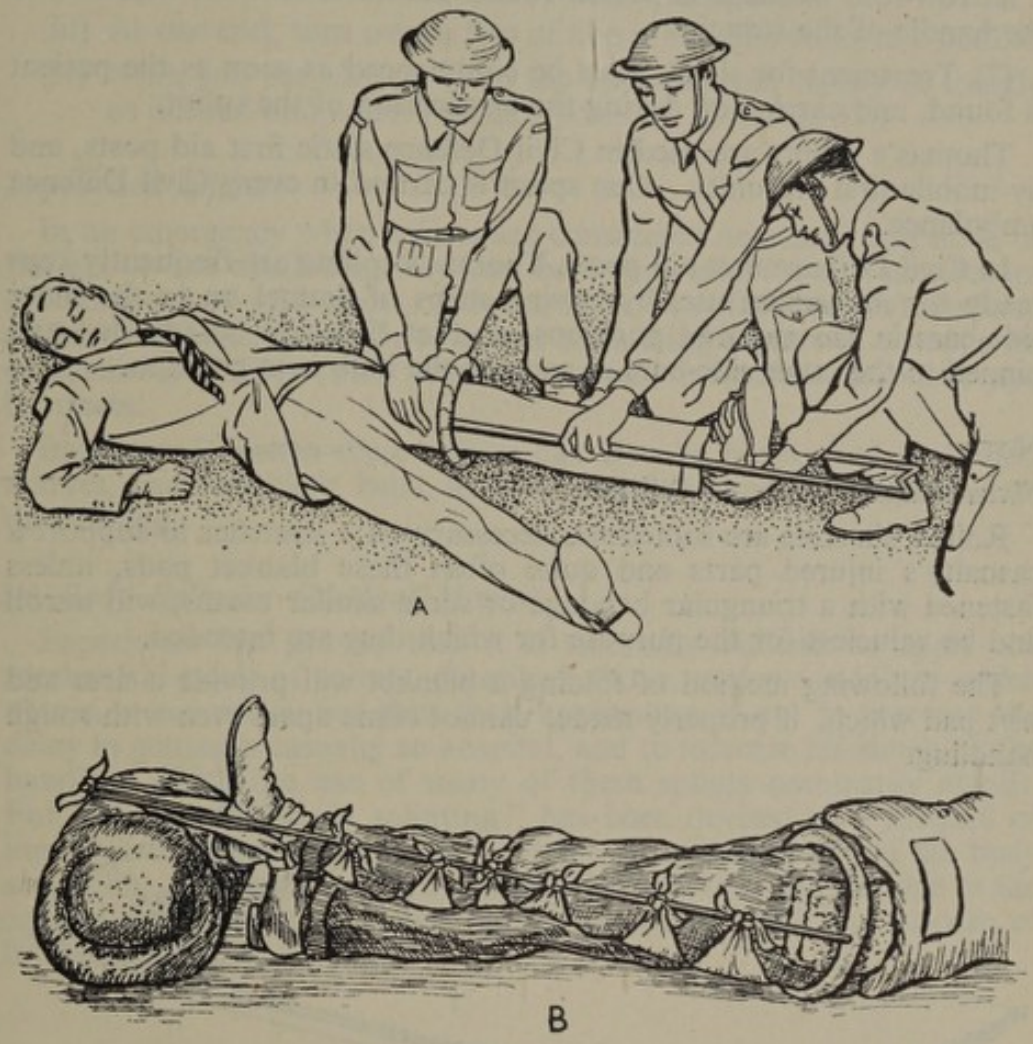

Fig. 36—The Thomas Splint

A—Limb Supported Whilst Splint is Slipped On

B—Splint Applied with Triangular Bandages

(5) If a stirrup (foot-piece) is used, it is sprung on to the side-bars and adjusted so that the shaped part fits against the sole of the foot, thus preventing any side movement. A narrow-fold bandage is then applied as a figure-of-eight to include the foot, ankle and stirrup, by placing the centre of the bandage under the sole of the foot, bringing the ends forward, crossing them on the instep, taking them down behind the ankle, crossing them again, then bringing them up outside the side-bars and tying them off in front of the limb. This can also be carried out where no stirrup is used.

(6) If a suspension bar is used instead of a roll of blanket, it is fitted to the stretcher poles with its horizontal part a hand's breadth in front of the foot, and its grips away from the rumners. The splint is slung

about a hand's breadth below the horizontal part of the bar by bandages tied to the side-bars of the splint. To prevent any movement sideways, the ends of these bandages are tied round the upright portions of the suspension bar. To prevent movement of the splint in an upward direction (e.g., by jolting of the stretcher over rough ground) a narrow-fold bandage is passed round the outer side-bar and tied to the handle of the stretcher.

(7) Treatment for shock must be commenced as soon as the patient is found, and carried on during the application of the splint.

Thomas's splints are used in Civil Defence static first aid posts, and by mobile first aid units. One splint is carried in every Civil Defence ambulance.

In Civil Defence first aid posts, Thomas's splints are frequently kept ready for immediate use, by sewing strips of flannel on to the inner side-bars in the required positions, so that they can be adjusted and pinned to the outer side-bars as soon as the limb is in position.

NOTE :

Fixed Blanket Pads or Pillows

Rolled blankets are sometimes necessary on a stretcher to support a casualty's injured parts and quite often these blanket pads, unless fastened with a triangular bandage or some similar means, will unroll and be valueless for the purpose for which they are intended.

The following method of folding a blanket will provide a firm and soft pad which, if properly made, cannot come apart even with rough handling.

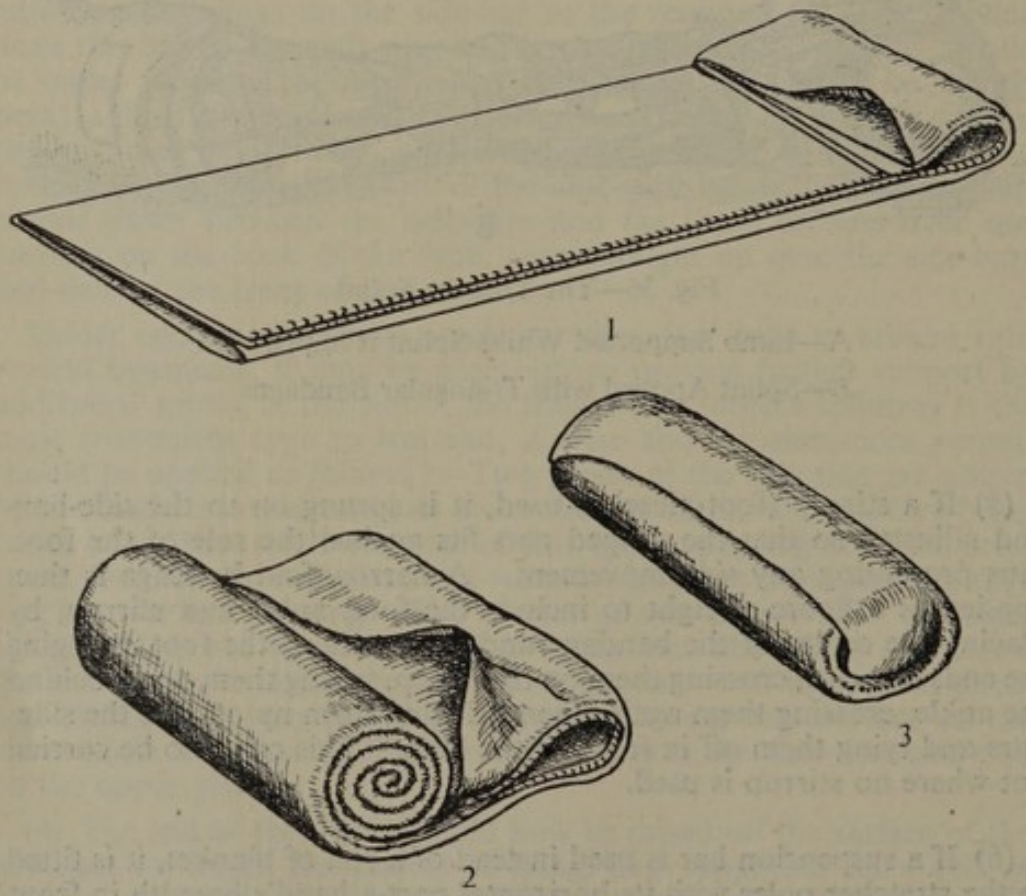

Fig. 37—Making Pad or Pillow With One Blanket—Three Stages

Only one blanket is needed for this and the method of folding is as follows :—

(i) Fold the blanket in half with bound edges together.

(ii) Then fold again, lengthwise, making four folds of blanket, and lay on flat surface with bound edges uppermost.

(iii) At one end, turn over a flap of about 8 inches to form a pocket.

(iv) Next, roll the blanket from the opposite end, tightly or loosely as desired and insert roll into pocket. (See Fig. 37.)

Improvised splints

In an emergency when splints are considered necessary and none of the above are available, they can be improvised from a number of articles, such as odd pieces of wood, laths, etc. (from debris), walking sticks, umbrellas, rolls of newspaper containing a piece of wood, rolls of cardboard, rifles (with bolts drawn and magazines emptied) and bayonets.

Bandages to fasten these splints can also be improvised from ties, scarves, handkerchiefs, belts, military webbing straps or strips of torn up clothing.

(*b*) *Body Splinting* (*Natural Means*)

Experience has proved that it is not only difficult to apply the mechanical types of splints, described above, under conditions which obtain in air-raids, but that their application is apt to increase the delay in getting a casualty to hospital, and to increase his shock by the handling which the use of many of these splints necessarily entails. For this reason " body splinting " has been devised as a method of immobilising fractures of bones in limbs by utilising parts of the body as a splint, e.g., by securing an injured limb to the opposite one in the case of fractures of the lower limb, and to the trunk in the case of fractures of the upper limb.

CHAPTER XI

SPECIAL FRACTURES

The majority of fractures can be adequately dealt with by applying the general rules for first-aid treatment, and by using common sense. Certain fractures, however, call for special mention.

Fracture of the Skull

This may occur either on the top or sides of the head (vault) or in the base of the skull.

(*a*) Of the Vault

This is generally due to direct violence, e.g., a blow or a fall upon the head, and may be *open* or *closed*. The skull may be cracked or splintered and the bone at the site of the break driven inwards, forming what is known as a *depressed fracture*. Bleeding from the fracture or a piece or pieces of broken bone driven inwards may press upon the brain. In such a case a condition known as *compression of the brain* results. In every fracture of the skull there is bound to be some bleeding within its cavity, but in many instances this does not actually press upon the brain. In most cases there is a condition which is known as *concussion* of the brain (a shaking up or stunning). This varies according to the severity of the injury from a headache and dazed state which passes off, to complete unconsciousness.

(*b*) Of the base of the Skull

This is generally the result of indirect violence and may, for example, be caused by a blow upon the jaw, or when a person falls from a height and lands upon his feet or buttocks. In this case the shelf within the skull upon which the brain rests is cracked or broken and, as in a fracture of the vault, bleeding from it may produce compression of the brain.

It will be seen from the above that the main dangers of a fractured skull are its effects upon the brain and nervous system. Of these effects *concussion* or *stunning* is by itself the least severe, and may pass off without any serious consequences. If, however, the damage has led to bleeding and pressure on the brain a casualty will become rapidly or gradually worse and his life will be in great danger. It is therefore of the utmost importance for a first aid worker to be able to know what to look for so that he can find out whether the skull is broken, and if so, whether it is causing pressure on the brain. In any case, he must regard every fracture of the skull as a serious condition and bear in mind that even if the signs of compression of the brain are not evident at first they may come on later. In consequence, the casualty must be seen by a doctor and removed to hospital as soon as possible.

The symptons, signs and treatment of *concussion* and *compression* of the brain and of fracture of the base of the skull will be described separately under Insensibility—Chapter XVI.

First Aid Treatment of Fractured Skull

(1) Lay the patient down with his head on a pillow or rolled-up blanket. Apply a clean dry dressing over any wound on the head and bandage lightly unless there is much bleeding, then bandage firmly. If

a depressed fracture is found or suspected a "Built up" dressing (See page 47) should be placed over the site of the fracture so as not to press upon it, and bandaged lightly. If blood or a watery fluid is coming from the ear, nose or mouth, a light dressing should be placed over the ear to prevent disease germs from getting into it. No attempt should be made to plug up the orifice of the ear or nose to prevent blood from escaping. The patient's head should be turned towards the side from which blood is coming.

(2) Treat shock by the use of blankets and by well protected hot water bottles placed at the sides and feet of the patient. Nothing to drink should be given to the casualty even if he regains consciousness, for fear of causing him to vomit.

(3) If possible get a doctor to see the patient, but this must not delay his removal to hospital.

(4) Send the patient to hospital in an ambulance. If he is unconscious the ambulance attendant must be instructed to see that his tongue does not fall back and obstruct breathing. This is best done by placing the hand under his jaw with his head turned on one side.

(5) The head should be steadied between sandbags to prevent any movement taking place.

(6) A label should be affixed to the patient if at an incident and on it the symbol X should be written. The immediate attention of the hospital authorities must be called to the case by the ambulance attendant on arrival at the hospital.

Fracture of the Lower Jaw

This is always due to direct violence, e.g., a blow or fall, and in the majority of cases is *open* as there is a wound inside the mouth from which blood is coming : occasionally a wound is found on the chin, e.g., from a fragment of bomb or shell or a bullet. A *closed* fracture is comparatively rare.

Symptoms and Signs

(1) Severe pain in jaw with difficulty in speaking and swallowing.

(2) Shock, which may be severe.

(3) Characteristic attitude of the patient who may be found sitting down and leaning forwards with his chin supported on the palm of his hand.

(4) Swelling and tenderness over the site of the fracture.

(5) Deformity of the face and irregularity in the line of the teeth.

(6) The patient may feel the ends of the broken bone grating together and a first-aid worker is very likely to notice this sensation (crepitus) while steadying the jaw with the hand.

(7) Blood stained saliva coming from the mouth.

(8) There may be extensive damage to the jaw, e.g., when a portion is carried away by a bomb or shell fragment. In such a case the tongue is liable to slip backwards into the throat and suffocate the patient, especially if he is unconscious.

(9) Blood from the wound in the mouth may do the same or may be swallowed and vomited later.

(1) Warn the patient not to try to speak.

(2) Apply a clean, dry dressing (e.g., mine) to any external wound.

(3) With the patient leaning forward support the lower jaw with the palm of the hand, gently pressing the teeth of the lower jaw against those of the upper ; then apply a bandage to maintain this position.

(4) The best form of bandage which is simple and easy to apply is that known as " the barrel bandage ". This method should always be used when there is a danger of the tongue slipping backwards into the throat as referred to in (8) above. To apply this bandage :—

(5) Without relaxing support of the jaw, place the centre of a narrow-fold triangular bandage under the jaw, and well back, over the dressing. Carry the ends of the bandage upwards in front of the ears and loosely tie the first loop of a reef knot on the top of the head.

(6) While an assistant supports the jaw, hold the loose ends in your hands and with your fingers open out the knot on the top of the head so as to form two loops, one passing forwards and the other backwards.

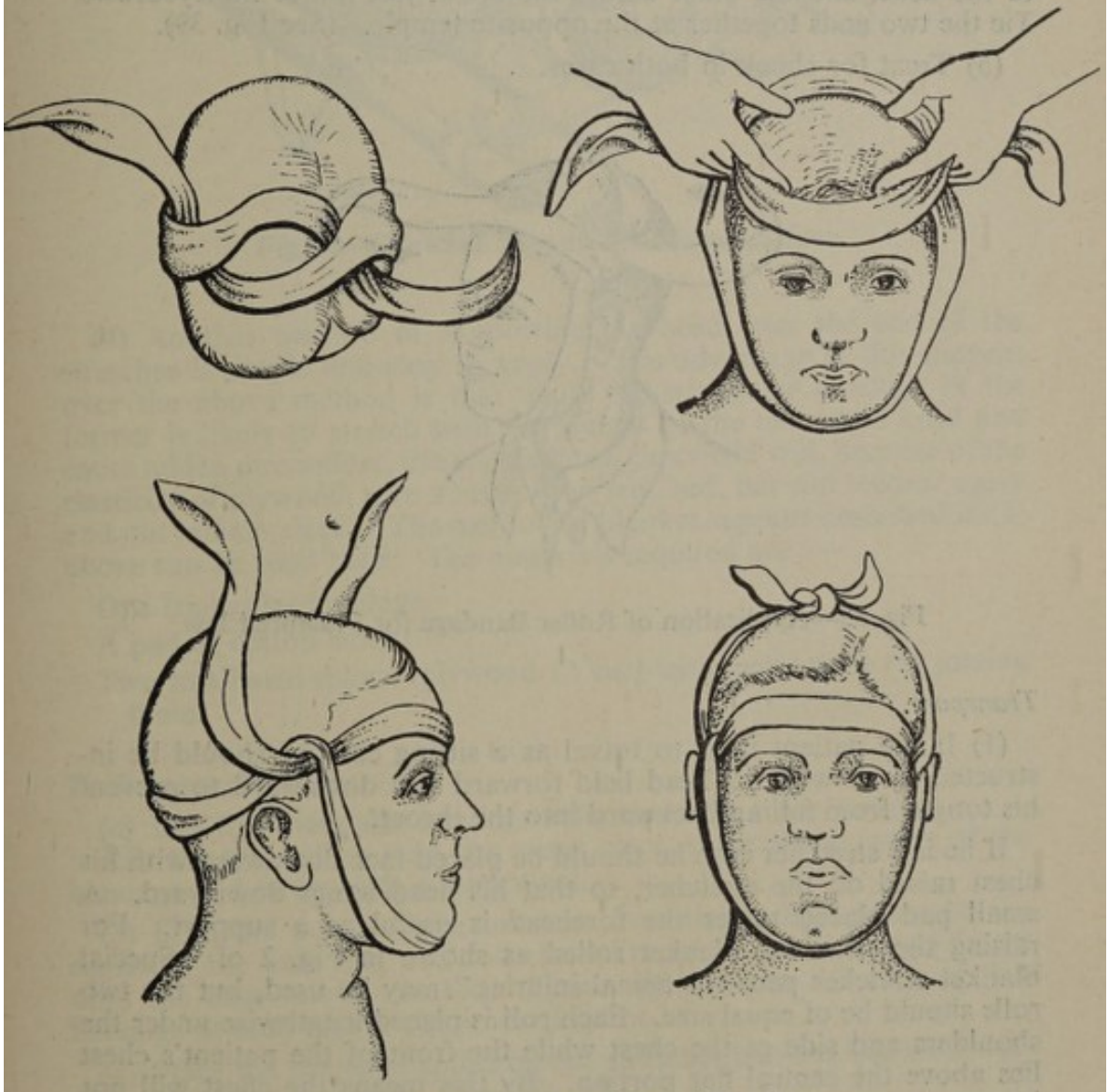

Fig. 38—Application of Barrel Bandage

(7) Guide the forward loop on to the forehead until it lies just above the eyebrows, carry the backward loop on to the back of the head just above the nape of the neck.

(8) Gather up the free ends of the bandage and adjust them so that each cross-over is just in front of the ear ; then tie them on the top of the head. (See Fig. 38).

NOTE.—As an alternative to a triangular bandage, a roller bandage of suitable length may be used.

Another method can be used when no assistant is available to support the lower jaw.

(1) Place a pad of wool or dressing over the injury and support the lower jaw against the upper with the palm of the hand.

(2) Place a narrow-fold triangular bandage under the jaw with one end of the bandage about 6 ins. longer than the other. Carry the longer end over the head, in front of the ear, to the opposite temple.

(3) Bring the shorter end of the bandage up to meet the longer end at the temple and wind the ends round each other.

(4) Take one end round the back of the head, just above the nape of the neck, and the other across the brow, just above the eyebrows. Tie the two ends together at the opposite temple. (See Fig. 39).

(5) Treat for shock in both cases.

Fig. 39—Application of Roller Bandage for Fractured Jaw

Transport

(1) If the patient is fit to travel as a sitting case he should be instructed to sit with his head held forward and downward to prevent his tongue from falling backward into the throat.

If he is a stretcher case he should be placed face downward with his chest raised off the stretcher, so that his head hangs downward. A small pad placed under the forehead is useful as a support. For raising the chest the blanket rolled as shown in Fig. 2 of " Special blanket stretcher pads for spinal injuries " may be used, but the two rolls should be of equal size. Each roll is placed lengthwise under the shoulders and side of the chest while the front of the patient's chest lies above the central flat portion. By this means the chest will not be compressed and breathing rendered difficult.

(2) A more satisfactory method is to allow his head to hang over the end of the stretcher ; this ensures that the tongue cannot fall backward and moreover allows free drainage from the mouth.

(3) In order to support his head in this position the patient is placed on the stretcher with his chest upon a folded blanket beneath which two splints of sufficient length to reach as far as the ends of the stretcher poles are inserted. These should be about a foot apart and protrude one on either side of the patient's head ; his weight will keep them in position. A triangular bandage (narrow-fold) is then tied to one pole, passed over the ends of the two splints and tied to the opposite pole, thus providing a sling upon which the forehead rests. (See Fig. 40.)

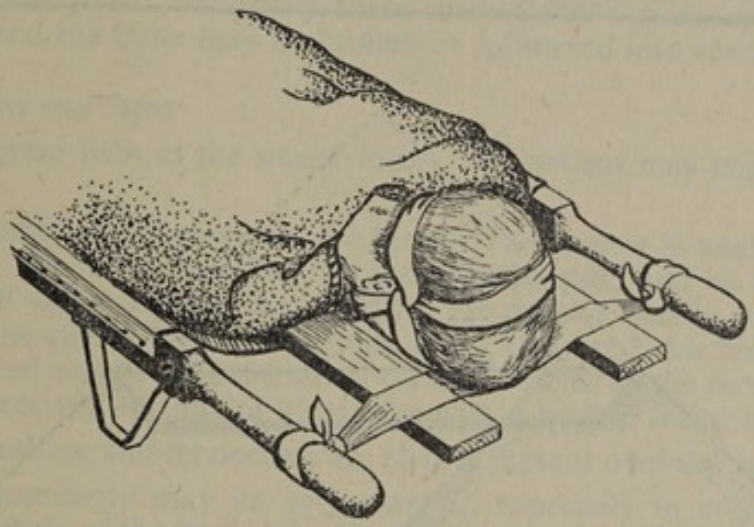

Fig. 40—Stretcher Support for Fractured Jaw

(4) Another method of supporting the head over the end of the stretcher is simple and easy to apply. The advantage of this support over the above method is that while the triangular bandage in the former is likely to stretch with the weight of the casualty's head and cause added discomfort, the support now described will, because of the elasticity of plywood, give a little when required, but will recover again and not remain slack. The method of blanket support described in (1) above can be used here. The materials required are :—

One triangular bandage.

A pad of cotton wool.

Two small arm splints (plywood 12 ins.) with metal piece for joining them.

To Prepare the Support

(*a*) Lay the triangular bandage fully open on a flat surface.

Join the two splints with the metal piece, place in the centre of the bandage and cover with cotton wool.

(*b*) Fold the point of the bandage over the padded splint to the centre of the base line and roll the splint up in it neatly and firmly until the base line is reached. There will now be a length of free bandage at each end of the covered splint.

(*c*) Place the prepared splint on the stretcher handles and fix it with the ends of the bandage. (See Fig. 41.)

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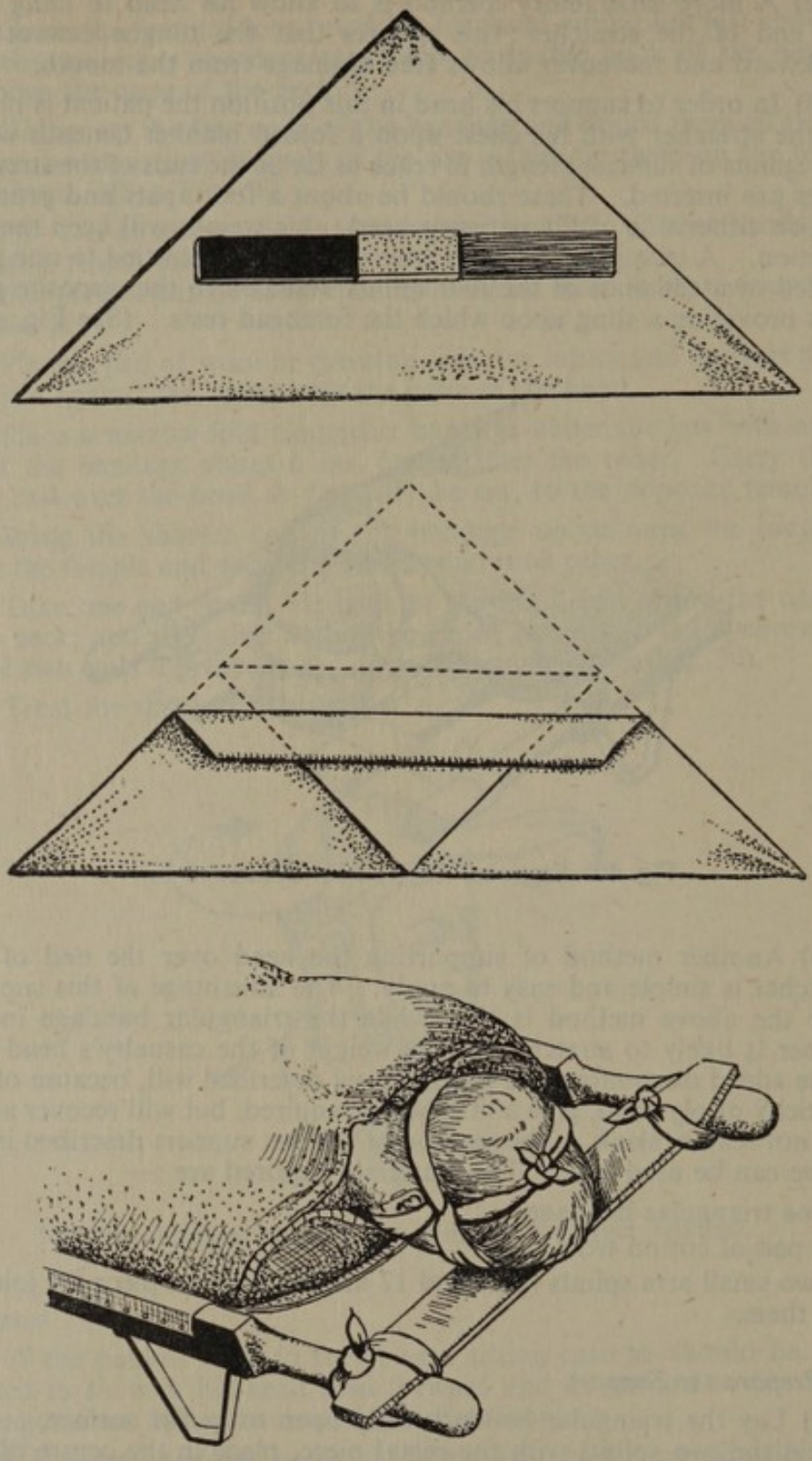

Fig. 41—Stretcher Support for Fractured Jaw

Loading into Ambulance

It is advisable to load a casualty of this nature feet-first into an ambulance to prevent any portion of his overhanging face from striking against the cross bars of the stretcher fitment (particularly of Civil Defence ambulances) while the stretcher is being pushed home along the

tracks. A lower berth should be selected so that blood and vomit can be collected into a bowl. The ambulance attendant must be given special instructions regarding this type of casualty and ordered to report to the hospital authorities immediately on arrival. The label tied on the casualty should be marked with an X.

Fracture of the Collar Bone

This bone is generally broken by indirect violence such as a fall on the flat of the hand with the arm outstretched, in which case it is most frequently a *closed fracture.* It may also be broken by direct violence as when a beam falls upon it or when it is struck by a fragment of bomb or shell. In nearly every case of this sort an *open fracture* results and the bone may be broken or splintered into several pieces.

Symptoms and Signs

(1) Severe pain at the site of injury. A patient may hear the bone snap.

(2) Some loss of power in the limb. The patient is unable to raise the arm above the shoulder on the affected side, and as the pain is increased when the arm hangs down, the patient usually supports the arm at the elbow with the opposite hand, and bends his head towards the injured side to ease the strain on the muscles of the neck. This is a characteristic attitude of a casualty with a broken collar bone.

(3) Swelling and tenderness are always present over the injured part.

(4) Irregularity may be very marked, especially in a thin person, and the ends of the broken bone can often be felt if a finger is passed lightly along the line of the collar bone. This is the result of the pulling of muscles attached to the bone as these may cause the broken fragments to override by pulling them together.

(5) Deformity of the shoulder is generally noticeable, the rounded portion being flattened as compared with the sound side.

(6) Shock is frequently not severe in a closed fracture but may be severe in the case of an open fracture associated with extensive bruising, bleeding, and perhaps burning of the skin, e.g., from a hot piece of metal.

First Aid Treatment of a Broken Collar Bone

The object is to fix the arm and forearm in such a position that they are supported, and the irregularity in the collar bone as far as possible corrected.

(1) Remove the coat and waistcoat of the patient with great care and gentleness beginning with the sound side ; undo the brace (if worn) on the injured side.

(2) Dress any external wound after removing sufficient clothing to uncover it. The dressing is kept in position by a shoulder bandage. (See Fig. 13).

(3) Place a pad about the size of a man's fist, made from folded up triangular bandages or clothing, in the patient's armpit ; put the arm close to the side of the body and the forearm across the chest with the open hand pointing towards the opposite shoulder.

(4) Raise the elbow, keeping it close to the side and apply a St. John sling, tying it over the uninjured shoulder.

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(5) Bind the elbow to the trunk with a broad-fold bandage placed just above the point of the elbow, outside the sling, and tied on the opposite side of the chest. The object of this bandage is to pull the upper end of the bone (humerus) outwards, carrying the shoulder with it, using this bone as a lever and the pad as a fulcrum. (See Fig. 42.)

(6) Feel the pulse at the wrist on the injured side, and compare it with that on the sound side, to make sure that the pad in the armpit is not pressing on blood vessels and stopping the circulation. *This is very important.*

(7) Treat for Shock.

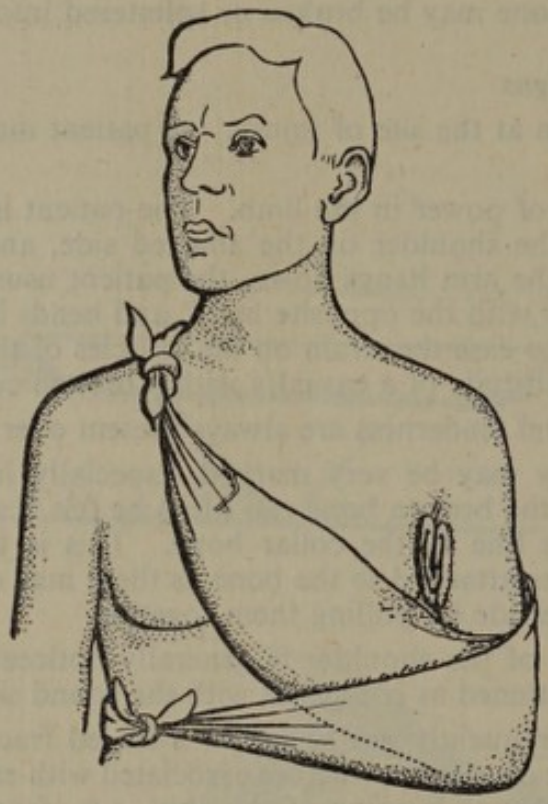

Fig. 42—Treatment of Broken Collar Bone

First Aid Treatment if both Collar Bones are Broken

This is not as common as the fracture of one collar bone, but it may occur when a person falls from a height on to both hands with the arms extended. This fracture is generally a *closed* one.

(8) Three triangular bandages are necessary. A narrow-fold bandage is passed over each collar bone and through the armpit from the front and tied behind with a reef-knot to form a ring. The ends of these two bandages are then tied together over a flat pad of dressing adjusted between the shoulders ; while this is being done the shoulders should be gently braced back in order to correct any deformity caused by overriding of the broken fragments of bone.

(9) Cross the patient's arm on his chest and apply a broad-fold bandage round his body and over the arms to act as a double sling. Tie the knot of the bandage below the wrists. (See Fig. 43.)

(10) When both collar bones are broken a casualty should always be a stretcher case. When only one is broken a casualty may be

carried in a sitting case car or even be allowed to walk with assistance. If, however, he is suffering from severe shock or has other injuries, he must be regarded as a stretcher case.

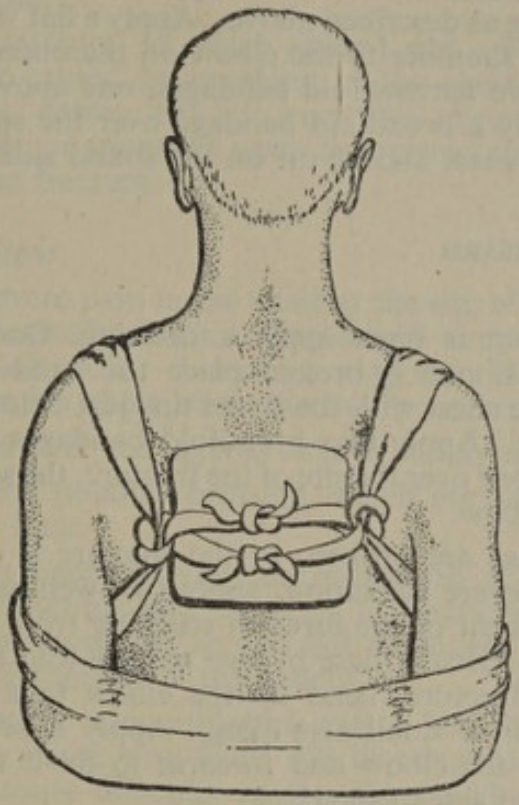

Fig. 43—Treatment of both Collar Bones Broken

Fracture of the Upper Arm

The upper arm is generally broken by *direct violence*, and the fracture may be either *closed* or *open*. Less often, as in the case of a collar bone, a fracture may result from *indirect violence* as by a fall on the hand with the arm outstretched. This fracture, which is usually in the region of the shoulder joint, is nearly always *closed*.

Symptoms and Signs

All the general symptoms and signs of a fracture are present. If the lower end of the bone is broken there may be considerable swelling around the elbow which prevents it from moving. Injury to a nerve in the upper arm may cause numbness and paralysis of the forearm and inability to bend or straighten the wrist. This is one example of a "complicated fracture."

First Aid Treatment

(1) Sit the patient down and remove only as much clothing as is necessary. Apply a dressing if the fracture is open.

(2) Bend up the elbow to a right angle and support it across the chest in a large arm sling. If the fracture is near the shoulder joint bandage the arm to the side of the chest with a broadfold bandage over the site of the fracture and tie it in the opposite armpit. Apply a second broadfold bandage over the point of the elbow and hand and

tie off on the sound side of the chest. If the fracture is near the elbow the upper bandage can be dispensed with. Splints are not usually necessary.

(3) If a splint should be required, support the arm across the chest in a large arm sling as described above. Apply a flat well-padded splint reaching from the shoulder to the elbow on the outer side of the arm and secure it by two narrow-fold bandages, one above and one below the fracture. Apply a broadfold bandage over the splint and sling to fix the arm to the chest and tie off on the sound side.

Fracture of Forearm

First Aid Treatment

(1) If the fracture is open apply a dressing. One or both bones may be broken. If one is broken place the hand and arm of the injured side on the chest with the finger tips just below the collar bone on the sound side. Apply two broadfold bandages over the arm to fix it to the trunk, one over the site of the fracture, the second supporting the point of the elbow.

(2) If both bones are broken, or the fracture is comminuted and accompanied by severe laceration, apply two well-padded flat splints on the back and front of the forearm reaching from the elbow to the tips of the fingers. Secure these by two narrow-fold bandages, one on each side of the fracture, bend up the elbow to a right angle and support the arm in a small arm sling. Apply a broadfold bandage over the point of the elbow and forearm to fix it to the trunk and tie off on the sound side of the chest.

(3) If splints are not readily available use plenty of padding round the injury to act as a splint.

(4) Protect against further shock and send patient to hospital.

Note :

A broken upper limb cannot be bound to the trunk when this has also been injured. In such a case splints and slings must always be used.

Fracture of Ribs

Ribs may be broken by :—

(*a*) Direct violence such as a blow on the chest wall (e.g., from bomb fragments, flying pieces of debris, or a fall). The fracture may be closed or open, and occurs at the point where the blow strikes, the ends of the broken bone being driven inwards. The force of the blow may drive the jagged ends of the broken bones into the organs in the chest or in the upper part of the belly, thus producing a complicated fracture (See Chapter X). The organs most frequently damaged in this way are the lungs, but the liver and less frequently the spleen may also be injured. An open wound of the chest wall may be found with broken ribs, but it must be remembered that every case of complicated fracture involving the lungs is to be considered as a form of open fracture, even though there is no external wound, since the air within the lungs can get to the broken bone in the same way as it can from outside the body when there is an external wound.

(*b*) Indirect violence may also break ribs by applying pressure to the front and back of the chest, compressing the ribs and so bending

them till they break at a point away from the point of pressure. In this case the ends of the broken bones are forced outwards. An example of this is provided by a child's wooden hoop which will tend to break outwards at its sides when it is stood upright and heavily pressed against the ground.

This type of fracture, in which several ribs are usually broken, is most commonly caused by crushing of the chest by such things as beams, masonry, debris, etc. ; it may also occur when persons are squeezed together or trampled upon in a crowd during a panic. It is generally a closed fracture.

Symptoms and Signs

(1) A sharp severe pain in the chest at the site of the fracture, made worse when the casualty takes a deep breath or coughs ; he therefore takes short quick breaths. A casualty may say that he felt something snap or break in his chest when the injury occurred.

(2) Tenderness over the injured area is nearly always present.

(3) Swelling and possibly bruising, which are not usually found at first but appear later.

(4) If a hand is placed flat over the broken rib or on the breast bone, crepitus (See Symptoms and Signs of a Fracture, Chapter X) may be felt. This sign, however, should not be sought for deliberately as it increases the discomfort of the patient.

(5) If the fracture is complicated and a lung has been damaged, bright red blood mixed with froth will be coughed up, and shortness of breath with some difficulty in breathing will occur. This is an example of visible internal hæmorrhage. Injuries to the liver and spleen are uncommon, but should they occur the symptoms and signs are those of concealed internal hæmorrhage, and the condition is a very grave one.

(6) An open wound may exist over the site of the fractured ribs, allowing direct entrance of air which is sucked into and blown out of the lung with a whistling sound as the patient breathes in and out. Breathing becomes increasingly difficult as the lung tends to collapse, and the life of the patient is in danger.

(7) Shock is always present in some degree with fractured ribs, but is more marked and increases rapidly in severity with a complicated fracture, and in the condition described above at (6).

(8) The pulse rate is usually increased in an uncomplicated closed fracture, but in the other cases described above it continues to increase and becomes weaker until it is difficult to feel at the wrist.

First Aid Treatment

(*a*) For a Closed Uncomplicated Fracture :—

(1) Place the centre of a broad-fold triangular bandage just below the site of the fracture, and tie it on the opposite side of the chest wall. As the patient breathes out the knot should be tied as firmly as possible.

(2) A second similar bandage is placed in the same manner, with its centre just above the fracture, so as to overlap the first bandage by half its width. The bandages can be applied over the clothing after the removal of the coat only.

(3) Support the arm on the injured side in a large arm sling. (See Fig. 44.)

(4) Treat for shock.

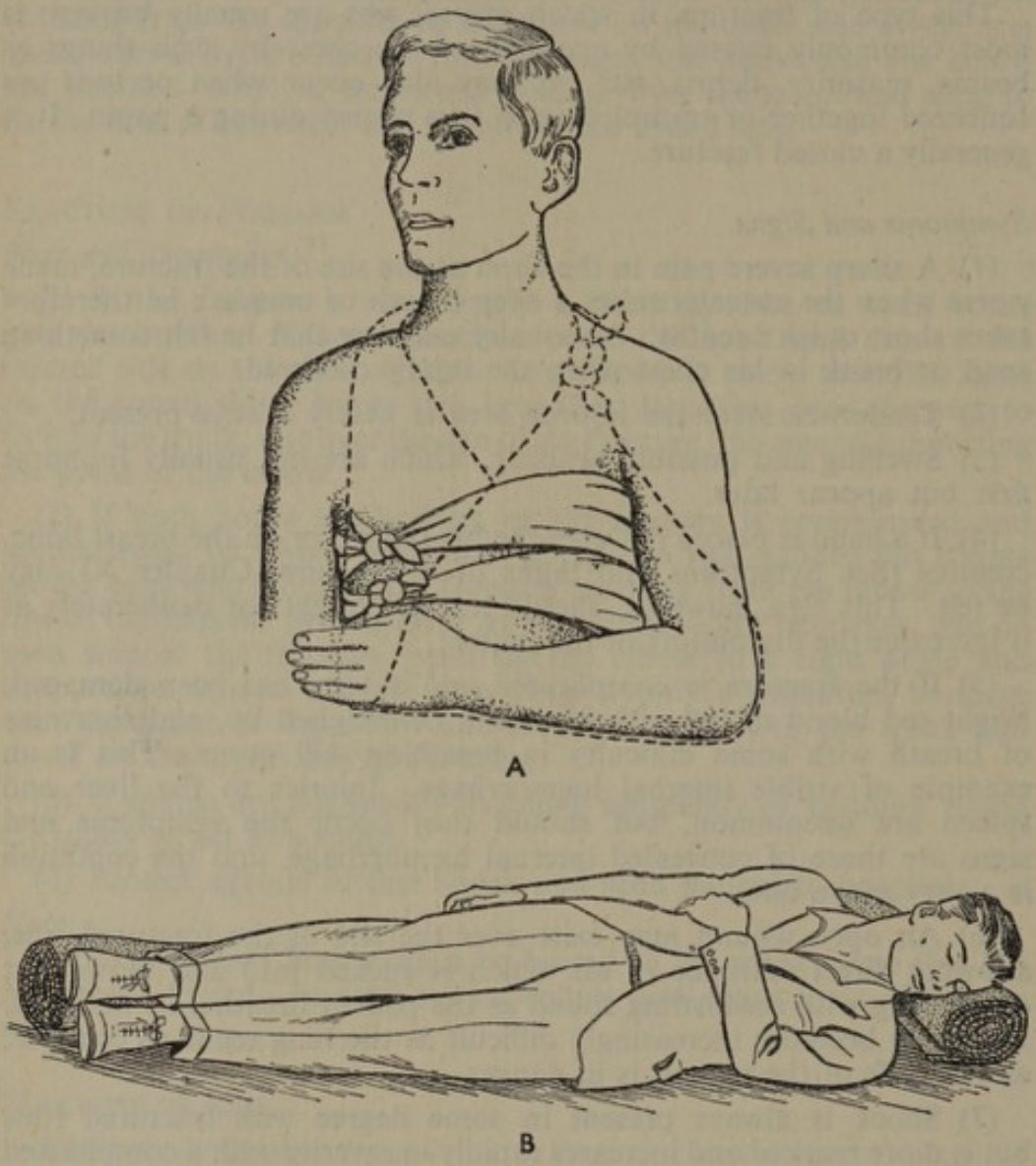

Fig. 44—Treatment of Fracture of the Ribs

A—Simple Fracture of the Ribs

B—Complicated Fracture of the Ribs. Showing Casualty Inclined on Tightly Rolled Blanket

(*b*) For a Complicated Fracture :—

(1) Lay the patient down with his body inclined towards the injured side with his shoulders slightly raised, and place a folded blanket lengthwise at his back to support him in this position.

(2) Remove the clothing especially if it is tight, as this tends to press the fragments of broken bone further into the lung.

For the same reason, bandages *must not* be applied as above at (*a*), (i) and (ii), but only to keep a dressing in position. (See Fig. 44.)

(3) Dress any external wound. If air is being sucked into the lung, a pad dressing should be placed over the opening into the chest and bandaged lightly.

(4) Place the arm on the injured side in a large arm sling.

(5) Treat for shock and send the patient as soon as possible to hospital, lying on a stretcher. If at an incident a label should be tied on the clothing of the patient, and marked with an X.

Fracture of the Spine

This type of fracture which is commonly referred to as a " broken back " is especially serious on account of damage which may be done to the spinal cord contained within the bony framework of the backbone.

There is a particular likelihood of this occurring if, in addition to a fracture, there is a dislocation of one or more bones of the spine, as these may press upon and crush or even sever the spinal cord.

A clean bullet wound in the spine frequently breaks parts of one or more bones without dislocating them ; consequently, unless the spinal cord is actually hit, there is less chance of its being damaged than if a fracture with dislocation has taken place from some other injury. When a fracture-dislocation, as it is called, has occurred, the greatest care has to be taken when moving the casualty so as not to increase any deformity which is pressing upon the spinal cord, and endanger the cord still further.

The spinal cord may, however, suffer severely from jarring by the impact of the bullet or other missile even though it may not actually have been struck. Any violent blow on the spine, whether bones are broken or not is liable to produce what is known as " spinal concussion." This condition is generally only temporary and clears up under appropriate treatment ; cases, however, do occur where permanent damage has resulted.

Causes of Fracture

(*a*) By direct violence : e.g., any severe blow on the spine from falling beams or debris, especially if a person is in a slightly stooping position at the time ; by the impact of a missile such as a bullet or fragment of bomb or shell ; when a person falls from a height and strikes the spine against some hard object, such as a wall, railing or ladder.

(*b*) By indirect violence : e.g., as when a person falls or jumps from a height or from a moving vehicle and lands on his feet with the legs held rigidly. A similar injury may occur when a person dives into shallow water and forcibly bends his neck by striking his head on the bottom ; or when a person falls from a height on to his head.

(*c*) In many cases the cause of the injury may be both direct and indirect violence, e.g., when a heavy weight, such as a sack of flour falling on the shoulders causes sudden and violent bending of the spine lower down.

Symptoms and Signs

(1) Pain and tenderness at the site of injury, aggravated by any movement.

(2) Shock is always present in some degree, but it is very marked where there is damage to the spinal cord.

(3) A wound may be present ; there may be swelling and bruising over the injured area.

(4) Irregularities of the lines of the bones may be present particularly in a fracture-dislocation, but this is by no means common.

(5) Paralysis and loss of sensation in both arms and legs, with breathing carried on by the diaphragm only, shows that an injury to the spinal cord in the lower part of the neck has occurred. In the upper part of the neck an injury to the spinal cord paralyses the breathing mechanism and causes death.

(6) The pupils of the eyes may be unequal in size in an injury of the lower part of the neck.

(7) Paralysis and loss of sensation in both legs occur when the spinal cord in the chest region has been damaged.

(8) Paralysis and loss of sensation is found in both legs when the spinal cord in the region of the loins (lumbar) is injured. At this level, loss of control over the bladder and bowels is evident. A patient is at first generally unable to pass urine and motions but later may pass both quite unconsciously without any control. In some cases he may be unable to pass either for long periods without assistance (e.g., catheter, enema, etc.) and his bladder and belly become very distended. Priapism (erection) occurs very early and is a constant sign of injury of the spine in the region of the small of the back.

(9) A patient may be either conscious or unconscious. Where there is a fracture of the spine without damage to the cord a patient is generally conscious and may even be capable of walking ; in cases of severe injury to the spinal cord with extreme shock, unconsciousness is frequently met with.

(10) All first aid workers must remember that a broken back can occur without damage to the spinal cord causing paralysis. Absence of paralysis must not therefore be taken as positive evidence that no fracture to the back has been sustained.

First Aid Treatment

(1) Where there is a suspected fracture of the spine and a doctor is available at the incident, he should be summoned. The patient should be warned not to move and he should be kept warm by means of blankets and hot water bottles. As the limbs and trunk may be insensitive particular care must be taken to protect them from burning by the hot water bottles.

(2) If no doctor is available, put pads between the ankles, knees and thighs and tie a figure-of-eight narrow-fold triangular bandage around the ankles and the feet, fastening the knot under the soles. Tie broad-fold triangular bandages round both knees and thighs over the pads placed between them.

(3) The greatest care must be taken in removing the patient from the incident since any error may have grave consequences.

In moving or lifting the patient his spine MUST NOT be bent, twisted or over extended at the site of injury. The risk of damage to the spinal cord is greatest in cases of fracture-dislocation, especially in the cervical and lumbar regions (i.e., the moveable parts of the spine).

(4) In a fracture of the spinal column *at any level* the patient must be transported *on his back*. If he is found in some other position he must be very carefully turned over " in one piece " by two or more bearers, four if possible.

(5) A stretcher should be brought and made ready. If the stretcher is of wood with canvas bed portion, it should be made rigid and quite flat by stiffening it with a series of short transverse boards, or a shutter, door, or planks of suitable length and width. A blanket folded lengthwise should be placed on the stretcher and special care taken that when the patient is laid upon it neither his clothes nor the blanket are wrinkled.

(6) The lifting and placing of the patient upon the stretcher should be done in one of the following ways, according to the material and to the number of helpers available.

The process should be carried out with the greatest care, taking particular trouble to see that the whole length of the patient's back, head, and legs are kept straight.

Method (*i*)

Five bearers are required. A blanket is placed lengthwise on the ground in line with the patient and rolled up for half its width. One bearer supports and applies gentle traction to the feet and legs if the lumbar region is fractured, or to the head if the neck is broken, while the patient is very carefully turned on his side by the other bearers, every precaution being taken that no movement occurs at the site of the fracture. The rolled portion of blanket is then placed close to the patient, and he is gently eased over the roll so that his back rests upon the unrolled portion ; the rolled portion is then unrolled so that he lies in the centre of the opened blanket. The two edges of the blanket are then rolled up against the patient's body and grasped by two bearers on each side. With the first bearer maintaining gentle traction on the feet and legs or on the head, as the case may be, all four bearers acting together lift the patient carefully and evenly while a sixth bearer, if available, slides the stretcher under him. If there is no one to slide the stretcher under the patient, the five bearers should move with short, smooth side paces until the patient is over the stretcher ; he is then slowly lowered on to it.

If only three bearers are available, one should go to each side of the patient and grasp the edge of the blanket with his hands wide apart and opposite to the patient's shoulders and hips, while the third bearer supports and applies gentle traction to the feet and legs or to the head. All three bearers acting together lift the patient and carefully lower him on to the stretcher.

Method (*ii*)

If a blanket is not available, open out the patient's coat and roll it firmly so that the roll is close up against his sides. Two bearers on each side grasp the rolled up coat and the clothing round his thighs while a fifth bearer, if available, supports the head and neck, or feet and legs.

Method (*iii*)

Where methods (i) and (ii) cannot be used at an incident owing to the presence of debris or an uneven surface beneath the patient, or if his clothing is damaged or destroyed, the following method may be adopted, but five fully trained bearers are necessary.

The patient can be lifted by means of *webbing bands*, as carried by the Civil Defence Rescue Parties. One band is worked into position beneath the patient's shoulders, a second beneath the small of his back, a third beneath the upper part of his thighs and a fourth beneath his calves. Two bearers stand on each side facing towards the patient and each grasps two handles, the bearer at the head end holding the handles of the bands passing beneath the shoulders and the upper part of the thighs, while the bearer at the foot end holds the handles of the bands passing beneath the hips and the calves, the two middle handles crossing one another. The fifth bearer supports and maintains gentle traction on the head when the fracture is in any part of the spine. Where it is certain or suspected that the fracture is in the lumbar region, a sixth fully-trained bearer is necessary to apply gentle traction to the feet and legs, while the fifth bearer supports but does *not* maintain traction on the head.

(7) Whether the injury is in the cervical or the lumbar region pillows or pads of clothing, large enough but not too large to preserve the normal curves of the spine should be placed upon the stretcher so as to be under the neck and small of the back of the casualty when he is laid upon it. With all spinal injuries the head should be steadied by a sandbag placed on each side of it. (See note below.)

(8) If it can be spared, a folded blanket should support the calves and thus relieve pressure on the heels.

(9) If the patient has to be carried over rough ground, it is often advantageous to minimise movement of his body on the stretcher by binding him firmly but not tightly to it with broad-fold triangular bandages.

(10) All cases of fractured spine at an incident should be labelled with the symbol X and sent in an ambulance to a hospital as soon as possible. The ambulance attendant must be informed of the nature of the injury, and directed to pass on this information to the hospital authorities on arrival.

NOTE

Special Blanket Stretcher Pads for Spinal Injuries

When a casualty suffering from spinal injury has to be transported, it is often difficult to determine how large or small to make the pillows or pads used to preserve the normal curves of the spine. The following method has been devised which with slight adjustment is applicable to any casualty. Only a standard issue blanket is required.

The preparation is as follows :—

(i) Fold blanket, lengthwise, into four and lay on flat surface.

(ii) Turn over about 3 in. at each end and continue folding one end for four more turns. This completes the smaller pad for casualty's neck.

(iii) Continue folding the opposite end until this pad is approximately 12 in. from the other (this distance can be measured by means of a small arm splint which is 12 in. long and is carried by Rescue Parties). The larger pad for the support of the lumbar region is then complete.

(iv) The completed pad can now be placed on a prepared stretcher and adjusted, where necessary, by the team leader as the casualty is being lowered. (See Fig. 45.)

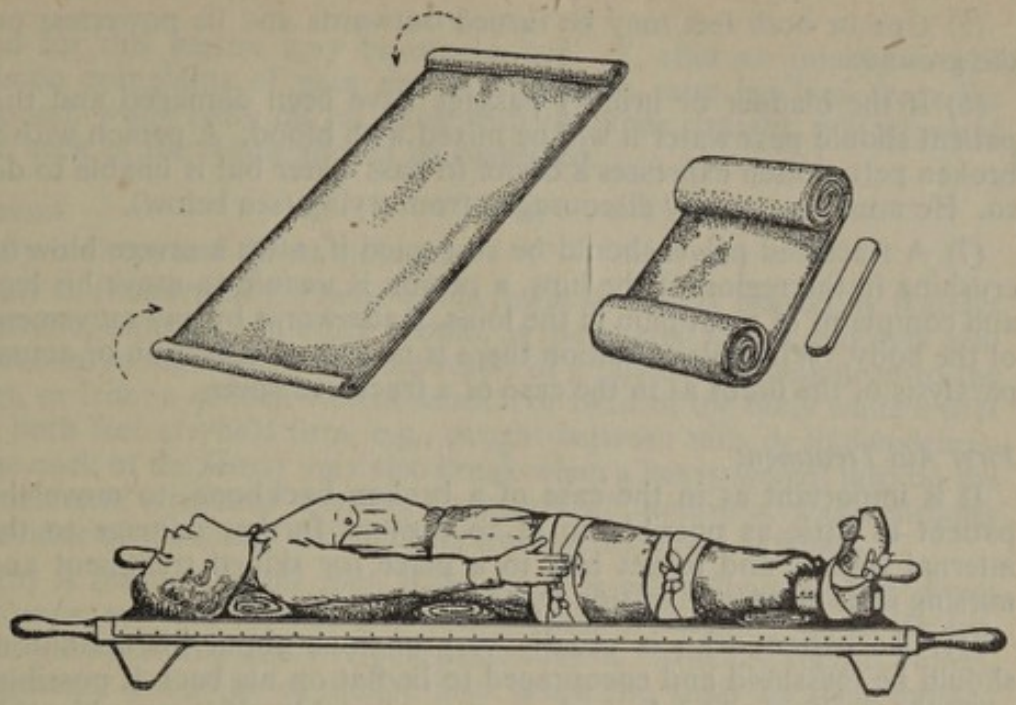

Fig. 45—Blanket Stretcher Pads for Spinal Injuries

Fracture of the Pelvis

In order to understand this type of fracture, a reference should first be made to the description and diagram of the pelvis on page 100. A broken pelvis is always serious owing to the risk of damage to the organs situated within its cavity, especially the bladder and urinary passage (urethra), and sometimes portions of the bowel ; blood vessels may also be injured by pieces of broken bone.

Causes

The bones of the pelvis are nearly always broken by direct violencee such as by the fall of a beam across the hips ; from the crushing of the hips by debris or fallen masonry, or when the wheels of a heavy vehicl, pass over the middle of the body of a person lying on the ground. A shunter on the railway caught about his middle between the buffers of moving waggons will almost certainly have his pelvis broken. Less frequently the pelvis may be broken by indirect violence, as when a person falls from a height and lands heavily on both feet with the legs held stiffly.

Symptoms and Signs

(1) A severe pain in the region of the hips, increased by any attempt at moving or by coughing.

(2) Shock which is always very marked and will increase if there is any internal bleeding. The patient may be unconscious.

(3) Marked tenderness with perhaps bruising and swelling over the loins and in one or both groins.

(4) Inability to walk or stand. The patient is unable to move his leg on the side of the fracture or both legs when the pelvis has been badly crushed ; he may complain of a sensation as if the lower part of his body is falling to pieces.

(5) One or both feet may be turned outwards and lie powerless on the ground.

(6) If the bladder or urinary passage have been damaged and the patient should pass water it will be mixed with blood. A person with a broken pelvis often expresses a desire to pass water but is unable to do so. He must be strongly discouraged from trying (see below).

(7) A fractured pelvis should be suspected if, after a severe blow or crushing in the region of the hips, a person is unable to move his legs and complains of great pain in the loins, made worse by any movement of the body. With this condition there is no loss of sensation or actual paralysis of the limbs as in the case of a fractured spine.

First Aid Treatment

It is important as in the case of a broken backbone, to move the patient as little as possible so as to prevent further damage to the internal organs, and to get him to a place for skilled treatment and nursing in as good a condition as possible.

(1) The patient who is usually very anxious about his condition, should be reassured and encouraged to lie flat on his back if possible, or in the position which he finds most comfortable. If it eases him, his knees may be slightly bent and supported on a folded blanket.

(2) He must be warned not to try to pass water, however much he may want to. The reason for this is that if the urinary passage or channel is torn, as it frequently is, urine will not be able to come out through it, but will pass into the cavity of the belly or into the soft tissues, causing a great deal of trouble and probably sepsis later on. Nothing must be given to the patient to drink, as this will encourage the desire and tendency to pass water.

(3) Gently pass a broad-fold triangular bandage round the hips and tie on the front of the body firmly, but not so tightly as to cause pain.

(4) Place a small pad between the ankles and tie the feet together with a figure-of-eight narrow-fold bandage ; place another pad between the knees and gently tie them together with a broad-fold bandage.

(5) Shock must be treated by the usual methods at the earliest opportunity.

(6) It is very important to summon medical assistance if a doctor is readily available ; if he is not, no time must be lost in sending the patient to hospital.

(7) The placing on a stretcher and removal of a patient should be carried out as for a fractured spine. If at an incident, a label should be attached to him and the label marked with an X. Instructions similar to those for a patient with a fractured spine should be given to the ambulance attendant who should be warned of the danger of allowing the patient to pass water.

FRACTURE OF THE FEMUR (THIGH BONE)

The thigh bone may be broken at its upper end, most commonly in the neck, at any point in its shaft, or at the lower end close to the knee joint. This type of fracture occurs quite frequently and must always be regarded as serious. In elderly and old people whose bones have become brittle, the neck of the femur is often broken as the result of a relatively slight injury, such as tripping over something and falling,

and for this reason may be overlooked. If, after an injury, an old person complains of pain and is unable to raise his heel from the ground, while lying on his back with the knee straight, a fracture of the neck of the femur should be suspected.

Causes

By indirect and direct violence.

(*a*) A fracture of *the neck of the femur* is usually caused by indirect violence, especially in older people, as mentioned above, but may also occur in younger people as the result of a fall from a height on to the feet, or from a sudden violent wrench or twist of the body while a foot or both feet are held firm, e.g., caught between rails or under debris. The neck of the femur may also break when a heavy weight falls on the shoulder of a person. Bullets, fragments of bombs or shells striking the neck of the femur will cause a fracture by direct violence.

(*b*) A fracture of *the shaft if the femur* is generally caused by direct violence, as from the fall of a heavy beam or masonry on to the leg, or if the wheel of a heavy vehicle passes over it. Missiles, such as bullets, fragments of bombs or shells, also break the shaft by their impact. The bone may also break when a person falls from a height and strikes it against some hard substance such as a wall or iron bar.

(*c*) A fracture of *the lower end* may result from any of the above examples of indirect or direct violence. This fracture is particularly serious if it extends into the knee joint.

TYPES OF FRACTURE

Any type of fracture, i.e., closed, open, complicated, comminuted, impacted or greenstick (as described under fractures pages 105-107) may be present when a thigh bone is broken. Deformity, however, may be very marked when the shaft is broken as the powerful muscles which are attached to it pull upon and twist the lower fragment of the broken bone so that it is dragged upwards, backwards and rotated outwards until it comes to lie behind the upper fragment. This causes the limb to become shorter and the leg and foot to be turned outwards. Another type which frequently occurs, particularly when there is a fracture of the neck or upper end of the shaft is the *impacted fracture*. This also causes shortening, and, unless this is marked and noticeable there may be difficulty in recognising the signs of fracture as they may be less evident than in the other types.

Symptoms and Signs

(1) Severe pain at the site of the fracture, increased by the slightest movement.

(2) Shock—which is usually very severe, especially in the case of an open or a comminuted fracture of the shaft.

(3) Loss of function—the patient is unable to raise the affected leg which lies helpless and rolled over on its outer side with the outer border of the foot lying on the ground. This position which is known as " eversion " is characteristic of a broken thigh bone.

(4) Tenderness over the injured area ; in a fracture of the neck this is in the region of the hip joint. Swelling, usually not obvious at first but may appear later.

(5) There may be a wound through which the broken ends of bone protrude.

(6) Deformity—which is usually present in some degree, and may be very apparent.

(7) Shortening of the injured limb in comparison with its fellow of the opposite side.

First Aid Treatment

This should be carried out in accordance with the general principles laid down in pages 108-115, and must be the same for a fracture in any part of the bone.

To immobilise the fracture at an incident where it is not practicable or desirable to use mechanical splints—

(1) Dress any wound which may be present and gently place the limb in as natural a position as possible, with the patient lying on his back.

(2) Put pads between the knees and ankles. Tie the feet together with a figure-of-eight narrow-fold, and the knees with a broad-fold triangular bandage.

(3) If the break is in the shaft, carry two narrow-fold bandages round both thighs, one above and one below the injury, and tie off on the sound side. (See Fig. 46.)

(4) Treat shock at the earliest opportunity, and place the patient on a stretcher. Attach a label to his clothing and mark it with an X.

(5) When the patient is loaded into the ambulance, the attendant must place sandbags on the outer side of each limb to prevent any movement during the journey to hospital ; on arrival there, she must notify the authorities of the nature of the case.

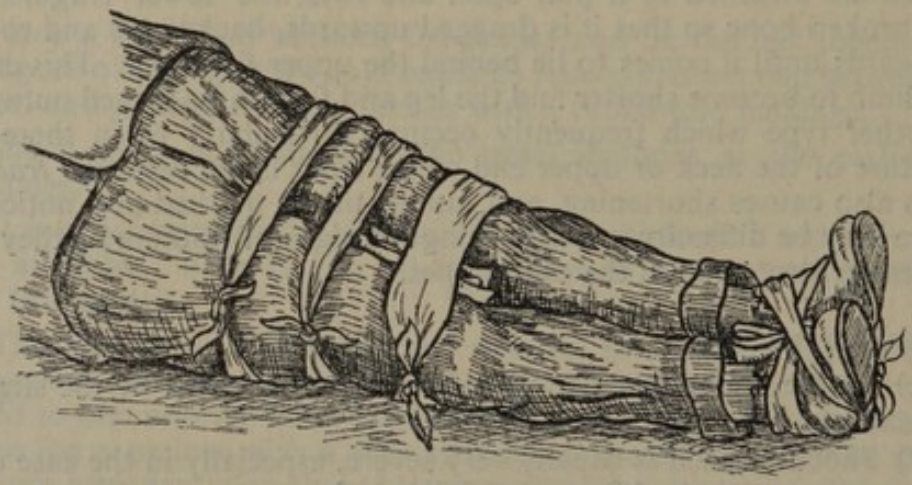

Fig. 46—Treatment of Broken Thigh Bone—Without a Splint

Note 1

If the fracture is open and severe bleeding has occurred, or if the bone has been broken into several pieces (comminuted), tie the feet together with a figure-of-eight narrow-fold bandage ; then apply a flat padded splint along the side of the body and injured limb, reaching from below the armpit to beyond the foot. Place a large pad of cotton wool, evenly spread out, on top of the dressing already applied to the

wound and between this and the splint ; this acts as extra padding and maintains an even pressure. Now apply the following bandages :—

(i) a broad-fold round the splint and chest below the armpits ;

(ii) a broad-fold round the splint and both hips ;

(iii) a broad-fold round the splint and both thighs over the site of the wound and pad of cotton wool ;

(iv) a broad-fold round both knees ;

(v) a narrow-fold round the splint and both legs ;

(vi) a narrow-fold as a figure-of-eight round the splint, both ankles and feet, covering the bandage already in position ;

(vii) all knots must be tied over the splint. (See Fig. 47.)

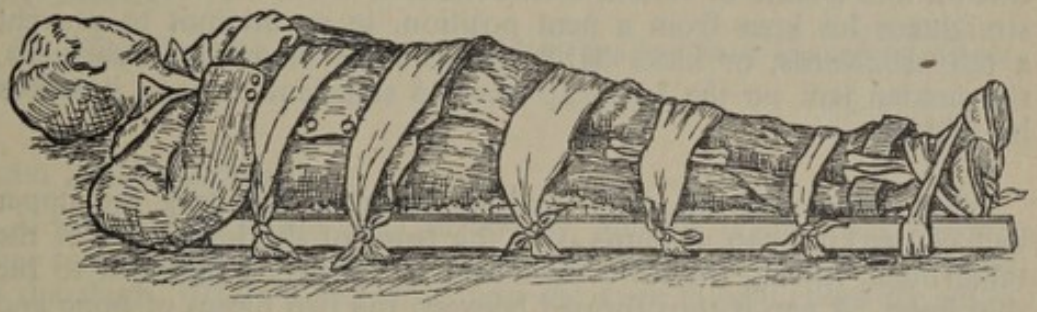

Fig. 47—Treatment of Broken Thigh Bone—With a Splint

Note 2

If both thigh bones are broken it is obvious that tying the legs together is of no use alone and that splints are necessary in addition. A long splint must be applied on either side, in the manner described above. If these are not immediately available, an efficient support can be improvised with a blanket and some shorter pieces of wood or other rigid material. The two ends of a blanket are brought together and the halved blanket thus formed is placed on the ground beside the patient with its upper border at the level of the hips and the lower at the feet. This side nearest to the patient is rolled up close to his body and he is placed upon the centre of the blanket in the manner described for a fractured spine. Pieces of wood, poles, or even stout paper folded up are enclosed in both sides of the blanket, which are then rolled up close to the patient's hips and limbs. Bandages are then placed round the hips, both thighs, both knees and both ankles and feet over the blanket trough to keep it in position.

Fracture of one or more Bones of the Leg (Tibia and Fibula)

The above principles of treatment apply in the case of these bones. Splints, if used, should extend from the middle or upper end of the thigh to beyond the foot.

Fracture of the Patella (Knee-Cap)

The knee-cap may be broken by direct violence such as a blow in falling or a heavy weight falling upon it, or by indirect violence caused by excessive muscular action. In the former case the bone may be broken in several pieces, while in the latter it is usually split right across. This fracture is comparatively rare and when it does occur may easily be overlooked.

A short reference to the structure of the patella will show what happens when it is broken in half.

The patella should be regarded as a flattened bone which is developed in the tendon of a set of powerful muscles which run down the front of the thigh and straighten the leg at the knee-joint, helping to keep the body in an upright position. Parts of the tendon of these muscles are inserted into the upper border of the patella, while the continuation of the tendon below the patella is inserted into the front of the upper part of the tibia (shin bone). If these powerful muscles are suddenly thrown into a state of violent contraction, as when a person suddenly straightens his knee from a bent position, in an attempt to prevent a fall backwards, or kicks hard against some unyielding substance, the sudden jerk on the knee-cap may be sufficient to snap it across its middle.

When this occurs the thigh muscles contract and drag the upper half of the knee-cap upwards over the front of the lower end of the thigh bone, leaving the lower half held by its strong ligament to the shin bone. A gap is thus formed between the two pieces of bone and this widens until it may become considerable, as the muscles remain in a state of spasm. When the bone has been cracked or broken into several pieces by direct violence, there may be no separation of the fragments, as these are held together by the tendon and ligament which are not torn to the same extent as in the former type of fracture (See Fig. 48.)

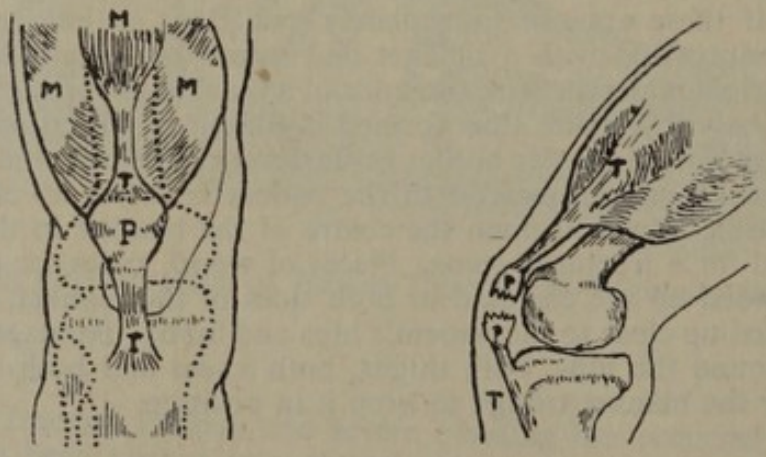

Fig. 48

P—Knee-Cap ; M—Muscle ; T—Tendons
Outline of Bones Forming Knee-Joint in Dotted Lines

Symptoms and Signs

(1) Severe pain over the front of the knee, made worse by any attempt at movement.

(2) Shock—usually worse when the bone is broken by direct violence.

(3) Marked tenderness and swelling over the knee-joint. Bruising occurs almost at once if the bone is broken by direct violence, somewhat later if by muscular action.

(4) If there is wide separation of the fragments, a space can sometimes be felt between them by gently placing a hand over the knee-cap before the joint becomes swollen ; a grating of the fragments together can occasionally be felt when there is no separation.

(5) When the bone is broken right across, the patient is quite unable to straighten the lower limb ; if there is no separation of the fragments he may be able to do so a little, but this causes great pain and increases muscular spasm.

(6) Blood and fluid collect rapidly within the joint which becomes very swollen.

(7) There may be a wound if the fracture has been caused by direct violence.

First Aid Treatment

A mechanical splint *must always be applied* behind the injured knee to prevent it from bending and, to relax the muscles on the front of the thigh. If this is not done and the knee is bent, possibly while the patient is being moved, spasm of the muscles will increase, the gap between the pieces of broken bone will widen, and if there is not already a gap the bending is likely to cause one.

(1) Prop the patient up in a semi-sitting position and support the head and shoulders on pillows or folded blankets in order to relax the muscles on the front of the thigh. At the same time an assistant will gently straighten and raise the limb, placing a blanket pad or clothing beneath the lower part of the leg so that the heel is about 12 inches off the ground. This will further relax the thigh muscles. Dress any wound which may be present.

(2) Place a padded flat splint, as wide as the patient's knee, along the back of the limb, extending from the upper part of the thigh to just beyond the heel. Fasten this to the limb by three narrow-fold triangular bandages :—

(i) Twice round the splint and upper part of the thigh and tied off in front ;

(ii) A double figure-of-eight round the splint, foot and ankle ;

(iii) The centre of a bandage is laid just above the knee-cap, its ends carried to the back and crossed over on the splint, then brought forward and tied below the knee-cap. This bandage should be applied firmly so as to draw the fragments of the broken bone together as much as possible.

(3) Treat for Shock.

(4) The patient should be kept in the semi-sitting position with his leg raised whilst being carried on a stretcher and in the ambulance. Care must be taken that the limb is not moved by jolting or when going round corners. (See Fig. 49.)

Fig. 49—Treatment of Broken Knee-Cap by Back Splint and Raising of Limb

CHAPTER XII

JOINTS

The bones of the skeleton are connected together at different parts of their surfaces. Where two or more bones come into contact a joint is formed. This is also called an articulation.

Joints are divided into three classes :—

(*a*) Immovable Joints.

(*b*) Slightly Movable Joints.

(*c*) Freely Movable Joints.

(*a*) An immovable joint is one in which the opposing, or articulating surfaces of the bones are joined together by connective tissue or by gristle, allowing no movement to take place. An example of this is found in the bones of the cranium.

(*b*) A slightly movable joint is one in which the opposing bony surfaces are either joined together by ligaments or united by broad, flattened discs of gristle. An example of this type of joint is found between the bones (vertebræ) which form the back-bone. In these joints a certain amount of movement takes place.

(*c*) A freely movable joint is one in which the opposing surfaces of the bones are completely separated from one another, but are bound together by strong fibrous bands and enveloped in a fibrous capsule. The surfaces of the bones which form the joints are covered with smooth, shiny gristle in order to facilitate movement and reduce friction. This is also aided by a lubricating fluid which comes from a membrane lining the fibrous capsule surrounding the joint. In long bones the ends are the parts which form the joints ; in the flat bones the joints are usually found at the edges ; in the short bones, joints are formed at various parts of their surfaces where they come into contact with one another.

Freely movable joints are divided into four main types :—

(i) *Ball-and-Socket Joint*

Each consists of a cup-shaped socket in a bone into which the rounded knob-like head of another bone fits. This form of joint has the widest range of movement of all joints and combines all the kinds of movement which are described below. The best example of this type of joint is that of the shoulder.

(ii) *Hinge-Joint*

In this joint the ends of the bones are connected to one another in such a way as to permit movement to take place in two directions only, and in the same place. These movements are bending (flexion) and straightening (extension) of the joint.

The best example of a hinge-joint is that of the elbow.

(iii) *Pivot-joint*

In this form of joint, movement is limited to rotation of one bone acting as a pivot within an encircling ring which is formed of bone or by a ligament.

An example of this type of joint is found at the upper part of the forearm where the head of the outer bone (radius), encircled by a ligament connecting it to the inner bone (ulna) revolves round the head of the ulna when the palm of the hand is turned upwards and downwards (supination and pronation).

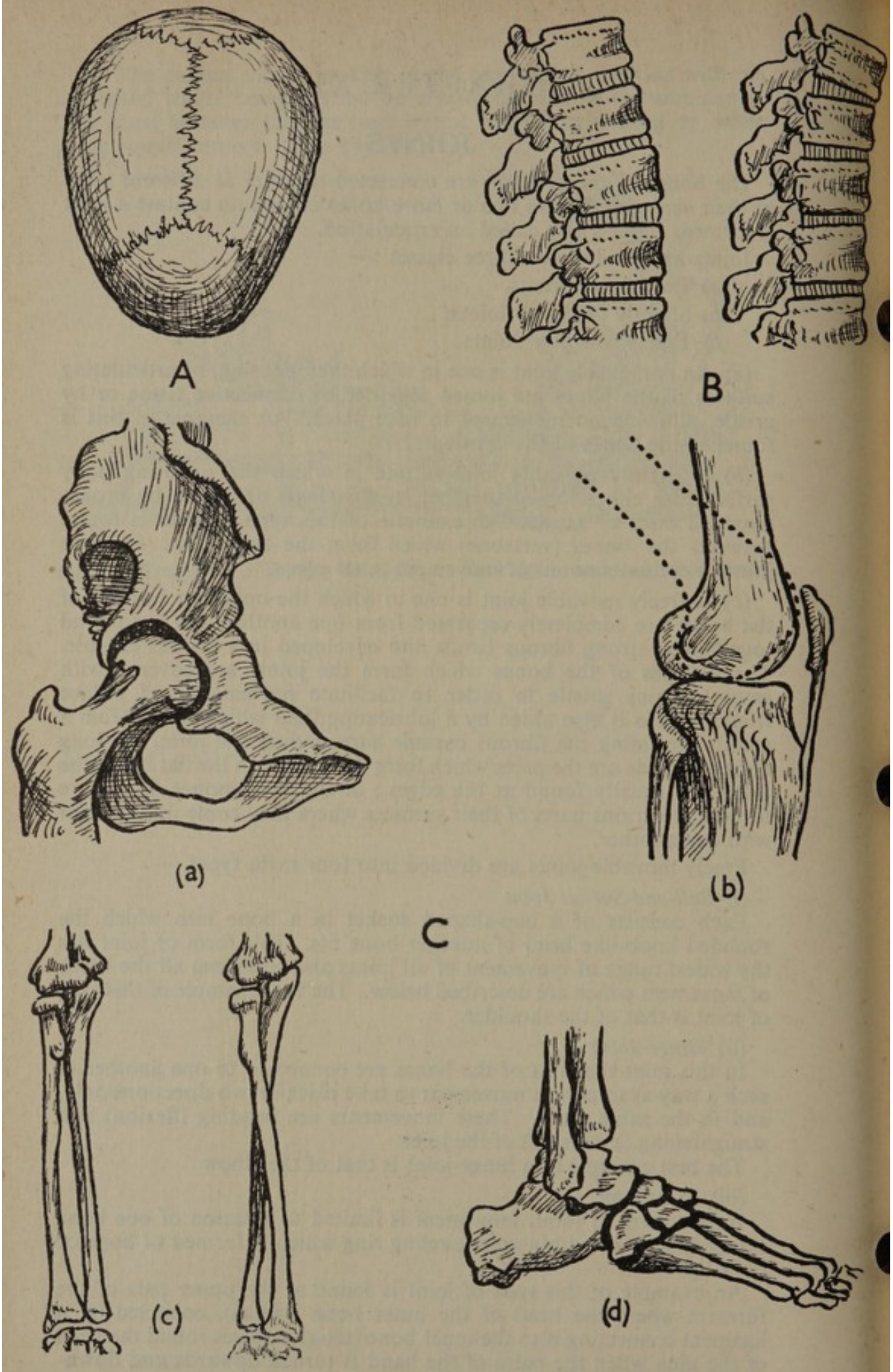

Fig. 50—Types of Joints

A—Immovable ; B—Slightly Movable.
C—Movable : (*a*) Ball and Socket, (*b*) Hinge, (*c*) Pivot, (*d*) Gliding

(iv) *Gliding-joint*

This is a joint which allows a gliding movement of the surfaces of two or more flat bones upon one another only. The joints of the bones of the wrist (carpus) and of the ankle (tarsus) form the best examples of this type of joint. (See Fig. 50.)

The kinds of movement permitted in joints are :—

(*a*) Gliding movement.

This is the simplest form of motion which can take place in a joint, one surface of a bone gliding over the surface of another without any twisting or turning movement. Examples of this are found in the bones of the wrist and ankle.

(*b*) Angular movement.

This occurs only between long bones and causes the angle between the ends of the bones to be increased or diminished. Four varieties of angular movement can take place.

(i) Forwards and backwards constituting *flexion* and *extension*, as in the case of the elbow-joint. When the elbow is bent or flexed the angle between the arm and the forearm is diminished, when the elbow is straightened or extended the angle is increased.

(ii) Towards and away from the centre line of the body, or, as in the case of the fingers and toes, from the centre of the hand and foot. These movements constitute what is called *adduction* and *abduction* (Latin prefix " ad " means " to " and " ab " means " from ").

Thus, when two fingers are widely separated the angle between them is greater than when they are brought nearer together. This forms an example of abduction and adduction.

Another example of abduction is the raising of an arm away from the side of the body ; bringing it back again is an example of adduction.

(iii) Circular movement, also known as *circumduction*. This is a circular, sweeping movement which takes place between the head of a bone and the socket in another bone into which it fits. Examples of this movement are best seen in the joints of the shoulder and hip.

(iv) Rotation. This is a form of movement in which a bone turns round on its own longitudinal axis, i.e., turns in its own length. This movement is well seen in the shoulder and hip joints.

It is very important for the student of first aid to understand and remember the joints in the body so that he will be in a better position to know how to deal with sprains and dislocations which are referred to below.

INJURIES TO JOINTS

(*a*) *Sprain*

This is a condition in which ligaments and other tissues surrounding a joint are stretched or torn as a result of sudden violence, usually indirect. There is, however, no displacement of the bones which form the joint. Sprains most commonly occur in the ankle, wrist, shoulder and knee following a fall in which these have been wrenched or twisted.

Symptoms and Signs

(1) Severe pain, which is increased by any movement of the joint.

(2) Shock, caused by the pain. Usually not so marked as in fractures or dislocations, although sometimes sufficiently severe to make a person vomit or faint.

(3) Marked tenderness over the site of the injury, followed by :—

(4) Swelling which is at first slight but rapidly increases.

(5) Loss of power in the affected part. Not so marked as in fractures.

(6) Bruising of the skin, due to bleeding from the deep structures which have been torn. This comes on a little later and may extend for some distance beyond the damaged area.

(7) No deformity in the joint, as in dislocations.

Treatment

The joint must be placed in the position most comfortable to the patient and kept at rest.

Firm bandaging over a thick pad of cotton wool will support the part, ease the pain and reduce the swelling, in severe cases it may be necessary to apply a splint. In a sprain of the upper limb the arm should be placed in a sling and a broad-fold triangular bandage applied over it to bind it to the body and prevent any movement. Cold compresses may be used in the early stages but hot fomentations are generally more soothing. If a sprain of the ankle occurs out of doors it is advisable to apply a bandage firmly as a figure-of-eight, over the boot and wet it with water in order to tighten it. *When in doubt* as to whether the injury is a sprain or a fracture *always treat as a fracture.*

Shock must of course be treated in the usual way.

(*b*) Strain

This is caused by the forcible stretching or wrenching of muscles and tendons in the same parts as a sprain occurs, and for similar reasons. Unlike a sprain, however, the muscles and tendons are not torn.

Symptoms and Signs

Are similar to those of a sprain but less marked, and the condition generally improves more rapidly.

Treatment

The same as for a sprain.

(*c*) Dislocation

This is a further and more serious stage in which as a result of violence usually indirect, but sometimes on account of muscular action, the bones which form a joint are forced out of their normal position. This is always accompanied by extensive stretching and tearing of the ligaments which keep the bones in their place.

Certain joints are more liable to be dislocated than others. Ball-and-socket joints, on account of their more extensive range of movement, are more frequently dislocated than hinge-joints. As an example, dislocation of the shoulder which is a ball-and-socket joint is more common than that of the elbow which is a hinge-joint. A dislocation combined with a fracture in or near a joint is a common occurrence, especially at the elbow, but it may also be found in the shoulder, ankle, or in an injury to the bones of the back-bone. (See Fig. 51.)

Symptoms and Signs

(1) Severe pain which is described as "sickening." It may not always be confined to the part involved but may extend down a limb owing to pressure by the displaced bone on nerves, e.g., the pain from a dislocation of the shoulder may extend down the arm and hand ; in some cases numbness may be complained of in the arm together with some loss of sensation when the part is touched.

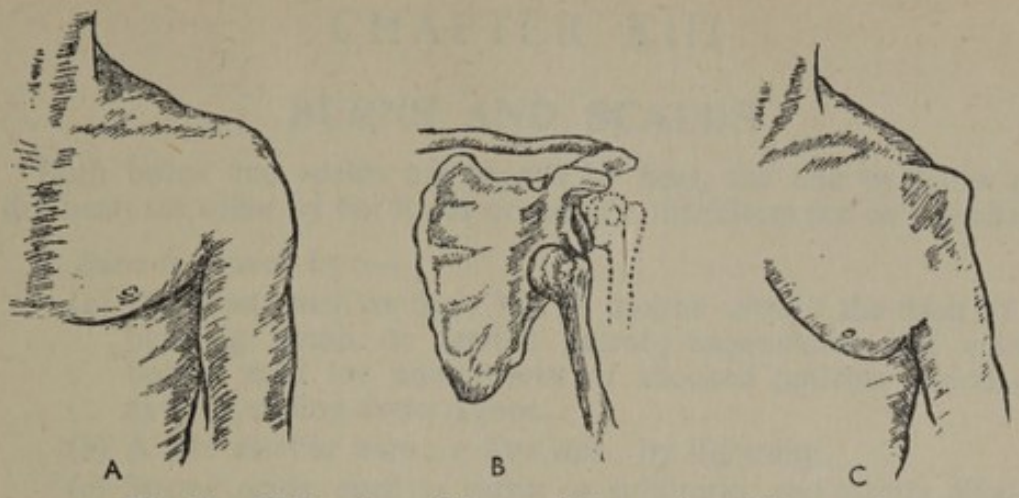

Fig. 51—Dislocation of Bone of Upper Arm (Humerus)

A—Outward Appearance before Dislocation
B—Dislocation of Bone from Normal Position—shown by dotted line
C—Outward Appearance After Dislocation

(2) Shock is usually severe and as marked as that caused by a fracture.

(3) Tenderness and swelling are always present around the joint.

(4) Locking or limitation of movement of the injured joint. This constitutes one of the chief differences between a dislocation and a fracture, as in the latter there is unnatural movement at the point where a bone is broken.

(5) Deformity of the part when compared with the opposite side. This may be very noticeable, especially in the shoulder, when the head of the bone of the upper arm (humerus) may be seen and felt beneath the outer end of the collarbone or sometimes in the armpit. In these cases the shoulder on that side is flattened, compared with the roundness of the opposite one, since the support given by the head of the humerus is absent.

(6) Bruising of the skin appears within a short time of the injury for the same reason as that given above for a sprain.

Treatment

When a first-aid worker decides or suspects that he is dealing with a dislocated joint, he must on no account try to put the bones back into their normal position. The injured man must be placed in the most comfortable position, which is probably that in which he is found.

A first-aid worker can do a great deal to ease the pain by supporting the limb and immobilising it in the same way as he would a fracture, using a triangular bandage as a sling, with plenty of padding and rolled-up blankets or clothes.

If he is in any doubt as to whether the case is one of dislocation or fracture or of both combined he must treat it as a fracture. Treatment to minimise shock must be started at the earliest opportunity and the patient must be sent to a first-aid post or hospital, unless a doctor is available at the incident.

CHAPTER XIII

BURNS AND SCALDS

Both burns and scalds are caused by heat, the one by flame or dry heat, the other by hot fluids or steam ; the effects are very similar.

A Burn is caused by :—

(*a*) Dry heat, such as fire ; hot or molten metal ; the flash of a bursting bomb or ignited petrol ; unprotected hot water bottles used for unconscious or shocked patients ; friction, as from sliding down a rope.

(*b*) A live electric wire ; a live rail ; by lightning.

(*c*) Strong acids, such as nitric or sulphuric, and strong alkalis such as caustic soda, quicklime, etc. The action of strong acids and alkalis upon the tissues is very much like that due to heat.

A Scald is caused by :—

Wet heat, such as boiling water and steam ; hot oil or tar ; boiling cooking fat, and the like.

The severity of a burn or scald depends upon the following main factors :—

(*a*) The extent of body surface burnt, and the parts of the body affected.

(*b*) The temperature of the substance which causes the burn (e.g., molten metal), or, in the case of a burn caused by an acid or an alkali, the strength of the chemical.

(*c*) The length of time which the heat acts upon the body.

(*d*) The age of the person burnt and his state of health at the time of injury. Children are particularly affected by the shock which follows a burn or scald, and by the deformities and contractures which sometimes result in their healing processes (See below " Effects of Burns " (*c*)).

Classification of Burns and Scalds

For the purposes of first aid it is enough to classify burns and scalds into two types only—superficial and deep. What is said hereafter about burns applies also to scalds.

(*a*) Superficial burns may cause only a reddening of the skin (erythema) or patches of skin may be destroyed with the formation of blisters.

(*b*) In deep burns the skin and superficial tissues are completely destroyed. In bad cases, wholesale destruction of muscles, nerves, blood vessels and even bone may occur, with charring of the whole burnt area.

Effects of Burns

The chief dangers resulting from burns of any part of the body are :—

(*a*) Shock.

(*b*) Local poisoning (sepsis), or blood poisoning (septicæmia).

(*c*) Permanent deformities from scarring.

(*a*) Shock is always present in some degree with all severe burns. It comes on rapidly and may be so intense as to cause death. The

degree of shock depends more upon the extent of a burn than on its depth. A superficial burn which involves one-fifth of the body surface causes far more shock than a deep burn which covers a smaller area, and a superficial burn over the chest or abdomen may be more dangerous than one which chars a part of a limb. The part of the body burned has also a marked influence on shock, e.g., burns of the chest and abdomen, and particularly those of the face and neck are attended by severe shock. First-aid workers must remember that it is shock which is responsible for the death of a large number of children and also of older persons who are badly burned.

(*b*) Poisoning.

As a result of the destruction of the skin and underlying tissues, the wound caused by a burn is less able to resist and becomes a suitable breeding ground for disease germs. Unless these can be prevented from getting into the wound, or be destroyed after they have got in, the poison which they produce may either cause a local infection of the wound or a general blood poisoning (See Chapter V). Although infection of the wound may take place at the time of injury, it is only later that any signs or symptoms of this become apparent. First-aid workers should always bear in mind the extreme liability of burns to infection from the outset, especially under air-raid conditions, and do all in their power to prevent further infection.

(*c*) Scarring.

The healing of a wound takes place by the formation of fibrous tissue which joins its edges together and produces a scar. While a scar is forming it is thin, delicate and pinkish as it contains many blood vessels. Gradually this scar contracts, becomes thicker, and loses its blood vessels, so that an old scar is hard and white when the wound has healed. The more quickly the surfaces of a wound are brought together, the less fibrous tissue is required to unite them; consequently, a wound whose edges are brought into close contact with one another, and in which healing is rapid, shows less contraction and a fainter scar afterwards than a wound which is allowed to gape and in which healing is slow. In the case of burns where there is extensive destruction of skin, the edges of the wound cannot be approximated and a great deal of fibrous tissue is formed in the course of healing. It is the subsequent contraction of this fibrous tissue which causes deformity. To prevent such scarring, skin grafting is constantly employed in the treatment of burns. Skin grafting cannot be employed successfully in the presence of infection, which adds to the importance of minimising the occurrence of infection from the earliest possible moment.

First Aid for Burned Casualties

It is obvious that before first aid treatment can be applied to the actual burns, a casualty must be removed from the source of danger or the source of danger from the casualty. During and after air raids, casualties are frequently found in burning buildings beneath smouldering or burning debris, or in basements in close proximity to fire. Such casualties may be more or less severely burnt, but in any case they are often in danger from the inhalation of smoke and certain poisonous gases which are generated in burning or burnt-out rooms, in confined spaces and in basements, especially if near to the explosion of H.E. bombs. Besides coal gas escaping from a broken gas main, there is often present another gas, carbon monoxide, which may

cause death. The inhalation of hot air from the flames or steam, especially in cases with burns on the face and neck may cause considerable damage to the upper air passages and lungs, resulting in fatal suffocation or serious illness which may later end in death. When casualties are rescued from burning buildings a rescuer must protect himself by covering his nose and mouth with a wet handkerchief or opened-up triangular bandage before entering the place where the casualty is. As soon as he reaches the casualty, he must pull him to the ground and smother the flames, if his clothing is on fire, by wrapping him in a blanket or some form of clothing, e.g., a coat, wet if possible, and he must also cover the person's face, nose, mouth and neck with similar material to that which covers his own. When the fire on the burning clothes has been extinguished, the casualty must be removed to a place of safety as quickly as possible and treated for shock (See Chapter III), and any other conditions from which he may be suffering. All cases of severe burns must be sent to hospital as stretcher cases by ambulance at the earliest opportunity after anti-shock and first aid treatment have been carried out. A label bearing the symbol X should be attached to them. At the incident a doctor should be summoned, if one is readily available, so that he may give an injection of morphine to relieve the pain and so reduce shock ; no time should, however, be lost in sending the patient to hospital if a doctor cannot be quickly found.

Severe burns and scalds must be treated as priority cases for despatch from the incident, the ambulance attendant being instructed to report their injury and condition immediately on arrival at the hospital. Cases of burns usually travel well provided they are despatched to hospital without delay and undue handling.

Minor burns involving small areas of the body should be sent to the nearest first aid post after first aid treatment at the incident.

Local Treatment of Burns

(*a*) *At an Incident*

(1) Do not remove more clothing than is absolutely necessary ; in particular, do not attempt to detach clothing which is sticking to a burn ; pain and shock are greatly increased by exposure of the burn to air. Blisters which may have formed should on no account be pricked but left intact.

(2) Do not attempt to cleanse the wound or apply any kind of oils or greases.

(3) Cover the burn with a large, clean, sterile dry dressing, several if necessary (e.g., large or medium first aid or mine dressings) as soon as possible and bandage firmly. Handle the part as little as possible.

(4) Immobilise the part ; this will reduce the pain. In the case of a slight burn of the upper limb it may be sufficient to use a sling, but in all cases of severe burns of the limbs the application of a splint over the dressing may be considered.

(*b*) *At a Mobile First Aid Unit or a Static First Aid Post*

As mentioned above, only minor burns should be sent to mobile first aid units or static first aid posts where first aid can be given. Casualties requiring surgical cleansing should be sent to a hospital as soon as their condition permits.

At a mobile first aid unit or static first aid post, first aid treatment will consist of measures to prevent or combat shock and to eliminate the danger of further sepsis ; without strict precautions first aid

procedures may themselves provide the means for fresh infection. Before the treatment of any burn is undertaken, first aid personnel should wear two or three layers of sterilised gauze as a mask covering the nose and mouth to prevent infection by droplets ; they must carefully wash their hands for at least two minutes and then dry them on a clean towel. No blankets should be allowed near the burnt area as they are likely to contain disease germs.

Reassurance as to his condition, rest, which should include immobilisation of the injured part if necessary, warmth, hot sweet tea, and the administration of morphine if the doctor considers it advisable, will do a great deal to restore a patient.

At mobile first aid units or static first aid posts the following drugs and dressings are available for treatment :—

(i) Antiseptics, such as euflavine and liquor antisepticus.

(ii) Bicarbonate of soda.

(iii) Burn dressings (impregnated with picric acid) ; absorbent gauze, lint, cotton absorbent ; wool cotton absorbent, mine dressings (Mobile first aid units only) ; bandages (roller and triangular).

(iv) No. 9 Cream.

Towards the end of the last war a cream was introduced for the treatment of superficial minor burns, e.g., of the hand or forearm, and also in more extensive burns, if, for any reason, the immediate removal of the casualty to hospital was impossible.

This cream, which was known as No. 9 Cream, was issued to first aid posts in selected areas and possessed the following advantages.

(*a*) It contained the best cleansing agent (Cetavlon) for the skin.

(*b*) Sulphanilamide, one of its ingredients, controlled infection. The addition of Penicillin Cream greatly increases its efficiency.

(*c*) It was soluble in water and therefore easily removed when hospital treatment was carried out later.

Treatment

(*a*) In minor burns where the parts are grossly fouled with dirt, they should be placed in a solution of bicarbonate of soda (baking *not* washing soda, two teaspoonfuls to a pint of warm boiled water). This will ease the pain and help the removal of the dirt. If any clothing is sticking to the wound the case should be dressed and sent to hospital without cleansing.

(*b*) After removal from this solution the wound should be cleansed with one of the antiseptics referred to above, dissolved or diluted in sterile water. Blisters should not be pricked except by a medical man if he considers it advisable.

(*c*) A dressing should then be applied over the wound. For this a burn dressing (wetted), or dry sterile gauze or lint may be used. It is advisable to apply any form of dressing in strips rather than in one piece as this prevents unnecessary exposure of the burn when it is redressed. The strips should overlap one another so that their removal is easier and the difficulties raised by part of the dressing sticking to the wound avoided. A thick pad of cotton wool should be put on over the dressing and bandaged firmly. Support for the injured part, if an upper limb, can be given by a sling.

(*d*) Burns of the face which do not involve the eyes and in which the skin is red only and not blistered, are best treated by taking a square piece of sterile lint and cutting holes in it for the eyes, nose and mouth. This is then applied to the face and kept in position by pieces of tape, previously sewn to its corners, and tied behind the patient's head. If there is any blistering of the skin the patient should be sent to hospital after dressing the burnt area.

(*e*) Directions for the application of No. 9 Cream :—

(*a*) The cream may be applied to the wound with a metal spatula, knife blade or spoon, previously sterilised by dipping for two minutes in boiling water or by passing through a flame. The burn should afterwards be covered with clean gauze or lint and firmly bandaged. Alternatively, the cream may be applied on pieces of clean gauze or lint, which are then laid on the injured area and kept in place by firm bandaging. The burn should *not* be washed, nor any blisters snipped before the cream is applied.

(*b*) As there is a slight risk of dermatitis from repeated application, this cream should not be applied on more than one or two occasions, and it should preferably not be left in contact with the skin for more than two days.

Cases should be sent to hospital for subsequent out-patient treatment.

(*c*) *In view of its oily nature, the cream should not be applied to burns which are likely to contain phosphorus until the full treatment of phosphorus burns has been carried out and examination of the burn in the dark fails to reveal phosphorescence.*

TREATMENT OF MINOR BURNS CAUSED BY STRONG ACIDS OR STRONG ALKALIS

(1) Thoroughly wash the affected part with water.

(2) If the burn is caused by a strong acid, bathe the part freely with a weak alkaline lotion, such as that made by dissolving two tablespoonfuls of bicarbonate of soda (baking soda) in a pint of water, or with milk in water or with milk.

(3) If the burn is caused by a strong alkali (e.g., quicklime) brush off any which is adhering to the wound and flush the part with water. Bathe freely with a weak acid lotion, e.g., vinegar or lime juice in water (half and half).

(4) Thereafter treat as an ordinary burn.

Quicklime in the Eye

Brush away any visible particles and irrigate the eyeball with one part of vinegar in four parts of warm water. If vinegar is not available, use warm water. After thorough irrigation with large quantities of fluid, close the lids, apply a soft pad, e.g., of cotton wool, or a folded handkerchief, and secure it with a firm bandage. The case must be seen by a doctor as soon as possible.

Acid in the Eye (e.g., sulphuric acid, " oil of vitriol ")

Irrigate the eye well with a solution of baking soda (2 teaspoonfuls to a pint of warm water), and apply pad and bandage as above. The case should be seen by a doctor as soon as possible.

Phosphorus Burns

Phosphorus continues to burn on the surface of wounded tissues and should therefore be removed as soon as possible.

(1) Water must be applied immediately to the affected part to extinguish any burning phosphorus and to keep the area moist. (Water from the water bottle may be used for this purpose.)

(2) A clean mine dressing or clean lint or clean cloth soaked in water should be applied over the burn. Whichever dressing is used it *must* be kept wet, otherwise it may burst into flames.

(3) With the wet dressing in place, the casualty, if a sitting case or able to walk, should be conveyed or directed *at once* to the nearest mobile first aid unit, static first aid post or hospital for further treatment.

(4) Stretcher cases must be sent direct to a hospital with the least possible delay. To ensure immediate attention at the hospital, those casualties must be marked with a P as indicated in Chapter XXIII.

(5) On no account should oils, greasy dressings, Tannic Acid, Triple Dye or Brilliant Green be used in the treatment of phosphorus burns until after every trace of phosphorus has disappeared from the tissues.

Oils and grease are solvents of phosphorus, and their use, while phosphorus is present, may cause poisoning from absorption.

FIRST AID TREATMENT OF PARTICLES OF PHOSPHORUS IN THE EYE

(1) At an Incident—

Keep the eye as wet as possible until the phosphorus particles can be removed. This is best done by flushing the eye copiously and *at once* with water from a water bottle and then putting a clean, soft pad dressing, soaked in water, over the eye. This dressing *must* be kept wet, and the patient sent as soon as possible to a mobile first aid unit, static first aid post or hospital, whichever is nearer. Care must be taken to label the patient and to mark on the label a " P."

(2) At a First Aid Post—

The most important first aid measure is the removal of the phosphorus particles from the eye. These can be rendered harmless and more easily seen by the instillation of several drops of a 1 per cent. solution of copper sulphate prior to their removal ; if the eyelids are closed by spasm they must be opened. Liquid paraffin, olive oil or cod-liver oil should not be employed as a first aid measure. The patient should then be sent to hospital for early examination and further treatment, if necessary, by an Ophthalmic Surgeon.

Flash and Radiation Burns from Atomic Bombs

When an atomic bomb bursts in the air there is an instantaneous output of radiations of all kinds, from infra-red (below the red end of the spectrum) through those of visible light and ultra-violet (beyond the violet end of the spectrum), to those characterised as X-rays.

The " Burning " radiations are emitted in a fraction of a second, and therefore affect the exposed skin of all those within a mile and a half of bombs such as those used at Nagasaki and Hiroshima. The period of action is so short that almost anything in the way of clothes, or other intervening substances, however flimsy, affords protection. White materials are more efficient than black of the same thickness, but coloured textiles, even when quite thin, minimise damage.

Unless there is long enough warning for taking cover there is as yet no satisfactory means of preventing flash burns of *exposed* parts, e.g., face and hands.

When they occur it is likely that great numbers of casualities will be affected simultaneously ; indeed, most survivors in the open will be thus burnt in addition to other injuries they may have received.

People exposed within a few hundred yards of the burst may have their skin dark brown or black, and whether or not otherwise injured, die very shortly. Those at greater distances suffer burns which are " superficial " not " deep," and vary from something comparable to severe " sun-burns " to severe blistering with loss of the surface cuticle. They are extremely painful.

Treatment is to cover the affected part as soon as possible with a sterile dressing as for any other burns, whether of the face and neck or of the extremities. It is improbable, in the conditions following an atomic bomb burst, that hospital accommodation will be available for the immediate treatment of flash-burns, and it may be necessary to make burn dressings or ointment in collapsible tubes available to the public for personal supply and application.

The burns due to fires and conflagrations caused by the atomic bombs differ in no way from those already well known, but the multiplicity of the points at which fires start adds so greatly to the difficulties of fire services that the number of casualties is likely to be very large.

The X-ray effects will not produce casualties for first aid attention. People exposed to intensities of such a degree as to be fatal within a matter of hours will almost always suffer other injuries resulting directly or indirectly from blast, which would have probably killed them several times over. Survivors should be taken to hospital forthwith.

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CHAPTER XIV

THE BREATHING (RESPIRATORY) SYSTEM

Breathing is the process by which air passes into and out of the body to allow the blood to absorb oxygen from the air and give off carbon-dioxide or carbonic acid gas as a waste product.

The special breathing organs are the lungs, and it is in their capillaries that the blood changes from a dark purple red (venous) to a bright scarlet (arterial).

The Lungs are two highly elastic, spongy organs which lie one on either side of the heart and the big blood vessels, and fill up most of the available space in the chest cavity. Each lung is roughly conical in shape with its apex projecting into the neck behind the collar bone, and its base resting upon the diaphragm. This is a strong muscular dome-shaped partition, with its convex surface upwards, which separates the contents of the chest from those of the belly.

The lungs are composed of an innumerable quantity of little air sacs, cells or pouches (alveoli) so that as large a surface as possible is packed into a small space ; in the extremely thin walls of these sacs is a network of capillaries. Each lung is enclosed in a double bag of smooth, glistening membrane (pleura), one layer of which lines the inner side of the chest cavity, while the other is continued on to the outer surface of the lungs. Between the two layers of this membrane there is a small amount of watery fluid which moistens the opposed surfaces and permits of a gliding movement up and down during breathing.

The Air Passages through which the air reaches the lungs are :—

(*a*) The nose and mouth.
(*b*) The throat (pharynx).
(*c*) The sound box (larynx).
(*d*) The windpipe.
(*e*) The two main air tubes (bronchi), one for each lung and many lesser branches.

(*a*) The Nose consists of two cavities leading from the nostrils to the throat. They are separated from one another by a central partition made up partly of gristle (cartilage) and partly of bone. Each cavity is lined by a special kind of cells which secrete a sticky fluid known as mucus. Air as it passes through the nose (and mouth when open) is moistened, filtered and warmed.

(*b*) The Throat (Pharynx) is a cavity situated at the back of the nose and mouth through which pass, not only air to the lungs, but also food and liquid to the stomach, through the gullet (Oesophagus).

The throat opens into :—

(*c*) The Sound Box (Larynx) which is a kind of box at the upper portion of the Windpipe, in front of the opening of the gullet and protected in front by a prominent plate of gristle which is familiarly known as " Adam's apple " (Thyroid cartilage). In the larynx is situated the organ of voice production, and the vocal cords. At the upper opening of the larynx there is a leaf-shaped flap of cartilage (Epiglottis), which acts like a trap door and when closed down prevents

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food from passing into the windpipe during the act of swallowing. During breathing this flap remains wide open. The larynx is continued down the neck as a tube, the windpipe.

(*d*) The Windpipe (Trachea). This is a tube four to five inches long and ¾ inch wide, made of muscle and fibrous tissue strengthened by U-shaped rings of gristle, so that it is always open for air to pass down. It passes down in front of the gullet into the chest cavity where it divides into two tubes, one of which goes to the right and the other to the left lung. Each of these tubes is called—

(*e*) An Air-Tube (Bronchus, plural Bronchi). When these tubes reach the lungs they branch out in all directions like the branches of a tree, becoming smaller and their walls thinner as they proceed to their closed endings, which are the air sacs or cells mentioned above.

The trachea and the bronchi are lined with mucous membrane, the inner surface of which is covered with small hair-like processes. These by a waving or lashing movement remove dust or foreign matter brought in with the air.

It is by means of these organs of breathing that air is taken into the lungs and oxygen given to the blood. While oxygen is being taken into the blood, carbon-dioxide and watery vapour pass from the blood into the air sacs of the lungs and are breathed out through the air passages. The air which we breathe is composed mainly of two gases, oxygen and nitrogen, with a small amount of carbon-dioxide.

The oxygen is absorbed by the blood, the nitrogen merely passes into and out of the lungs without being absorbed. Oxygen combines with the hæmoglobin contained in the red corpuscles of the blood which then becomes a bright scarlet colour, as in the arteries. When the hæmoglobin gives up its oxygen to the body tissues, the blood then becomes darker in colour, as in the veins.

The importance of oxygen to the body will be recognised when it is understood that it is *essential* for the chemical processes which go on all the time in every organ and tissue. If the oxygen supply is reduced the tissues cannot do their work properly ; if it is stopped they cannot function at all. The brain is specially sensitive to reduced oxygen supply and unconsciousness is one of the signs of this. When the oxygen supply is cut off death soon follows, and even if efforts to save a patient's life are successful permanent damage to the brain may result. The time factor is therefore of extreme importance in dealing with this condition.

The Mechanism of Respiration

Respiration is carried out by the alternate expansion and contraction of the chest, by means of which the air is drawn into and expelled from the lungs. A complete act of respiration consists of an inspiration (breathing in) which allows air to enter the lungs, immediately followed by an expiration (breathing out) which drives air out of the lungs, followed by a pause. In a normal person at rest a complete respiration occurs once in every four seconds, or fifteen times a minute. This rate is increased during exertion and also in many diseases. How the mechanism of respiration works is shown below :—

(*a*) Inspiration

In this the chest is expanded by the action of various muscles. One of these, the diaphragm, when relaxed, is arched upwards. It is fixed to the lower end of the breast bone, the lower ribs and the backbone and thus forms the floor of the chest cavity (see above). When air is breathed

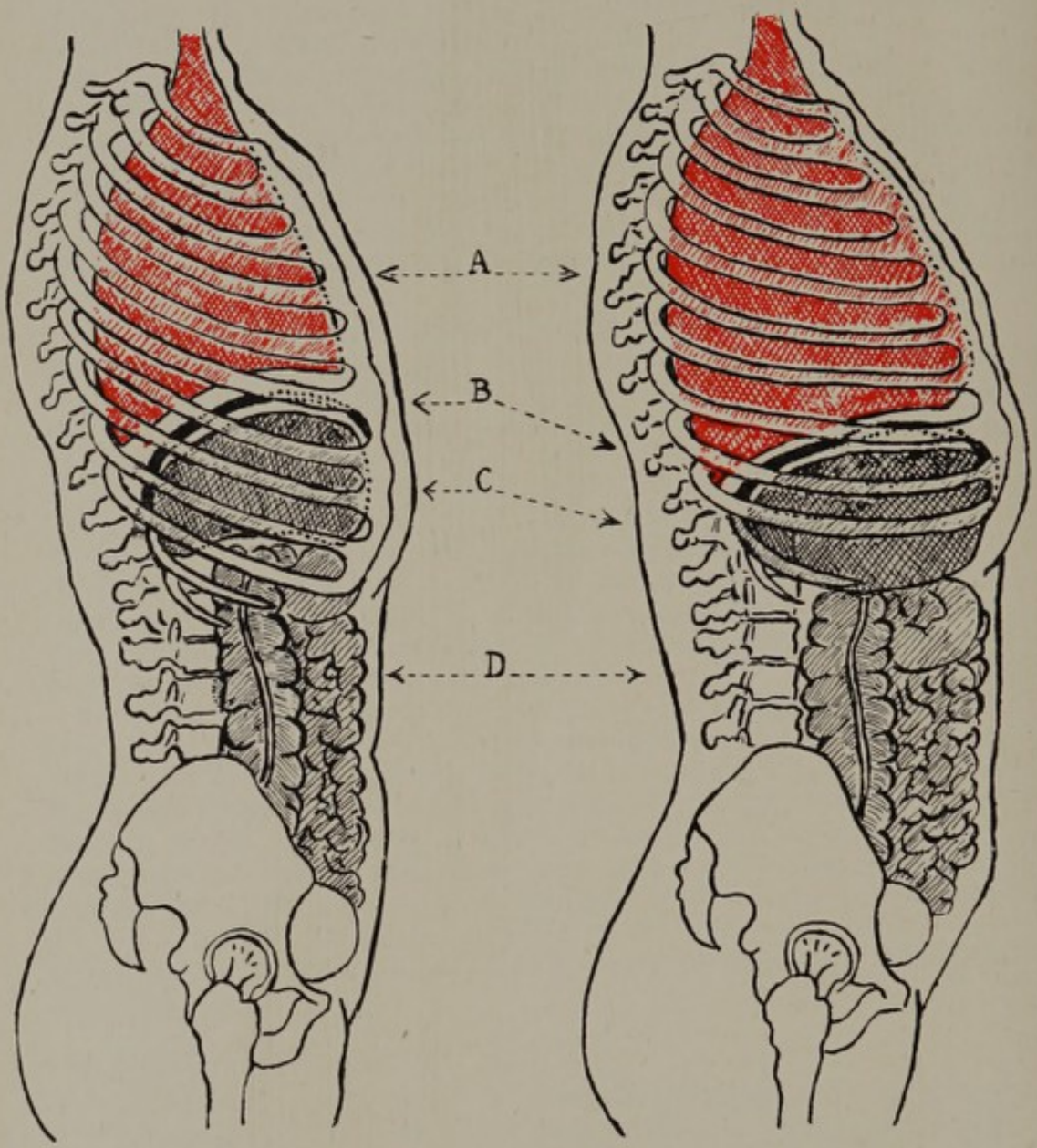

Fig. 52—Expiration—Inspiration

A—Lungs
B—Diaphragm
C—Liver
D—Stomach and Intestines

in, the diaphragm contracts and becomes flatter, pushing the belly contents downward and enlarging the cavity of the chest from above downwards. Various muscles are attached to the ribs, and these raise them and at the same time carry the breastbone upward and forward, thus increasing the size of the chest, making it broader from side to side and deeper from front to back.

As the chest cavity enlarges, atmospheric pressure causes air to pass through the mouth and nostrils down the windpipe and air tubes (bronchi) into the air sacs and expands the lungs, just as one blows up a child's balloon. The air remains long enough to allow the oxygen to pass through the capillaries into the blood, and for water vapour and carbon-dioxide to pass from the blood into the air.

(*b*) Expiration

When inspiration is completed the diaphragm relaxes and resumes its position of being arched upwards. It is aided in this by the contraction of muscles in the belly wall which push the belly contents up against the diaphragm. The muscles which raised the ribs and breastbone relax and the chest walls subside. The cavity of the chest is thus reduced in size by its own elasticity and that of the lungs, and air is consequently expelled from them. (See Fig. 52.)

CHAPTER XV

SUFFOCATION (ASPHYXIA)

Suffocation is a condition which results from interference with or stoppage of breathing, thereby causing a deficiency of oxygen in the blood.

Causes

There are many causes of suffocation and they may be classified as follows :—

(a) Inability to Breathe owing to Obstruction of Air Passages

(i) By mechanical means

Blocking of the nose and mouth by dust and dirt (e.g., from damaged buildings) ; a dental plate becoming dislodged and stuck in the throat or windpipe (e.g., in an unconscious person) ; inhaling blood from a broken jaw, or food or liquid which has been vomited into the mouth (e.g., in semi-conscious casualties) and drowning, form examples.

Even though the air passages may not be completely obstructed, a serious interference to breathing, which may be very dangerous and cause great alarm, sometimes occurs when a piece of food or other substance, however small, has been sucked or blown down into the windpipe (" gone down the wrong way "). Death has been known to result from this cause.

(ii) By pressure on the air passages

Pressure on the chest by fallen masonry, beams, etc., or in people buried under the debris of houses during air raids ; crushing of the chest when people are so tightly crowded together that there is no room for them to move ; strangling or throttling, and smothering are quoted as examples.

(iii) By complications of disease or accident

Obstruction of the throat and air passages may occur in certain illnesses, notably diphtheria, or from inflammation and swelling caused by drinking too hot liquids ; by the sting of some kinds of insects inside the mouth or on the face or neck.

(b) Paralysis and Spasm of the Nerves and Muscles of Breathing

A severe electric shock caused by contact with a " live " current may produce a stoppage of breathing by paralysing the nerves and muscles concerned ; this may also happen in a person struck by lightning.

Breathing may be completely or partially stopped during an epileptic fit or in an attack of convulsions (e.g., in young children) by spasm of the respiratory muscles.

(c) Breathing certain Poisonous Gases

(i) Carbon monoxide is frequently met with in the course of mining and tunnelling operations (the " after-damp " of mines being well known), in gas escaping from broken gas mains, in gas ovens, coke stoves and charcoal braziers, motor-car exhaust fumes and in confined spaces in burnt out or burning buildings, or following the burst of a high-explosive bomb or shell. Accumulation of carbon-dioxide which is also poisonous may be met with in the last two instances.

(ii) Certain gases used in industrial processes, of which common examples are ammonia and chlorine.

(iii) In chemical warfare, phosgene and other lung irritant gases.

General Symptoms and Signs of Suffocation

These vary according to whether the suffocation is partial or complete ; the former may pass on to the latter.

(*a*) Partial Suffocation

(1) A person finds great difficulty in breathing, and becomes restless.

(2) Breathing becomes jerky and a struggle to remove any obstruction and to obtain air takes place. A man will tear at his throat and clothing.

(3) Coughing and spluttering. Where the tissues of the throat are swollen and cause an obstruction there may be a sound of whistling as the air passes through the narrowed opening of the air passage.

(4) Face becomes livid ; the veins in the neck stand out like cords and are filled with blood ; the lips and fingernails turn blue, eyes may become prominent, staring and blood-shot.

(5) Unconsciousness may ensue, slowly or quickly, according to the severity of the case.

(*b*) Complete Suffocation

There is complete unconsciousness and breathing entirely stops. Within a short time the heart stops beating and a person dies.

The first stage of restlessness and fighting for breath may last up to five minutes, according to the degree of obstruction. After this unconsciousness usually supervenes unless the condition is relieved.

Treatment of Suffocation

General Principles

The first step is to remove the patient from the source of danger, for example, a room filled with gas, or the source of danger from the patient, such as debris, furniture, etc., in a demolished room.

The second step is to make a rapid examination to ensure that the air passages are free, and to clear them if necessary.

The third step, if breathing has ceased, is to restore natural breathing by artificial respiration, after loosening all tight clothing, and to maintain the natural body temperature by blankets and hot water bottles while this is being carried out.

Treatment of Special Conditions

(*a*) *Fire Smoke or Gas*

Instructions as to how a rescuer should protect himself and a casualty whom he is removing from a burning room are given in Chapter XIII, (First Aid for Burned Casualties), and must be observed here.

(1) A rescuer may forget that the wearing of a respirator gives no protection against coal gas ; the respirator is in fact a danger because it masks the characteristic smell of the gas. If a respirator is used as a protection against smoke, its container should be covered by some form of extra filter, such as an old sock, otherwise the filter inside the container will be clogged by smoke particles and breathing rendered difficult.

The Remote Breathing Apparatus can be used with great advantage in smoke-filled rooms.

As soon as a casualty has been brought to a place of safety, artificial respiration must be started at once if he is not breathing.

(*b*) *Crushing by Debris, Furniture, etc.*

When breathing is obstructed by debris, furniture, beams, etc., pressing on a person's chest, they must be removed as soon as possible and artificial respiration started on the spot if the casualty has stopped breathing.

(*c*) *Electric Shock*

Contact with an electric circuit may produce very severe burns and shock, in addition to causing a casualty to stop breathing. He will probably be unable to free himself owing to the current depriving him of all power of movement, so he must be removed at once or the current cut off. His rescuer *must*, however, protect himself before he touches the patient, otherwise he will also become a casualty.

(i) He must stand on a substance which does not allow a current to pass through it ; this is known as a non-conductor. Amongst such easily available substances are a piece of wood, straw, a brick, a piece of linoleum, a rubber mat or rubber-soled shoes, a sheet of glass or china plate. Whatever substance is used, *it must be dry*, since even a trace of moisture will conduct electricity.

(ii) The hands of the rescuer must be protected from the injured person and from the current by covering them with such things as dry clothing, an india-rubber tobacco pouch, a rubber hot water bottle, a pair of rubber gloves or a thick bundle of dry newspaper. The patient may be dragged away from the electric contact by means of a dry loop of rope, a dry bandage, or a dry walking stick with a crooked handle, *not on any account* an umbrella, as this contains metal ribs and *all metals are conductors of electricity*.

Artificial respiration, if necessary, must be started as soon as the sufferer has been freed ; burns are treated in the same way as ordinary burns.

(*d*) *Choking*

The patient's mouth should be opened and a forefinger passed down the throat as far as possible to clear out any obstacle whether it be a dental plate, dust, mud or debris which is lodged there. Children, and in some cases adults, may be held by the legs head downward and thumped between the shoulder blades. To prevent the tongue of an unconscious person from falling back into his throat and choking him, he should be laid on his face, if practicable, and his head turned to one side. If it is necessary to keep him lying on his back, his head should be turned to one side and the lower jaw pressed upward and forward by a forefinger and thumb placed beneath it. Instead of this the tongue may be pulled forward and grasped by a first-aid worker with a forefinger and thumb covered with a piece of material to prevent it from slipping.

ARTIFICIAL RESPIRATION

This, as its name implies, is a means of restoring natural breathing, when it has ceased, by reproducing the normal movements of expiration and inspiration, and is carried out by squeezing air out of the lungs and then allowing the atmospheric pressure to fill them up again.

Of the many methods which have been devised it will suffice to describe three here.

(a) Schæfer's Method

This can be carried out by using the hands, and only one operator is necessary. It is simple and easy to apply, and should normally be used at an incident where *it is of the utmost importance as in all forms of artificial respiration* to " start operations " at the earliest possible moment, since every second's delay makes recovery less likely. The patient should be placed lying on his face as this position greatly facilitates the flow of water, mud, weeds, etc., from his mouth, which is particularly valuable in treatment of the apparently drowned.

Instructions to Operator

(1) *Make certain that the air passages are free*, loosen all tight clothing, then lay the patient face downward with his head turned to one side and his arms laid forward.

(2) *Kneel* beside or astride the patient's thighs facing his head and place the palms of your hands on the small of his back, the wrists nearly touching, the thumbs as near as possible to one another, and the fingers fitting into the soft part on either side of the backbone between the ribs and the hip bones.

(3) *Keeping the arms straight*, swing your body slowly forward from the hips until your shoulders are directly above your hands and your weight presses down on the patient's back. This compresses his belly against the ground and forces the contents of the belly upwards against the diaphragm which is pushed up with a piston-like action, driving air out of the lungs and at the same time stimulating the heart. (N.B.—Do not press too hard ; remember that an unconscious person's muscles do not resist as they do in a conscious person, so heavy pressure may rupture the liver, or even break one or more ribs.) As soon as you swing forward count slowly, one, two (or to obtain the correct timing of seconds " twenty-one," " twenty-two"), then :—

(4) *Without removing the hands*, swing your body slowly backward to its original position, thus relaxing the pressure on the back. The contents of the belly now fall back into their normal position, the diaphragm descends and air re-enters the lungs. During this part of the operation count slowly, one, two, three (or " twenty-one," " twenty-two," " twenty-three ").

(5) Repeat this forward and backward movement 12 times a minute, without any marked pause (two seconds for pressure, three seconds for relaxation). (See Fig. 53.)

(6) *When natural breathing reappears*, regulate the movements to correspond with it.

(7) *While artificial respiration is in progress*, and without interfering with it in any way, it is important that the circulation should be restored and maintained by means of blankets and hot water bottles. Rubbing the legs and arms towards the heart should be carried out by one or more assistants, *but only when the patient shows signs of recovery.*

(8) A useful addition to Schæfer's method is that known as the " Drinker combined method " which aims at allowing more air to enter the lungs during inspiration. This is carried out, while Schæfer's method is in progress, by an assistant who kneels at the head of the patient and grasps his upper arms. When the operator relaxes his pressure on the loins, this assistant lifts the patient's arms from the ground. When pressure is applied to the loins the assistant allows the arms to lie on the ground.

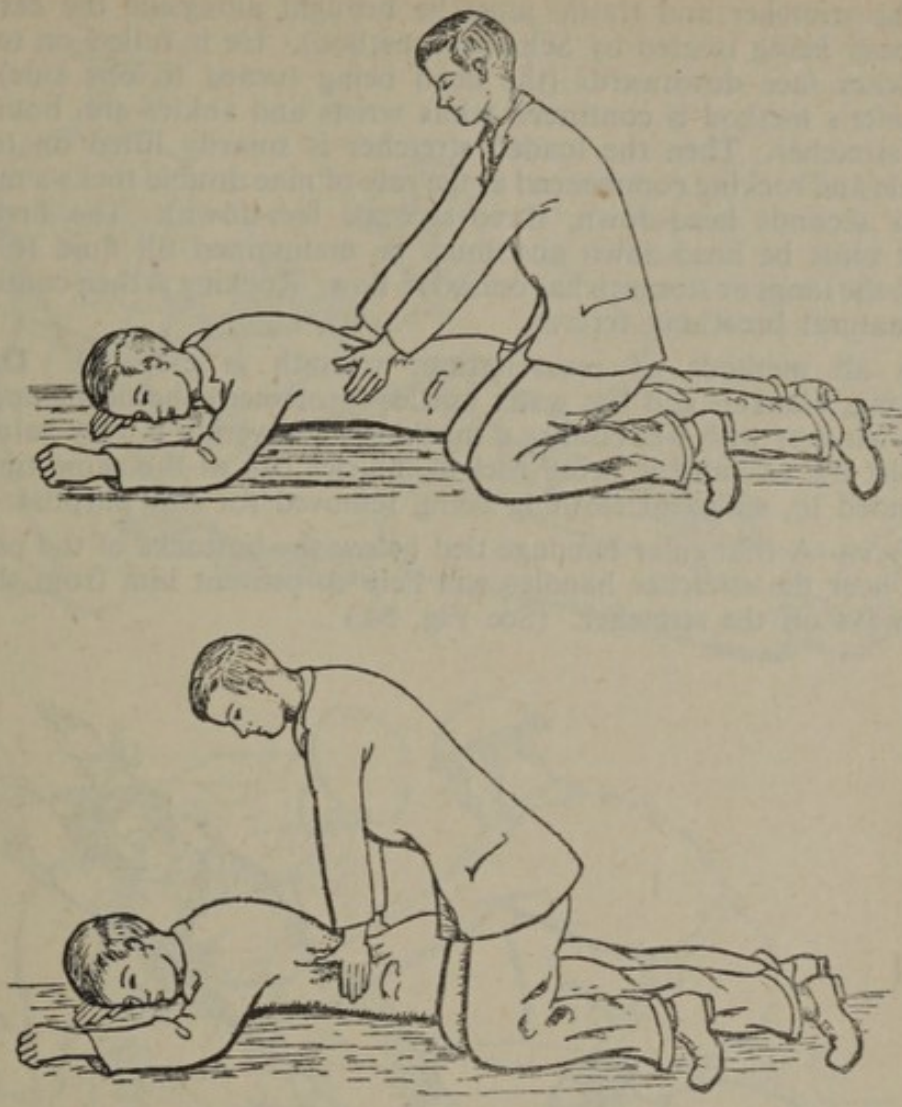

Fig. 53—Schæfer's Method of Artificial Respiration

Caution

Schæfer's method must not be used where there is a severe injury, possibly a fractured backbone or an injury to the abdomen. In such cases Eve's method described below must be used, omitting Schæfer's method and putting the casualty straight on to a stretcher for rocking.

(*b*) *The Rocking Method of Resuscitation*

This is Dr. F. C. Eve's method, in which the weight of the abdominal contents moves the diaphragm up and down. It is an effective supplementary method which may be used without delay after Schæfer's method has already been started. One person can do the rocking but two are needed for the preliminary stages. The materials required are a plane (a stretcher, door, etc.) to which the casualty can be fastened, a fulcrum on which to rock the plane, and nails, chocks or other means to prevent the centre of the plane sliding on the fulcrum during rocking.

To obtain the necessary rock of 45 degrees (half a right-angle) a bar-topped trestle, 34 inches high is best as a fulcrum. Instead of a trestle, a rope slung from a beam, a broken wall, a builder's two-wheel cart, etc., can be improvised.

The stretcher and trestle must be brought alongside the casualty (already being treated by Schæfer's method). He is rolled on to the stretcher face downwards (the head being turned to one side) and Schæfer's method is continued while wrists and ankles are bound to the stretcher. Then the loaded stretcher is smartly lifted on to the trestle and rocking commenced at the rate of nine double rocks a minute (four seconds head-down, three seconds feet-down). The first full rock must be head-down and must be maintained till fluid (if any) from the lungs or stomach has ceased to flow. Rocking is then continued till natural breathing returns.

In all methods of resuscitation, warmth is essential. During rocking, blankets and hot water bottles (protected) should be applied. In a wind or with wet clothes a mackintosh covering is very valuable. Whilst the casualty is being rocked injuries can at the same time be attended to, sufficient clothing being removed for this purpose.

Note.—A triangular bandage tied below the buttocks of the patient and over the stretcher handles will help to prevent him from sliding sideways off the stretcher. (See Fig. 54.)

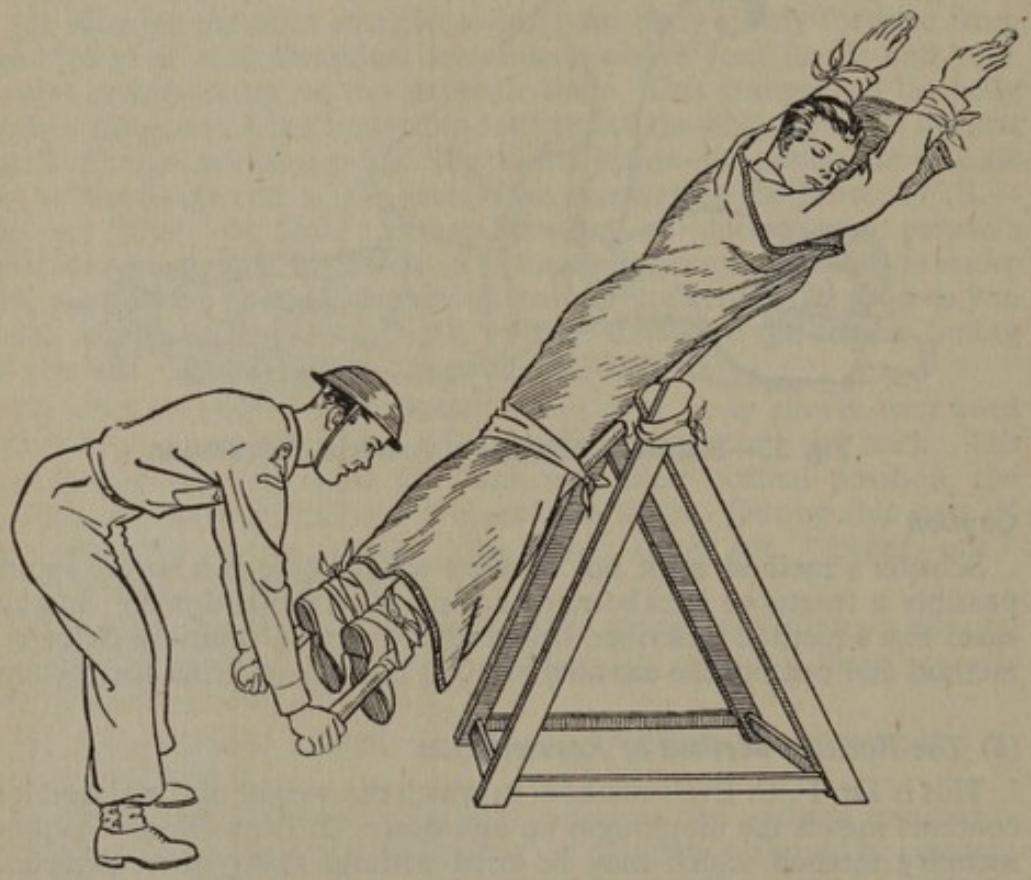

Fig. 54—Eve's " Rocking " Method of Resuscitation

(*c*) *Silvester's Method*

This method is used for patients who cannot be placed face downward (e.g., on account of a wound on the front of the body). It cannot be employed when the ribs or arms are injured.

At least two persons are necessary to carry out this method, one to perform the artificial respiration and one to hold the tongue forward,

Fig. 55—Silvester's Method of Artificial Respiration
A—Inspiration
B—Inspiration
C—Expiration

as the patient is placed lying on his back. It is more tiring for the operator than the two methods described above and frequent reliefs of operators may be required.

Instructions to Operator

(1) *Clear the nose and mouth* of the patient of any obstruction and place him on his back upon a flat surface, with a folded blanket or a bundle of clothing beneath his shoulders. Undo all tight clothing. The assistant must catch hold of and draw the tongue forwards to prevent it from falling backwards and blocking the windpipe, covering his fingers and thumb with a handkerchief or triangular bandage so that they will not slip off the tongue. If a second assistant is available, he should hold the patient's feet.

(2) *Kneel* in a comfortable position behind the patient's head, facing his feet, and grasp his forearms just below the elbows.

(3) Draw the forearms upwards and outwards with a sweeping movement over and above the head towards you, as far as they will go, until the elbows touch the ground. This allows air to enter the lungs. Count slowly, twenty-one, twenty-two, twenty-three ; then :—

(4) *Carry* the bent arms slowly forwards, downwards, and inwards with a similar sweeping movement, pressing the forearms and elbows firmly against the front and sides of the chest. This drives air out of the lungs.

(5) Continue these movements alternately 12 times a minute until natural breathing recommences, then regulate them to correspond with it. (See Fig. 55.)

(6) Promote warmth and circulation by warm blankets and hot water bottles, and by rubbing the limbs vigorously towards the heart *when breathing has re-commenced.*

Caution.—Artificial respiration by any method *must never* be performed on persons poisoned by lung irritant gases, or on casualties caused by blast.

CHAPTER XVI

INSENSIBILITY

Insensibility or unconsciousness is a condition in which a person loses consciousness and becomes incapable of feeling anything, or of knowing what is going on round about him. It is always due to a disturbance in the functions of the brain which prevents it from receiving any sensations from the outside world. The popular expression " dead to the world " is a very apt description of this condition.

Insensibility varies in degree from a short period, during which a person is partially or wholly unconscious of his surroundings, but soon recovers, to a deeper and progressive unconsciousness, with no signs of recovery, and this may end in death. The former condition from which a person can sometimes be roused is known as " stupor," the latter, from which he cannot be roused, as " coma."

Unconscious casualties found at air raid incidents are often a big problem to first aid workers as they are unable to obtain any information from the victims as to what has happened to them or what they feel. Rescue Parties have therefore to rely upon their knowledge and make a careful examination of the casualty before they can discover, from the signs which are present, what injury has caused the unconsciousness, and be able to render efficient first-aid. It is of great importance that they should know and be able quickly to recognise certain signs which distinguish one condition from another, even under the most difficult circumstances.

The causes of insensibility may be arranged in three main groups :—

(1) Failure of the blood supply to the brain.

(2) Injury to the skull or brain.

(3) The effect of certain diseases and of poisons upon the brain.

They may also be conveniently classified as—

(*a*) Primary ;

(*b*) Secondary.

(*a*) Primary causes include those in which a person becomes unconscious immediately as the result of an injury, or disease, or of certain poisons which directly affect the brain.

(*b*) Secondary causes are those in which unconsciousness occurs as the result of an injury or of disease which affects other parts of the body before involving the brain and nervous system.

As both these classes provide causes of unconsciousness among air raid casualties, a description of those conditions which are most frequently found at incidents will be given first ; those which may occur at any time apart from air raids follow.

(*a*) Primary :—

(i) Head injuries-causing concussion (stunning) or compression of the brain, with or without fracture of the skull.

(ii) Diseases. Apoplexy, epilepsy, infantile convulsions, and as a temporary nervous condition only, hysteria.

(iii) Poisons. Alcohol, prussic acid, opium and morphine, chloroform, ether, certain narcotic drugs, etc.

(*b*) Secondary :—

(i) Suffocation (asphyxia), by the cutting off of the supply of oxygen to the blood and consequently to the brain.

(ii) Shock, occasioned by pain, severe bleeding and other causes.

(iii) Fainting (syncope), a result of diminution in the supply of blood to the brain as a result of injury, or in certain forms of heart disease.

(iv) Diseases, such as diabetes (causing coma), kidney disease (causing uræmia), and conditions known as heat exhaustion and heat-stroke.

Head Injuries—Concussion and Compression of the Brain

Reference is made to these conditions under fracture of the skull, on pages 119-120, it only remains for a description of the symptoms and signs associated with them to be given here.

Symptoms and Signs of Concussion of the Brain

(1) These depend upon the severity of the injury. In a mild case of concussion caused by a blow upon the head a person feels dazed, giddy and shaken, and may vomit. This may only last a few seconds or minutes and then pass off. If the blow is severe, unconsciousness will come on at once and may last for several hours.

(2) All the signs of shock are present, i.e.—

(3) the face is pale and cold, and may be covered with a clammy sweat, as may also the body.

(4) the breathing is shallow and quiet.

(5) the pulse is quick and feeble ;

(6) the patient can sometimes be roused if shouted at but cannot understand clearly what is said or reply intelligently, and soon relapses into unconsciousness.

(7) The pupils of the eyes are equal in size, are often small and react to light (i.e., become small when eyes are opened or when a light is shone into them, and regain their normal size when it is removed), except in severe cases of concussion, when they may be both large and fail to react to light. The pupils of the eyes are an important distinguishing feature between concussion and compression of the brain, as in cases of concussion they are always equal in size, whether large or small, while in compression one may be larger than the other. It must be borne in mind, however, that it is often extremely difficult for first aid workers to examine the eyes of an unconscious casualty at an incident and moreover much damage can be caused by opening them with dirty fingers and allowing dust and grit to get into them. Eyes should therefore only be examined with the utmost care by an experienced first aid worker who has taken all precautions against injuring them, and when it is essential that they should be examined before a decision can be made as to the patient's condition. It is far better not to waste time in trying to examine the eyes under difficult conditions, but to carry out necessary first aid and send the casualty to hospital as soon as possible, whether he is thought to be suffering from concussion or compression, as in either case the patient is in need of urgent hospital treatment.

(8) There is no sign of limpness or paralysis of the limbs on one side of the body as there may be in a case of compression.

(9) A patient with concussion will probably vomit when consciousness begins to return. This is a fairly constant sign.

(10) A confused-mental condition often persists for some time after the patient is quite conscious ; during this time he may speak and behave in a strange manner and frequently will remember nothing of what has happened to him.

Symptoms and Signs of Compression of the Brain

(1) In nearly every case of compression there has been a previous stage of concussion, and the signs of compression may follow directly on this or after an appreciable interval. In some instances, however, a patient appears to have recovered from the effects of concussion and it is only later that symptoms and signs of compression make their appearance. This is due to lessening or stoppage of the bleeding inside the skull during the period of shock and its restarting when the patient recovers. With this possibility in mind, all cases of head injuries, with signs of concussion, should be treated with great respect and not disposed of before they have been seen by a doctor.

(2) In the early stage of compression a patient may be very restless and complain of a severe headache. There may be twitching in the muscles of the body or one or other limb on one side only, caused by irritation of the brain by pressure. As the bleeding continues and this pressure becomes greater the twitchings cease and the limbs become limp and useless (see below at (8)). At this stage the patient becomes unconscious and the typical signs of compression develop.

(3) The face is flushed and hot and the temperature of the body is raised—it may reach 108 degrees F.

(4) The breathing is slow, deep and snoring in character, the cheeks are puffed in and out with each act of respiration.

(5) The pulse is slow (may fall to 30-40 beats per minute) but strong and bounding.

(6) The patient cannot be roused from his unconscious state.

(7) The pupils of the eyes are larger than normal and one may be larger than the other. Both are fixed and do not react to light.

(8) If the limbs on one side of the body are raised they will be found to be limp and lifeless in comparison with those of the other side. This is due to the pressure of blood on that part of the brain which is concerned with movement, and results in paralysis of the control which it exercises over the muscles and nerves. Owing to the arrangement of nerves passing from the brain to the spinal cord, this paralysis is often found on the opposite side of the body to the site of injury to the brain (e.g., if the right side of the brain is injured, the left side of the body is paralysed).

Symptoms and Signs of Fracture of the Base of the Skull

These are usually similar to those of concussion or compression of the brain, often there may only be signs of concussion with a bruise or wound on the scalp to indicate an injury to the head. One feature of fractures of the base of the skull is that loss of consciousness does not always occur. A fracture of the base of the skull should always be suspected if, in addition to a head injury in a conscious or unconscious person, there is marked shock, bleeding from the nose and ears, less frequently from the mouth, and sometimes into one eye causing it to be blood-shot.

APOPLEXY

This is referred to here although it cannot rightly be classed as an air-raid injury.

The commonest cause of apoplexy (familiarly known as an apoplectic fit or seizure) is the bursting of a diseased artery in the brain or its blocking by a blood clot. This is most liable to occur in later life and the symptoms, signs and treatment are those of compression of the brain.

HYSTERIA

Is a condition in which a person loses control of his reason and emotions as the result of some mental shock. It is said to occur more frequently among women than among men, but surprisingly few instances have been met with in either sex at air-raid incidents.

Hysterical persons are usually noisy, may laugh, cry or swear immoderately, are often violent and throw their limbs about. In an effort to arouse the sympathy of bystanders they may fall down, but are careful not to injure themselves. Spasms may occur which resemble those of an epileptic fit.

In an epileptic fit, however, the patient is unconscious, often bites his tongue, and may hurt himself when he falls down, whereas hysterical persons do not become unconscious (although they may pretend to), nor bite their tongues.

Treatment

(1) Hysteria should be treated by the avoidance of sympathy and by firm handling. If cases are found during or after air-raids they should be handed over to the police or to wardens to be taken to first-aid posts, otherwise they are likely to be a nuisance to and obstruct Civil Defence personnel in their work of treating other casualties.

(2) A person in an *epileptic fit* must be prevented from biting his tongue and from injuring himself in any way—e.g., in falling or by striking his body or limbs against articles of furniture, debris, etc., while he is in a state of convulsion. A piece of wood, pencil or penholder covered with some soft material should be placed between his teeth as a gag ; this can often be done easily at the commencement of a fit, but it is undesirable to try and force a gag between the teeth when they are firmly clenched. All tight clothing round neck, waist and chest must be loosened and the patient given plenty of air. No attempt should be made to check the convulsions, which will cease of their own accord. After the convulsions have ceased and the patient is conscious he should be wrapped in blankets and removed to a first-aid post. He will probably fall into a deep sleep, and should be encouraged to do so, care being taken for someone to watch him in case another fit should occur. Warm milk may be given to him, but no stimulant drink of any kind, such as tea, coffee, sal volatile, etc.

(6) SUFFOCATION (ASPHYXIA)

See Chapter XV.

(7) SHOCK

See Chapter III.

(8) FAINTING (SYNCOPE)

Is a temporary sudden loss of consciousness which may be due to a mental disturbance or shock unconnected with any injury. Fright, grief, a stuffy atmosphere, over-exertion, horrifying sights, etc., are

liable to cause a person to faint, and he will be more easily affected if he is tired, hungry, thirsty, or overloaded by heavy or tight clothing. The symptoms and signs of fainting are similar to those of shock, which cause a fall in blood pressure. This results in a diminished supply of blood reaching the brain.

Treatment

The same as for shock. It is often sufficient to lay a fainting person down or make him sit with his head between his knees and he will soon recover. All tight clothing should be loosened and plenty of fresh air given ; the crowding of onlookers round a fainting person should be prevented. Smelling salts are useful in mild cases as is also sal volatile (half a teaspoonful in a wineglass of water) when the patient can swallow.

DIABETES

A patient who suffers from Diabetes is dependent on regular injections of a substance called insulin and if he should miss these or be deprived of food for some time (e.g., as a result of an air-raid he may be trapped in a building or in debris) he is liable to sudden illness and pass into a state of deep unconsciousness (diabetic coma) which may end in death. Shock, injury, excitement, over-exertion and over indulgence in starchy foods are among the causes which also bring on this condition.

Symptoms and Signs

(1) Headache, faintness and giddiness, in the early stage.

(2) Sometimes pain in the stomach and restlessness—followed by :—

(3) An increasing drowsiness ; patient may have difficulty in expressing himself and his speech is slurred. This may give rise to a faulty suspicion of drunkenness.

(4) Breathing is slow and sighing, air hunger is frequently present (See page 70).

(5) A peculiar odour resembling that of apples, or in some cases of nail polish (due to acetone) in the breath.

(6) The pupils of the eyes are usually small, equal in size and react to light.

(7) Muscular twitchings and in some cases convulsions.

(8) Unconsciousness which may come on suddenly without any of the above symptoms and signs, or gradually. Sudden unconsciousness in a patient known to be suffering from diabetes should indicate the onset of coma.

Treatment

Members of the Civil Defence Corps may meet such cases in the performance of their duties, and their attention must be drawn to the methods provided by the Diabetic Association for the identification of such patients. Under normal conditions a diabetic patient looks so well that a stranger would not know that there was anything the matter with him. It is therefore important that he should carry in his pocket o rround his neck or wrist the information that he is a diabetic and is taking insulin. The Diabetic Association will issue a card, on request, to such patients and this should always be carried by them inside the National Identity card. On the front of the card which has the left-hand upper corner marked red, and with the word " Important " on it, is noted " The bearer of this card is a diabetic and takes insulin. In the event of sudden confusion or faintness please give 2 tablespoonfuls

of sugar in water and communicate with the nearest doctor." On the reverse of the card, the name, address and telephone number of the patient, and of the doctor attending him, together with the number of insulin units and the amount of carbohydrate taken by him daily, are given.

As a patient's clothes may be burnt as the result of a bomb injury, a special fibre identity disc is issued as a further precaution, and this should be worn round the neck or wrist. This disc bears the statement on the front that the wearer is an insulin case and that a doctor must be notified ; on the reverse is the address of the Diabetic Association and a registered number (see Fig. 56).

If a diabetic patient who takes insulin is conscious and requires assistance although uninjured, he should be given some sugar, sweets, chocolate or a sweetened drink and sent to hospital as soon as possible. If he is unconscious he should on no account be given sweetened drinks but must be transferred to hospital at once. The ambulance attendant must be informed of the nature and urgency of the case and instructed to notify the hospital authorities immediately on arrival.

A diabetic patient should always remember the dangers which may occur, and it is up to him to lighten the work of the Civil Defence Corps as much as possible by carrying in his pocket some extra sugar, sweets or biscuits, in case he is prevented by an air raid from getting home in time for a meal.

Uræmia

This is a complication which may occur in persons suffering from kidney disease, and is due to accumulation in the system of poisonous substances which are normally got rid of by the kidneys, in the urine. Uræmia is one of the causes of insensibility and in its later stages produces a state of complete unconsciousness known as Uræmic coma —a very serious condition.

People with kidney disease are usually already under medical treatment, but the onset of uræmia may be sudden enough to need the assistance of Civil Defence personnel at an air raid incident.

Symptoms and Signs

(1) As a rule uræmia comes on gradually with a severe headache and often vomiting.

(2) Convulsions frequently occur and a person may have fits which resemble those of epilepsy.

(3) The pupils are usually small, equal in size and react to light.

(4) Increasing drowsiness.

(5) Difficulty in breathing when a patient attempts to lie down, or a special form of breathing in which several deep breaths are taken followed by several shallow breaths, which may be hardly perceptible. These periods of deep breathing alternate with periods of shallow breathing about three times a minute, and are a danger sign in cases of uræmia.

(6) An odour of urine in the breath.

(7) Unconsciousness which deepens into a state of coma.

Treatment

If a person is found or suspected to be suffering from uræmia at an incident, he should be warmly wrapped up, labelled, and sent at once to hospital, the label being marked with an X. The ambulance

IMPORTANT

The bearer of this card is a diabetic and takes Insulin. In the event of sudden confusion or faintness please give 2 tablespoonfuls of sugar in water and communicate with the nearest doctor.

P.T.O

ISSUED BY THE DIABETIC ASSOCIATION., 152 HARLEY ST. W.1.

NAME .....

ADDRESS .....

.....

Telephone No. .....

INSULIN UNITS TAKEN DAILY { Morning. / Evening

CARBOHYDRATE PER DAY .....

DOCTOR ATTENDING .....

.....

Fig. 56—Special Card and Identity Disc as Carried by Diabetics

attendant must be instructed to report his condition to the hospital authorities immediately on arrival. A doctor should always be sent for to see the case if he is readily available at an incident.

Heat Exhaustion

This condition is not frequent in this country, but may occur among men working for any length of time in places where the temperature is high, especially if for one reason or another they may not be in the best state of health. In hot tropical countries heat exhaustion is fairly common. Excessive drinking of alcohol predisposes to the occurrence of heat exhaustion and heat stroke. Civil Defence personnel especially when wearing protective clothing, and members of the Fire Service, working under unfavourable conditions may be affected in the course of their duties ; soldiers carrying heavy equipment are sometimes overcome after strenuous exercise on a hot day.

Symptoms and Signs

(1) Headache and a feeling of faintness and giddiness which may come on suddenly, causing a person to stagger and fall down.
(2) Face is pale.
(3) Skin cold and damp.
(4) Pupils of eyes dilated.
(5) Breathing quiet and shallow.
(6) Pulse feeble and rapid.
(7) Temperature sub-normal.
(8) Partial but seldom complete unconsciousness.

Treatment

(1) As for shock.
(2) Lay patient on his back and loosen all clothing. If unconscious turn his head to one side to prevent the tongue from falling back into the throat.
(3) Smelling salts are useful and sal volatile (1 teaspoonful in half a tumbler of water) may be given if the patient can swallow.
(4) Do not allow him to walk but send him to hospital as a stretcher case, well wrapped up and lying flat.

Heatstroke

This is rare in a country with a temperate climate, but in hot tropical countries it is comparatively frequent either as a result of the direct rays of the sun, in which case it is called sunstroke, or by overheating of the body in a moist hot atmosphere without necessarily exposing it to the suns' rays. Heatstroke occurs under the same conditions which cause heat exhaustion but is far more serious.

Men working at high pressure in the engine rooms of ships or stoking boilers in badly ventilated basement rooms during hot weather are liable to suffer from heatstroke. Although few cases are usually reported it is possible that such may occur and, if recognised, will be greatly benefited by correct and timely first aid.

Symptoms and Signs

(1) There may be a feeling of uneasiness and restlessness with headache and perhaps vomiting for some hours before the attack develops. One symptom which is fairly constant is the frequent desire to pass water.

(2) Sudden unconsciousness, which may be preceded by a period of delirium, or may be the first evidence of trouble without any previous symptoms or signs.

(3) The face is suffused and burning hot.

(4) The eyes bloodshot, pupils contracted.

(5) The skin hot and dry.

(6) Breathing sometimes quiet ; may be noisy and laboured.

(7) Pulse feeble and rapid.

(8) Temperature rises and may even reach as high as 108 F.

(9) Complete unconsciousness which may end in death.

Treatment

(1) Loosen all clothing, keep the patient lying flat and cool the skin by every possible means.

(2) If the patient cannot be seen by a doctor or removed to hospital at once, urgent measures are necessary, therefore—

(3) Ensure that the tongue cannot fall back into his throat if he is unconscious.

(4) Pour cold water over his head and face. Remove his clothing and wrap him in a wet sheet or blanket which must be constantly kept wet with cold water.

(5) If breathing should cease carry out artificial respiration.

(6) If he regains consciousness get him to drink plenty of cold water, in which half a teaspoonful of common salt to the pint has been dissolved.

(7) Send him to hospital as soon as possible as a case of urgency.

Examination and First Aid Treatment of an Insensible Person

The reason for the insensibility may be obvious, especially under air-raid conditions ; even if this is not so, a prolonged examination of the patient is unnecessary and indeed inadvisable, as such cases should, as a rule, be sent to hospital as soon as possible. The following points will, however, be useful for the guidance of a first-aid worker.

Examination

On approaching the patient the following points should be noted in regard to his appearance and surroundings. In what position is he lying, natural or unnatural ? Is he breathing or not ? Is his face pale, flushed or blue (cyanosed) ? Can a wound be seen or are there signs of blood about, etc. ? In short, try to picture in what way he differs from a normal person found asleep.

Treatment

(1) Send for a doctor if possible ; pending his arrival—

(2) Where the patient's face is pale, lay him flat, and face downward with his head turned to one side ; if his face is flushed or blue, raise and support the head and shoulders. If you cannot clearly see the colour of the patient's face owing to darkness or bad light, some hint of his condition may be obtained by placing a hand on his forehead. If his face is pale the skin may feel cold and clammy ; if it is flushed or blue the skin may feel hot.

(3) Control any serious bleeding.

(4) Loosen any tight clothing and let him have plenty of air.

(5) Keep him warm with blankets and hot water bottles, which must be protected to prevent them from burning his skin.

(6) Do not give anything by the mouth.

(7) If a doctor is not available send the casualty to hospital in an ambulance.

The commoner causes of insensibility, e.g., head injuries, diseases, fainting, suffocation, etc., have already been described. The information obtained from your observations will all be of value to the doctor when he arrives and immediate treatment may save the patient's life. Relatives or bystanders may be able to add to this information, e.g., by saying what happened before the patient became unconscious, for how long he has been in this condition, whether the onset was sudden or gradual.

CHAPTER XVII

CRUSHING INJURY—INJURIES FROM ATMOSPHERIC AND FROM IMMERSION BLAST —ABDOMINAL INJURY

A large proportion of casualties is caused by the collapse of buildings during air-raids. Of these casualties, some are found to be pinned down by beams, brickwork or other heavy debris across their limbs and other portions of the body and may remain trapped for several hours, especially at night.

Some of these casualties, when extricated, show little external sign of injury and may complain of nothing more than numbness and stiffness of the muscles in the crushed part, even though this has been subjected to considerable pressure. Their general condition may appear quite good, both during the time they are trapped and after they are freed. Many recover completely after appropriate treatment and rest in hospital. In some cases, however, " shock " develops within a few hours. With adequate blood transfusion all but the most severe cases survive. In some of these patients, after recovery from " shock " the kidneys become unable to excrete urine, and if this inability is not overcome within six to eight days, the patient will die because of the accumulation of waste products in the body. Such cases are said to have developed " crush syndrome " (" syndrome " being the term applied to a group of symptoms occurring together regularly and constituting a disease or condition to which a particular name is given). It should be emphasised that this syndrome only occurs when the blood supply to the muscle has been cut off for such a time that the muscle dies. This happens more frequently to the limb muscles, since they are less protected than those of the body. Certain substances derived from the dead muscle poison the kidneys, but only if the urine is acid. For this reason alkaline drinks should be given at the earliest opportunity to ensure that the harmful substances are washed out rapidly by an alkaline urine in which they can do no harm. This damage to the kidneys is done soon after release, but does not become evident until the lapse of many hours, by which time the patient should be in hospital. It is much easier to prevent the kidney damage than to cure it ; prevention therefore is of the greatest importance, and the earlier steps are taken to make the urine alkaline the better. This should be done for all persons who have been trapped by debris for one hour or more, as they may possibly develop crush syndrome, whatever their apparent condition at the time of release. They must all be treated as severe casualties in whom early action may avert a serious outcome.

Action to be taken on Encountering Casualties Trapped beneath Heavy Debris

(*a*) If there is a doctor at the incident, notify him immediately a trapped casualty is located. He may be able to give valuable treatment while the victim is being released, and to make special arrangements for his disposal after release.

(*b*) If no doctor is immediately available, report the presence of trapped casualties to the Damage Control Officer.

(*c*) Treatment at the Incident :

Apply the following treatment, *if only a limb or limbs are involved.*

(1) Give plenty of liquid, up to four pints by the mouth, if there are no signs of any abdominal injury. For the reasons given above, this should be administered if practicable before the pressure is relieved, *but in no case must this delay extrication.* If baking soda (bicarbonate of soda) is available, dissolve two level teaspoonfuls in a pint of cold water and let the patient drink as much of this as he can. Follow this with drinks of hot sweet tea or coffee. Tea or coffee, other mild alkalis (magnesia, alkali powder for indigestion, etc.) or even plain water should be given if baking soda is not available. *Never give washing soda.* In the case of a casualty who is trapped in a position difficult to reach, the use of an india-rubber feeding tube is sometimes necessary. It may be difficult to prevent liquid delivered into the mouth under pressure from entering the air passages and flooding the lungs. It is dangerous therefore to administer liquid through a tube from a height, and no fluid should be given unless the position of the casualty allows him to control the flow.

(2) Give the usual treatment for shock. It is advisable to raise a limb which has been compressed, to leave it *uncovered*, and not to place hot water bottles near it. The application of heat after release causes a sudden rush of blood, with increased swelling in the numbed and damaged limb, and a consequent reduction of circulating blood volume in the body. This increases shock. The circulation should be allowed to return to normal gradually. (Limbs subjected to prolonged immersion in water should be treated in this way.)

(3) Attach a label to the casualty and mark it with a bold X. (See Chapter XXIII for details of the Standard Casualty Label.)

All these cases must be despatched to hospital by ambulance, and the ambulance attendant must be given full information about the injury and instructed to notify the hospital authorities immediately on arrival.

Injuries From Atmospheric Blast

Injuries from atmospheric blast alone were rare during the Battle of Britain, but in the bombardment of Malta they were common, because of the weight of the attack and of the structure of the shelters, which were largely subterranean and deep in rock. With the introduction of new explosives and heavier air attacks on this country such injuries became more common.

There is a marked variation of individual symptoms, and of their intensity, which depends upon the distance of the casualty from the explosion, the size and quality of the explosive charge, and nature of protection. Cumulative experience of the effects of atmospheric blast on a person, who is not at once killed by it, has enabled a clear picture of these effects to be formed.

Certain signs and symptoms are constant and may be observed by the first aid worker at the incident.

These are shock, which comes on immediately and is always profound in severe exposures, and restlessness, which is pronounced in such cases and present in most. There is a sense of fatigue which affects the will as well as the muscles and sometimes there is an inability to stand.

The first or positive pressure wave, which is always set up on the detonation of an explosive, very soon loses its velocity and force, 1,500 to 2,000 feet per second, but it strikes a nearby body (within 30 feet) with the impact and strength of a severe blow which affects principally the internal organs on that side of the body which faces the explosion. It may cause bleeding in these organs, especially in the lung of that side.

Signs and Symptoms

The first signs of this lung injury are usually not seen until an hour or two after the exposure, when a dry cough with difficulty in breathing is accompanied by pain in the chest, a pain which is increased by the coughing. Cyanosis also becomes evident at this time.

The coughing up of blood, or of sputum tinged with blood soon occurs, for in these cases there is bleeding into the tissues of the lungs.

Pain in the abdomen is uncommon ; when it does occur it is usually associated with injury to one or other of the abdominal contents.

Pain in the ears is not infrequent and may indicate rupture of the ear drums, though this may occur without any symptoms at the time. Later, partial or complete deafness frequently follows, otherwise there is singularly little effect on the skull or its contents.

Treatment

The first essential in the handling of these casualties at the incident is to treat the profound shock from which they all suffer. Wrap the person warmly in blankets, apply hot water bottles, place him on a stretcher and send him as a stretcher case in an ambulance to a hospital as soon as possible.

No attempt must be made to carry out any form of artificial respiration

Morphine should be avoided except in cases where there is great restlessness, when ⅓ to ¼ grain may be given by a doctor.

For the pain in the chest, increased by the bouts of coughing, a broadfold triangular bandage round the chest over the clothing will give some relief.

When there are no signs of injury to abdominal organs, hot sweet tea may be given. *Cigarettes must not be given or allowed.*

Label the person with an X, and inform the ambulance attendant of the nature of the case, so that she may keep the patient fully recumbent on the way to hospital and pass on the information on arrival there.

Injuries from Immersion Blast

Injuries, due to immersion blast are serious.

The detonation of an explosive beneath the surface of water, sets up a single high pressure wave of compression which travels at the rate of 5,000 feet per second (the same speed as that of sound in water). Its force " decreases directly with the distance from the centre of the explosion."

The force of this wave, when it strikes the immersed body, is felt mainly by those organs which contain air, so that water blast injuries occur chiefly in the lungs, and in the gut (notably in the small intestine and cæcum). Where both lung and abdominal injuries occur together, the abdominal symptoms will always be more prominent at the incident than those resulting from the lung injuries. Whether the damage is slight or severe will depend on the intensity and proximity of the blast wave.

Injuries to the solid abdominal organs, the liver, spleen and kidneys do occur, but they are rare.

Symptoms

At the instant of the explosion there is the sensation of a violent blow on the immersed abdominal wall caused by the high pressure (blast) wave striking the body. In some cases, so long as the body remains immersed, there is mild abdominal discomfort only ; in other cases, some 5 to 30 minutes after the blow there is sudden and excruciating pain in the abdomen, with tense rigid abdominal muscles. Blood may be passed by the bowel, or the motions may be blood tinged as, in a number of cases, there is bleeding from the damaged lining membrane of the gut and sometimes the gut is perforated or torn. External bruising of the abdomen is infrequent. Inability to stand for variable periods after removal from the water is very common.

If the lungs are injured their injuries will resemble those caused in the lung by atmospheric blast (see above).

First Aid Treatment

The injuries to the abdomen and lungs from which persons may suffer who have been exposed to immersion blast, give a clear indication of the first aid treatment required.

(1) Gentle handling is essential in all movement of the patient, from the time he is being taken out of the water until he is safely in the hospital.

(2) Complete rest in the recumbent position, *even if the patient at the time of the incident shows no signs or symptoms of severe injury.*

(3) First aid treatment for shock. Remove the wet clothing as gently and as soon as possible and wrap in warmed blankets. Do not give fluids by the mouth (hot sweet tea, etc.) without the permission of a doctor.

(4) Early removal to a hospital. These cases travel badly, and it must always be borne in mind that two serious complications may occur later, i.e., perforation of the gut between the sixth and seventh day after exposure leading to a very serious condition, and water-logging of the lungs.

(5) Generally, morphine should not be given because of its depressant action on the respiratory centre, but where there is acute pain, or great restlessness, it will usually be given by a doctor before removal to a hospital.

(6) The case must be labelled, and the label marked with the heading " Immersion blast ", and the symbol X. If morphine has been given this should also be noted (time and dose). On the journey to the hospital the ambulance attendant should be informed of the nature of the case, and instructed to bring it to the immediate notice of the hospital's casualty receiving personnel.

ABDOMINAL INJURY

The most common form of injury to the belly as a result of an air-raid is a penetrating wound of the abdominal wall, which may or may not have extended through all its protective layers of skin, muscle and fat and opened up the abdominal cavity itself. A frequent cause of this injury is a piece of metal from any type of H.E. missile, or it may be due to fragments of glass, stones or rubble blown through the

air by blast from an exploding H.E. missile. Although a penetrating wound of the abdomen is most frequently found on its front or side walls, it must be remembered that a wound which involves the interior of the belly may be caused by fragments of metal, etc., which may have entered it through the buttock, chest wall or back, especially when a person has been lying or crouching down when hit. First-aid workers must always bear this fact in mind when they suspect an internal abdominal injury, and no external wound is visible on the front of the body. Otherwise they may miss the actual entrance wound elsewhere. Wounds of the belly also occur from machine gun or rifle bullets but these are generally perforating, with an entrance and exit wound.

Any wound of the abdomen must be regarded as extremely serious, on account of the important organs contained within it, it may easily prove fatal within a short space of time.

The chief dangers and immediate cause of death are :—

(*a*) Internal Hæmorrhage.

(*b*) Shock. Any wound of the belly which causes protrusion of the bowel is accompanied by severe shock.

(*c*) Septic poisoning which is caused by infection of the wound by disease germs at the time of injury, and frequently causes death or serious illness at a later date.

First Aid Treatment

No time must be lost in sending a patient with an abdominal injury to hospital. A first aid worker cannot hope to check internal hæmorrhage, and should not waste time in trying to do so. He can, however, do something to minimise the shock from which the patient is suffering.

(1) Lay the patient down on his back on a folded blanket or blanketed stretcher with his knees drawn up and supported on a rolled up blanket placed beneath them. Support his head and shoulders on pillows or rolled up blankets. This position relaxes the abdominal muscles and may prevent more bowel from coming out, if any has protruded. Place a protected hot water bottle at his feet, between his thighs and on each side on his chest—do not place a hot water bottle near the wound. Wrap him in blankets leaving a space for the wound to be dressed.

(2) Dress the external wound. If intestines protrude from the wound do not attempt to touch or replace them, but cover them at once with a large sterile dressing and bandage firmly but not too tightly. A large first aid or mine dressing is useful but should be covered with a broad-fold triangular bandage over the roller bandage as an extra support. Cover the abdomen with a blanket. (See Fig. 57).

(3) If there is no protrusion of the bowel, treat the patient as above, whether the wound is horizontal or vertical. Cover the abdomen with a blanket.

(4) Do not give anything by the mouth.

(5) Do not move the patient unnecessarily until he is ready to be placed in the ambulance. Remembering that every movement increases shock, move him with the utmost care and gentleness.

(6) Call a doctor to see the case if one is available.

(7) Label patient and mark an X on the label. Draw the attention of the ambulance attendant to the case. She will bring it to the notice of the hospital authorities for priority treatment on arrival there.

Fig. 57—Treatment of Wound of Belly

CHAPTER XVIII

TYPES OF INJURY

Wounds and injuries which are met with during air-raids are of many different types and multiple injuries are frequently found. One of the principle causes of casualties, especially when people are caught in the street or in shops, arises from pieces of broken glass blown in all directions. People who take refuge in shelters will frequently escape such injury, although cases of temporary or permanent deafness may result from the blast itself. As is to be expected eye injuries bulk largely amongst those due to flying fragments of broken glass and other materials ; gross injuries also will be caused by flying masses of debris, rubble, stones, bricks and when people are thrown violently against hard substances. (This latter is known as a displacement injury).

INJURIES CAN BE CLASSIFIED as :—

(*a*) *Lacerated and Contused Wounds*

These are common and may be extremely severe, with serious damage to the trunk and internal organs ; limbs are sometimes completely torn off. Wounds may be less openly destructive but associated with severe crushing of muscular and other tissues ; or there may be multiple injuries. Such injuries may be primary, that is due to direct impact of flying debris, or secondary, when a person is blown against some hard, jagged or rough object. There may be little bleeding at first with these injuries because of the accompanying shock. The wounds are nearly always covered with dirt and dust, and fragments of metal or clothing ; all kinds of debris may be embedded in them.

(*b*) *Punctured Wounds*

75 per cent. of fragments from H.E. bombs are extremely small but travel with very high velocity. The wounds they cause on the skin are often insignificant but the damage to the tissues beneath is frequently very extensive. The brain and other organs may be severely injured. The skin may be peppered with minute wounds from fragments of glass, brick, stone, metal or wood, and such wounds are sometimes difficult to distinguish from those caused by small fragments of H.E. bombs. Multiple punctured wounds may occur from flying splinters of glass and secondary missiles.

Shock may be severe with punctured wounds but the main danger is from hæmorrhage, especially internal bleeding, and it may be sufficient to cause death within a short time.

(*c*) *Penetrating Wounds*

These are almost twice as common amongst casualties in the open as compared with those under cover. Gross lacerations and penetrating wounds are frequently inflicted by massive bomb splinters. They are most often found in casualties which occur close to the explosion of a bomb, without any intervening structure as a protection.

Penetrating wounds may be caused by splinters of bombs, by fragments of shells, by pieces of broken glass, by flying stones, rubble

and the like, or by machine gun and rifle bullets. If the missile is retained in the body it constitutes a " penetrating " wound ; if it passes right through the body a " perforating " wound results. In the case of a perforating wound the entrance wound may be of small size, and the exit wound frequently much larger, especially if the missile has struck a bone in its passage through the body. If this is the case there is some likelihood of the entrance wound being overlooked and with attention concentrated on the exit wound, the seriousness of the damage caused by the passage of the missile may not be appreciated. In the case of penetrating wounds also, the underlying damage may be much more extensive than the size of the wound suggests.

Penetrating wounds of the chest wall and abdomen may prove rapidly fatal from severe injury to a vital organ or from internal hæmorrhage.

An " open pneumothorax " (which means the entry of air into the chest cavity from without, through a wound, causing collapse of the lung on that side by pressure of the air) is an example of a serious injury to the chest. This may produce what is known as a " sucking wound ", in which condition air and blood pass in and out of the wound as the patient breathes. With injuries of the chest and abdomen, apart from the danger of hæmorrhage, shock of some degree is always present, and may be so extreme as to constitute a grave menace to life. Fractures of the ribs are found in a large proportion of chest injuries, and are often associated with severe lacerations and penetrating wounds of the chest wall. The abdomen is also exposed to gross injuries from bomb splinters and pieces of flying debris ; injuries just as serious as extensive penetrating wounds.

(*d*) *Compression Injury and Suffocation* (*Asphyxia*)

These form a substantial proportion of casualties and are a common cause of death. In many cases where persons are crushed beneath debris, there is gross damage to the head or chest of fatal severity. Fractures, open and closed, especially of the bones of the skull, of the ribs and of the limbs, are met with among people crushed under girders, masonry, beams or other debris ; fractures of the spine are less frequent. Less dangerous injuries such as severe contusions occur also. Compression injuries may give rise to serious complications and require extremely careful treatment if life is to be saved. The chief of these complications is known as the " Crush Syndrome " (See Chapter XVII).

(*e*) *Summary*

The above account deals mainly with serious injuries and, therefore gives an incomplete picture of the type of casualties likely to be met with under actual air-raid conditions. Obviously, many slight injuries (e.g., slight contusions, sprains, minor burns, minor lacerations, cuts, etc.) which require treatment at first aid posts will also occur. In fact, from past records it is estimated that out of every 100 casualties 23.5 will be killed, 28.5 seriously injured (requiring admission to hospital) and 48 slightly injured (requiring treatment at first aid posts).

CHAPTER XIX

INITIAL DISPOSAL OF CASUALTIES TRANSPORT OF CASUALTIES

Before dealing with the problem of the disposal and transport of casualties a reference must be made to the type of casualties at air-raid incidents who *may* and who *will* require transport.

These types may be divided into :—

(*a*) Lightly Injured Casualties.

(*b*) Seriously Injured Casualties.

(*a*) *Lightly Injured Casualties.* At an incident at which there is a considerable number of casualties, approximately 48 per cent. will be lightly injured and some of them will have been dealt with by wardens and sent off to static first aid posts or mobile first aid units before the Rescue Parties arrive. The injuries sustained by some will prevent them from walking, while others will be quite capable of finding their way to their destination on foot. All lightly injured casualties should, after necessary first aid treatment, be directed or sent to the nearest mobile first aid unit or static first aid post, but occasions will arise when a decision by the Leader of the Rescue Party as to whether they can safely be sent on foot or should go in a vehicle may be difficult. Some casualties after first aid treatment profess themselves as fit to go home direct and wish to do so. This should be discouraged as far as possible, as, unless they attend at a mobile first aid unit or static first aid post, no record of their injury will be kept. At mobile first aid units and static first aid posts anti-tetanic serum is given, and this is essential for all injuries in which the skin has been broken.

As a general rule, casualties which should be sent to a first aid post are those who require rest, shelter, reassurance and first aid attention by a doctor, but are nevertheless not likely to require in-patient hospital treatment. If there is any doubt as to a patient's condition he must not be allowed to walk. A casualty who is allowed to proceed on foot to a mobile first aid unit or a static first aid post should, if possible be accompanied by a friend, relative, or a warden, if he can be spared. The patient will be glad of assistance and will not be likely to lose his way ; also, if his condition becomes worse on the road some help will be at hand. Similarly, it is advisable when possible for a friend to accompany a patient from the mobile first aid unit or static first aid post to his home. The following examples of some types of lightly injured casualties who should *not* be allowed to walk from an incident may be of assistance to first aid workers.

(i) If there is a marked degree of shock, which may be out of all proportion to the injury received.

(ii) If there is the slightest doubt as to whether there is an internal injury or not ; cases of multiple small injuries, although apparently superficial, may have caused some internal injury.

(iii) Casualties who have bled from an artery, even in a small wound.

(iv) Casualties with head wounds, even though they may appear slight.

(v) Casualties with an injury to a lower limb, unless it is only a slight flesh wound.

(vi) *All cases* of poisoning by a nerve or lung irritant gas must *on no account* be allowed to walk but must be sent at once to a

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hospital as stretcher cases. Other persons whose eyes have been contaminated by the liquid of a persistent gas (e.g., mustard gas) must be sent by car to a hospital as soon as their eyes have been thoroughly washed out with water (if seen within five minutes of their contamination), and their contaminated clothing removed.

(*b*) *Seriously Injured Casualties.* Seriously injured casualties (approximately 28 per cent. of all casualties) are those who are likely to require in-patient hospital treatment. They must not be allowed to walk but should be sent by ambulance direct to hospital from an incident, after necessary first aid treatment. An exception must be made of persons too severely injured to stand a long journey to the hospital until they have received attention from a doctor at a nearby mobile first aid unit, otherwise, if the hospital is near, they must be taken there.

A few examples of cases requiring hospital treatment are :—

(i) All cases of internal hæmorrhage ; open wounds of the chest (pneumothorax); shattered limbs ; grossly lacerated and crushed limbs ; wounds of belly ; open-complicated fractures ; fractures of the skull, spine, pelvis and thigh ; injuries involving the eye ; injuries involving the lower jaw and control of the tongue.

(ii) Cases of severe external hæmorrhage and of multiple or extensive burns.

(iii) Cases in which further shock is likely to supervene, as in persons trapped for long periods under debris, or exposed to cold and wet ; in fact, all but those with trivial injuries and those who are merely shaken, frightened or faint. It must not be forgotten that very small external wounds may be associated with severe damage beneath the surface.

(iv) All diabetic patients who may be injured or who are suddenly taken ill. (See Diabetes, Chapter XVI).

Method of Transport for Casualties at an Incident

The following methods of transport are used for casualties who should not be allowed or who are unable to walk.

(*a*) Stretchers—when these are available and can be used.

(*b*) By various means when stretchers are not available, or cannot be used :—

(i) Webbing bands.

(ii) Various types of hand carriage—hand seats—pick-a-back, fireman's lift, etc.

(iii) By using blankets as stretchers.

(*a*) *Stretchers*

A standard G.S. Stretcher has been adopted for use by the Civil Defence Corps and the Services.

Training in the use of Stretchers

The placing of casualties on stretchers, their removal from an incident and loading into ambulances should be in accordance with methods which experience has shown to be the most comfortable for the patients.

It is essential that stretcher bearers should receive some training in the form of drill for correct carriage and practice in loading, unloading and handling stretchers, but it is not considered necessary in these pages to formulate any new form of such drill, or to describe in detail

the drill laid down in the R.A.M.C. training Manual 1935 and adopted by the Voluntary Aid Societies.

Any form of drill must of necessity be modified to meet war conditions and cannot be too rigidly followed. The result of an efficient training, however, will be to promote and maintain concerted action and good team work among the rescue personnel and other first aid workers. The following simple exercises provide a basis for what is required.

(1) Four men of approximately the same height are allotted to carry each stretcher. They are called " bearers " and are numbered 1, 2, 3 and 4, each four men constituting a stretcher squad.

The No. 1 bearer of each squad is the leader and gives all orders.

The positions which these bearers take up in relation to a stretcher are :—

(*a*) No. 1, on the right of the stretcher with his toes in line with the front end of the right pole.

(*b*) No. 2, on the left of the stretcher in line with No. 1.

(*c*) No. 3, on the right of the stretcher behind No. 1, with his heels in line with the rear end of the right pole.

(*d*) No. 4, on the left of the stretcher in line with No. 3.

These positions are permanent.

Loading Stretchers

On the command " Lift Stretcher—Collect Wounded ". The Nos. 2 and 4 bearers stoop together and lift the closed stretcher by the handles with the right hand and rise together holding the stretcher at the full extent of the arm, runners to the right. The squad then doubles by the shortest route to the patient and halts three paces from and in line with his head. Nos. 2 and 4 place the closed stretcher on the ground and stand up while No. 1 goes forward to examine the patient.

On the command " Prepare Stretcher—Load Stretcher ". Nos. 2 and 4 bearers turn to the right, kneel on the left knee, unbuckle the transverse strap, separate the poles and straighten the traverse. They then rise together, leaving the opened stretcher on the ground, and go to the left of the patient No. 2 at his knees, No. 3 at his hips and No. 4 at his shoulders. No. 1 bearer has meanwhile taken up his position to the right of the patient at his hips. All bearers now turn inwards together, kneel on the left knee and pass their hands, palm upwards, beneath the body of the patient, No. 2 bearer supporting the legs, Nos. 1 and 3 by locking hands the thighs and hips, and No. 4 the shoulders and head. At a signal given by No. 1 bearer the patient is lifted gently off the ground on to the knees of Nos. 2, 3 and 4 bearers. No. 1 bearer then disengages and brings the stretcher which he places in front of the remaining bearers ready for the patient to be lowered on to it. He then takes up his former position, links hands with No. 3 bearer, and assists the other bearers to lower the patient on to the stretcher.

After wrapping the patient in the folds of the blankets previously laid upon the stretcher, all four bearers rise together and resume their original positions ready to lift the stretcher.

On the command " Lift Stretcher ". All bearers stoop together, grasp the stretcher poles, and lift the stretcher off the ground, holding it at the full length of their arms.

When No. 1 bearer gives the command "Advance" the bearers step off together with the inner foot (i.e., that nearest to the stretcher), knees slightly bent, using short shuffling steps, unless the stretcher has to be carried over debris. The party is thus out of step which prevents the stretcher from swinging and is more comfortable for the patient.

If only two men carry the stretcher the front man steps off with the left foot, the rear man with the right. As a rule it does not matter whether a casualty is carried head first or feet first. When going uphill it is more comfortable for the casualty to be carried head first, and when going downhill feet first, unless there is some reason to the contrary.

Shoulder carry

On the command "On shoulders lift Stretcher" the bearers turn inwards together, stoop, and grasping the stretcher poles with the hands wide apart, palms upwards, lift it slowly to the level of the shoulders. They then turn to the right or left, according to the direction they are going, and support the poles on the inner shoulder, steadying the stretcher with the other hand. Some padding on the shoulders is desirable.

Loading a Stretcher with only Two Bearers

The stretcher is again placed in line with the patient, preferably at his head. After dressing the wounds the two bearers stand astride the patient, facing the stretcher. The patient's arms are folded across his chest if he is unconscious, but, if not, he may be able to help by either pressing up from the ground, or by helping to lift himself by taking the leading bearer round the neck with one or both hands as he bends down. The bearers should both bend together, lift the patient by the shoulders and thighs and shuffle forwards, straddling the stretcher as they advance.

Carrying Stretchers

A stretcher should always be carried as nearly level as possible. On slopes, the injured extremity should be kept at a higher level, e.g., a casualty with head injuries should be carried head first upstairs ; one with a fracture or wound of the lower limbs head first downstairs.

Position of the Casualty on the Stretcher

The position of the casualty on the stretcher depends on the situation of the wound, but will usually be on the back. The following types of wounds or injury require special position :—

(i) In head injuries care must be taken that the injured part does not press against the stretcher. Casualties with severe injuries to the mouth and lower part of the face may need to be carried face downwards with the head hanging over the end of the stretcher in order to prevent the tongue falling back and causing choking. (See Chapter XI.)

(ii) For injuries to the lower limbs, the casualty should be laid on his back, inclining toward the injured side. This position is less liable than others to cause motion of the injured limb during transport. A casualty who is in splints should, however, be placed on his back and not inclined to the injured side.

(iii) For injuries to the upper limbs, if the patient is unable to walk he should be placed on his back or on the uninjured side, in this position there is less liability of displacement of a broken bone.

(iv) A casualty suffering from chest injuries should be placed with his chest well raised, his body being inclined towards the injured side. This tends to relieve any difficulty in breathing.

(v) Abdominal cases should be placed on the back, the abdominal wall relaxed by flexing the knees over a box, haversack or rolled coat and the head and shoulders raised. No attempt must be made to replace protruding organs.

(vi) In a fracture of the spinal column at any level, the casualty should be carried lying on his back on a rigid stretcher, with a blanket folded length-wise beneath him and a small pillow or pad under the neck and lumbar region, so as to maintain the normal curves of the spine.

CHAPTER XX

BLANKETING A STRETCHER : BLANKETING A BADLY INJURED CASUALTY : BLANKET LIFTS : SECURING CASUALTIES ON STRETCHERS

Blanketing a Stretcher

Before an injured person is placed on a stretcher, it should be covered with a blanket folded lengthwise so that he does not lie in direct contact with the canvas bed-portion. This adds to his comfort and keeps him warm, thus reducing shock. It is more important to place blankets under him than over him. With two layers of blanket underneath and one on top, a casualty is better off than with one layer underneath and two on top.

Two blankets only are required to blanket a stretcher properly. (See Fig. 58.)

(i) Lay one open blanket (A) lengthwise across the stretcher with one side close to the head end, and one end of the blanket having a slightly longer overlap of the stretcher than the other.

(ii) Fold a second blanket (B) in three folds lengthwise and lay it on top of the first blanket (A) along the stretcher with its upper edge about 15 ins. below the upper edge of the first blanket (A). There will now be four thicknesses of blanket upon which the patient will lie.

(iii) Open out the two ends at the foot of blanket (B) for about 2 ft. to form two flaps.

(iv) Roll up or pleat in concertina fashion the overhanging ends of blanket (A) and place them on the edges of the stretcher so that they

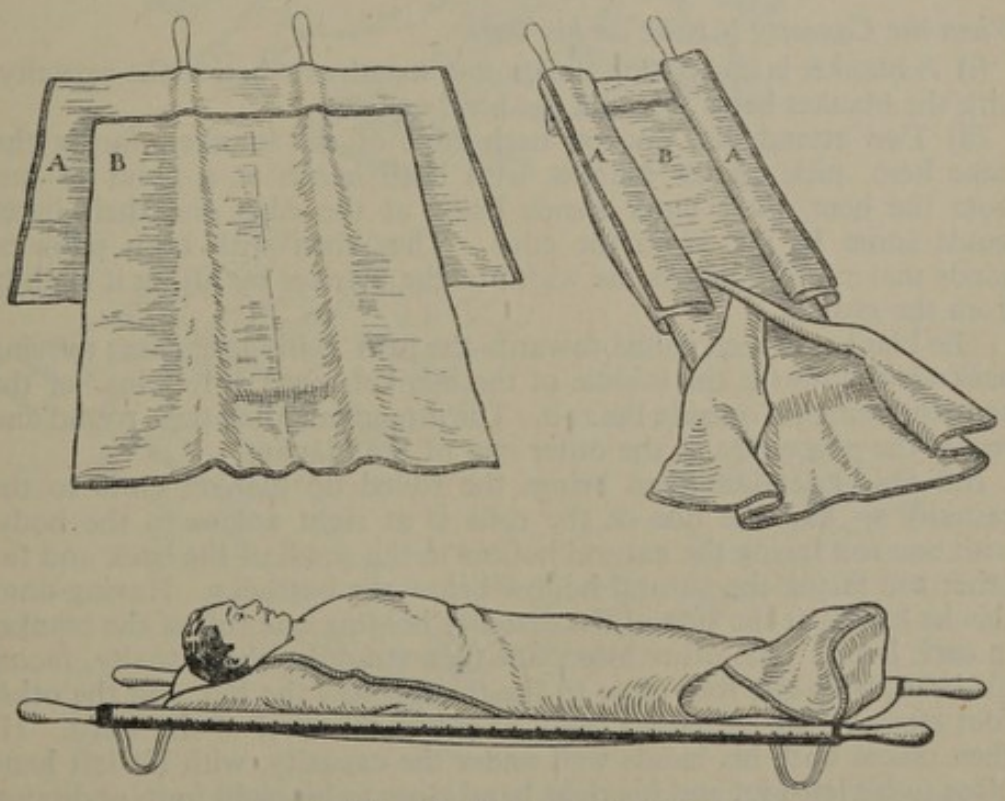


Fig. 58—Blanketing a Stretcher

will not drag on the ground when the stretcher is brought close to the patient.

(v) When the patient is laid upon the stretcher wrap the two flaps of blanket (B) round his feet and tuck the ends between them.

Open out the rolled up folds of blanket (A) and wrap first the short then the long end round the patient and tuck it well in at one side.

The casualty will now be warmly blanketed.

A simple blanket lift can be used to transfer a patient from a stretcher to a bed by two persons only, one grasping the blanket with both hands at the level of the patient's shoulders (so as to include blankets (A) and (B)), and a second holding the blanket with both hands at the ankles (to include also blankets (A) and (B)).

To secure Blankets as a Pack on a Stretcher

(i) Lay blankets (A) and (B) on the opened stretcher as described in (i) and (ii) above.

(ii) Fold in the two edges of blanket (A) taking the folds to the sides of the stretcher twice, then once again on to the stretcher.

(iii) Place the foot-end of blanket (B) on the stretcher, then fold it over and over with blanket (A) to form a flat pack, in the centre of which a hot water bottle can be placed. Secure the pack thus formed to the stretcher with a strap passed round it and the stretcher.

Placing a Blanket under a badly Injured Casualty

(*a*) To keep him warm.

(*b*) To form a blanket lift.

The method described below enables a badly injured casualty to be wrapped in a blanket, in such a way that he is subjected to the minimum of movement and his body is not raised more than 1 in. from the ground. It also enables a blanket lift to be used when necessary. (See Fig. 59.)

When the Casualty is lying on his Back

(i) A blanket is laid flat on the ground lengthwise beside the casualty, with the blanket hems towards the head and feet.

(ii) Two attendants, one on each edge of the blanket, facing the same hem, pick up the blanket with both hands at a point 18 ins. from the hem, their outer hands being at the edge and their inner hands some 12 ins. from the edge. They then with both pairs of hands make a fold across the width of the blanket by lifting it slightly from the ground.

The blanket is then rolled towards the hem, both attendants moving backwards towards the middle of the blanket, until only 2 ins. of the hem end remains outside the roll. The attendants then turn round and repeat the procedure at the other end of the blanket.

(iii) One attendant then brings the rolled up blanket close to the casualty so that the line of the rolls is at right angles to the body, with one roll facing the natural hollow in the small of the back and the other roll facing the natural hollow below the buttocks. Having done this he kneels at the side of the casualty holding one roll of the blanket in each hand. The other attendant then straddles the casualty, facing his head, with one foot close to the thigh below the hip, and the other foot close to the casualty's body at about the level of the waist. He then places both his hands well under the casualty, with his left hand close to his left foot and his right hand close to his right foot, and raises the buttocks of the casualty not more than 1 in. from the ground.

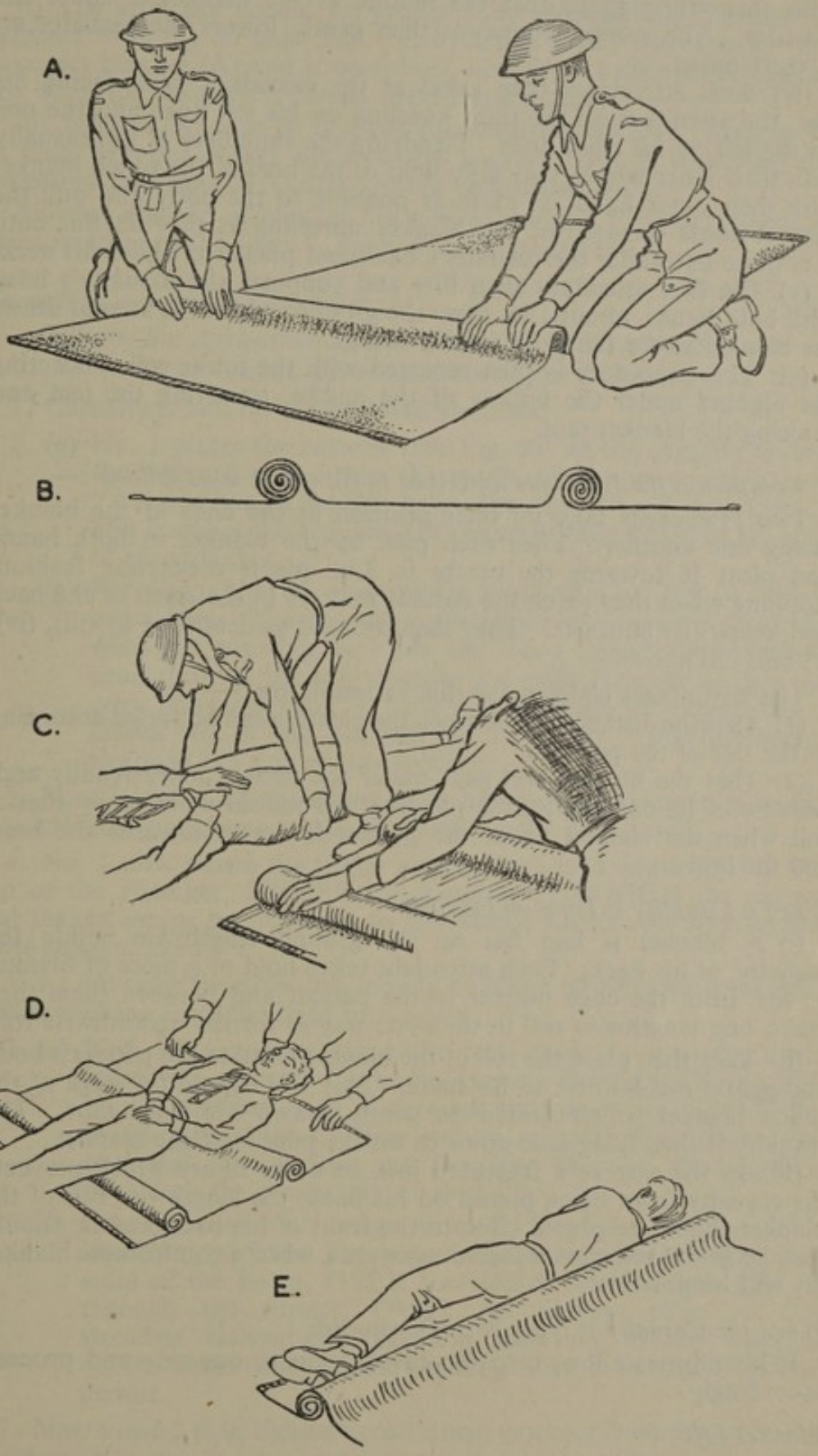


Fig. 59—Method of Placing Blanket under Casualty—A-D ; Alternative Method—E

The first attendant then pushes the rolls of the blanket halfway under the casualty and going round past the casualty's feet to the other side pulls them through so that the middle of the blanket is under the casualty. The second attendant then gently lowers the casualty on to the blanket.

(iv) Both attendants then kneel at the casualty's head facing his feet, the attendant on the right kneeling on his left knee and the one on the left on his right knee. Steadying the shoulders of the casualty with their inner hands, they take hold of the hem of the rolled blanket with their outer hands as close as possible to the body and pull the hem towards themselves, the blanket unrolling as they do this until it is quite flat under the casualty's back and puckered under his neck.

(v) The first attendant then lifts and supports the casualty's head with both hands, about 1 in. from the ground, whilst the second draws the blanket under the head until it is taut.

(vi) This procedure is then repeated with the lower roll, puckering the blanket under the hollow of the ankles, steadying the feet and drawing the blanket taut.

A variation in the technique described in (ii) *above is as follows :—*

Two attendants take up their position at the ends of the blanket facing one another. They each pick up the blanket in both hands and pleat it towards the centre in 3 in. pleats concertina fashion, stopping when they reach the natural hollows in the small of the back and below the buttocks. They then proceed as described in (iii), (iv), (v) and (vi) above.

The advantages claimed for this variation are :—

(1) That the distance left between the pleating can be varied according to the size of the patient.

(2) That the blanket will pass under the patient more readily and, because of its flat nature, the pleating will unfold more easily than a roll when the blanket under the patient is drawn towards the head and the heels.

When a Casualty is lying on his Side

(i) A blanket is laid flat on the ground lengthwise beside the casualty, at his back. Each attendant takes hold of a piece of blanket 15 ins. from the edge nearest to the patient and between them they make one lengthwise roll in the same way as for the breadthwise roll.

(ii) They then place the roll of the blanket close to the patient's body and gently roll him on to his back. This will expose the edge of the rolled blanket which should be gently drawn out until taut. The casualty is then lying face-upwards on the middle of the blanket.

(iii) In the case of a fractured jaw, or other injury which prevents the casualty from being placed on his back, the lengthwise roll of the blanket should be placed close to the front of his body and he should then be gently rolled over face-downwards, when a comfortable blanket lift will be possible.

When the Casualty is lying Face-Downwards

If his injuries allow, turn the casualty on to one side and proceed accordingly.

Blanket Lift

By placing a blanket under the casualty in the way described above a blanket lift can be used. Before, however, placing the casualty on

a stretcher the manner of preparing the stretcher as described in (i) to (iv) on page 223-224 must be varied, as follows :—

(i) The stretcher should be prepared by placing only blanket (B) referred to in (ii) on page 223. The blanket under the casualty thus becomes blanket (A) and is on top of, instead of underneath, blanket (B) when the casualty is placed upon the stretcher.

(ii) Blanket (A) must be wrapped round the patient first. Blanket (B) is then wrapped round his feet and tucked in, thus providing the necessary thickness of blanket around and beneath him.

Another method of blanket lift is given under " First aid treatment for a fracture of the spine ", method (1) on page 133.

Securing Casualties on Stretchers

Drill for the Application of the " Manifold " Stretcher Harness

(Two bearers are required to adjust harness)

1. Casualty is laid on the prepared stretcher.

2. (*a*) No. 1 places the harness (See Fig. 60) on the casualty so that the widened part covers the trunk, with cross strap marked " 1 " one hand's breadth below the chin. No. 2 assists No. 1 and bunches the free ends of the transverse straps at the side of the stretcher.

   (*b*) For Casualties of Abnormally Small Size—5 feet 4 inches and under. The harness is placed on the casualty with the wide part covering the trunk and No. 1 threads the casualty's head through the top window and pulls it down so that the cross strap marked " 1 " fits snugly behind the neck. No. 2 assists No. 1 and bunches the free ends of the transverse straps at the side of the stretcher.

3. Nos. 1 and 2 lift the stretcher to knee level and move it to the side until the transverse straps protrude on the buckle side.

4. No. 1 now passes the upper longitudinal head straps OVER the top of the stretcher, UNDER the handles, THROUGH the runner and makes secure by fastening to the buckle on its *own* side on the cross strap marked " 1 ".

5. At the same time No. 2 is loosely buckling off the four transverse straps working from the head to the feet.

6. (*a*) Both bearers now adjust the feet straps by crossing them below the soles of the boots, passing them OVER the side of the stretcher, BACK through the runner, up OVER the lower edge of the stretcher canvas, crossing them diagonally over the patients legs and fastening them to the opposite buckle on the cross strap marked " 3 ".

   (*b*) For Casualties of Large Size—6 feet and over. Both bearers adjust the feet straps by passing them below the soles of the boots, OVER the side of the stretcher, BACK through the runner, OVER the bottom edge of the stretcher canvas and fastening them off to the buckles on the same side, or the *opposite* side if length of straps permit.

7. Nos. 1 and 2 then tighten up all straps working from feet to head.

8. The stretcher is then tilted to test for security and all buckles inspected to ensure that there is no loosening. (See Fig. 61.)

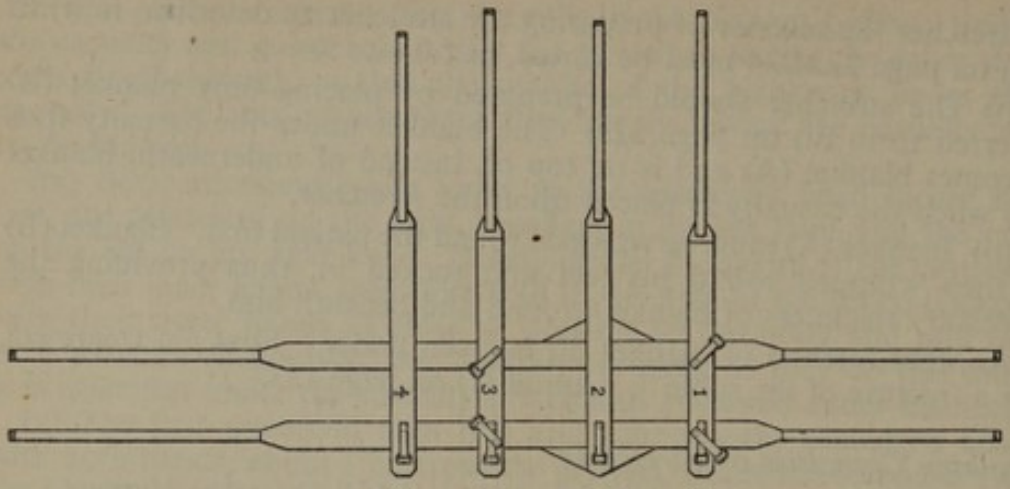


Fig. 60—" Manifold " Stretcher Harness

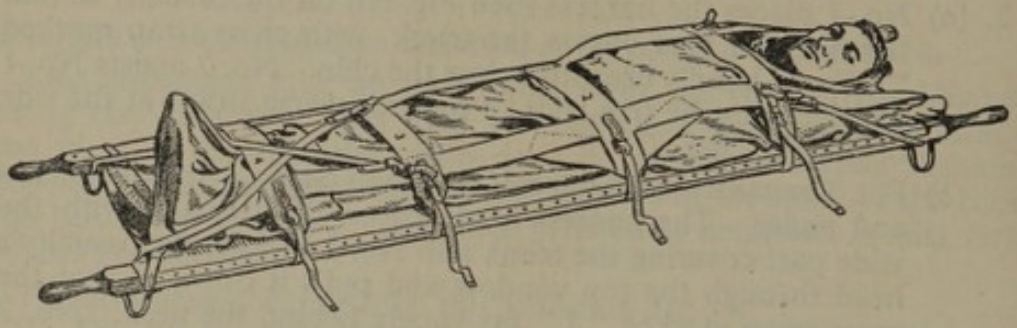


Fig. 61—Application of " Manifold " Stretcher Harness

CHAPTER XXI

TRANSPORT OF CASUALTIES AT AN INCIDENT WHEN STRETCHERS ARE NOT AVAILABLE OR CANNOT BE USED

Injured persons can be carried in several ways if no stretcher is available or it is impossible to use a stretcher.

(*a*) *By Webbing Bands*

Sets of webbing bands are carried by Rescue Parties and are used at incidents.

(i) For lifting a patient from the ground on to a stretcher.

(ii) For lifting and carrying a patient from a place where it is impossible to take a stretcher.

Each set consists of four bands made of stout canvas webbing 4½ inches wide and of two different lengths, two being 2 feet long, and two 3 feet long. The shorter bands are intended to go under the head or neck and the feet, and the longer ones under the chest and hips (or small of the back). At the ends of each band is a handle, a long and short, made of ¼ inch drawn steel wire welded at the joint, the long handle being 12 inches long and the short 4 inches. The long handles are used for pushing under the body of a patient lying on the ground, after which the webbing band is pulled through so that there will be a handle at each side. When pushing a band under a patient the long handle is grasped by the bearer with his right hand at the point where the handle joins the canvas, he then slightly raises the patient from the ground with his left hand and pushes the handle under his body ; the bearer on the other side raises the patient slightly with his left hand and pulls the handle and band through with his right hand ; it is only necessary to raise the patient a quarter of an inch from the ground. When a patient is lying close to a wall or other obstruction, it is not possible to pull the long handle through, so the short handle is bent over the long handle and pushed through by it ; the short handle is then pulled through and the long handle withdrawn at the same time.

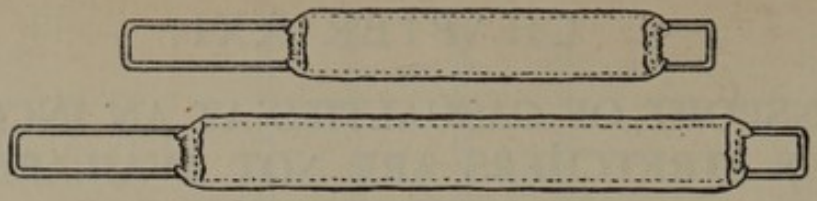
Several methods of carrying patients by webbing bands have been adopted to meet different situations. Training and practice in the carrying of patients by these bands is essential, and members of the Civil Defence Rescue Section are all trained in this, as are also other sections of the Civil Defence Corps who deal with casualties. It must be remembered that these webbing bands are not to be regarded as a substitute for a stretcher, but only as a means of taking a patient to a stretcher from a place where it is not possible to use one. (See Fig. 62.)

(*b*) *By various types of hand carriage:—*

Methods Suitable for one Bearer.

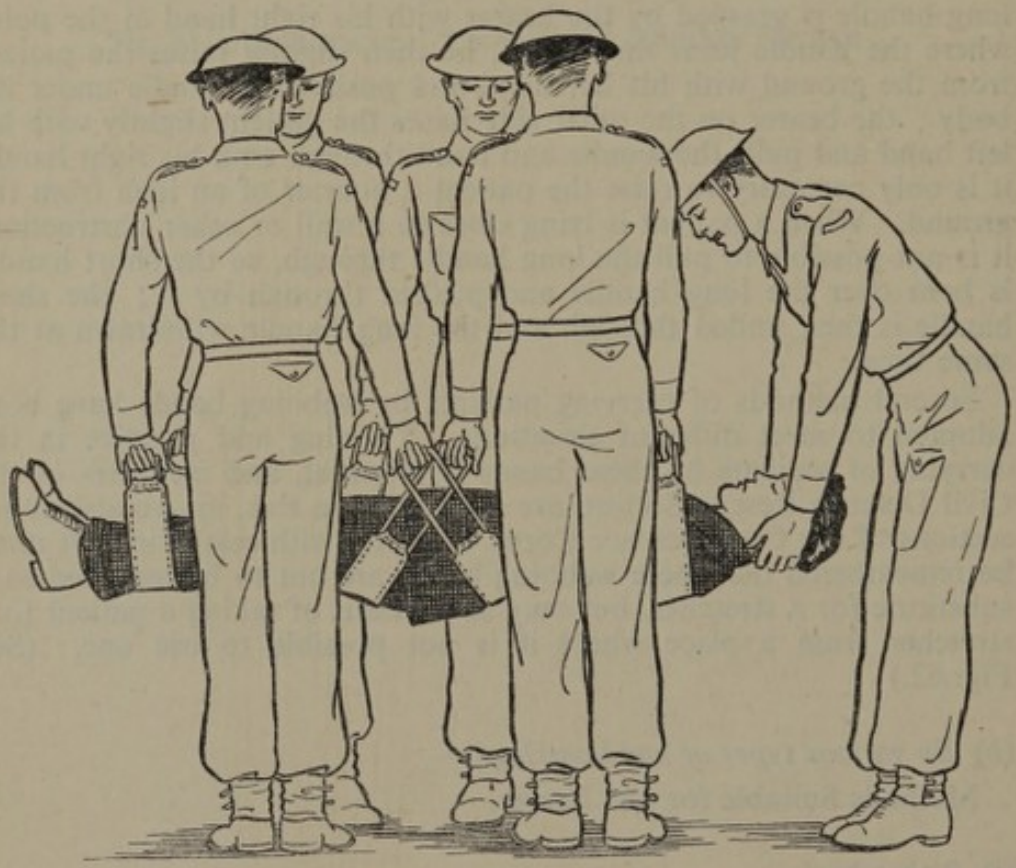
(i) *Pick-a-back*

Carry the casualty in the ordinary pick-a-back position. This is the best way if he is conscious and able to hold on.



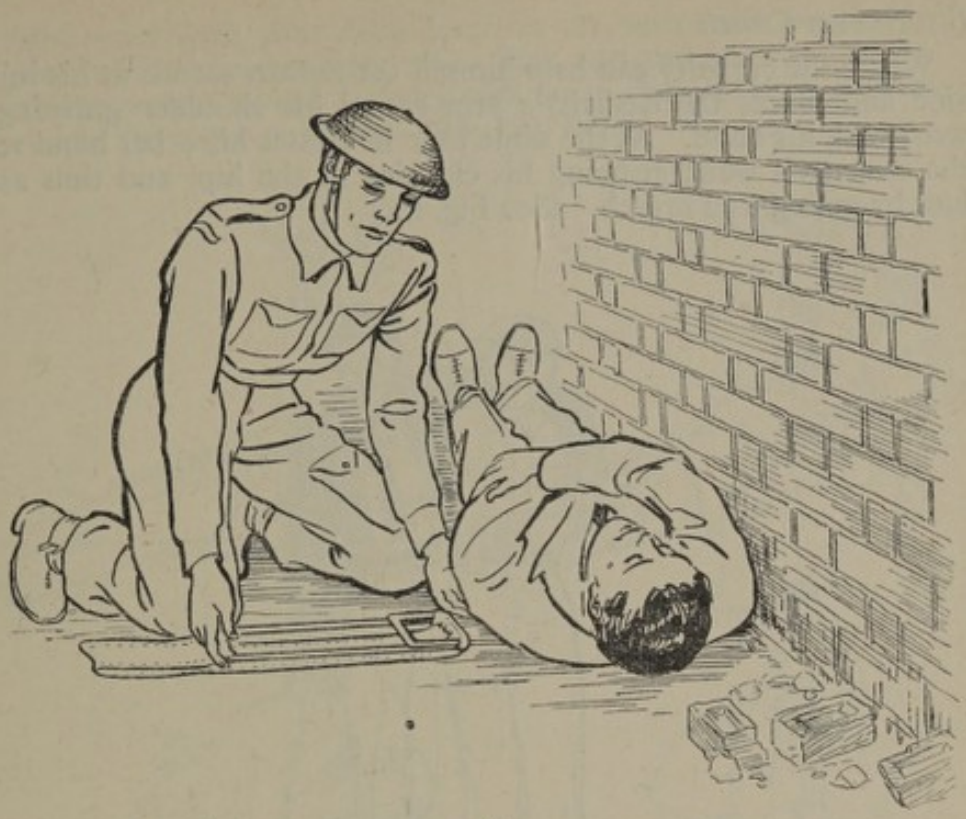
A

B



C

Fig. 62.—(See opposite page)



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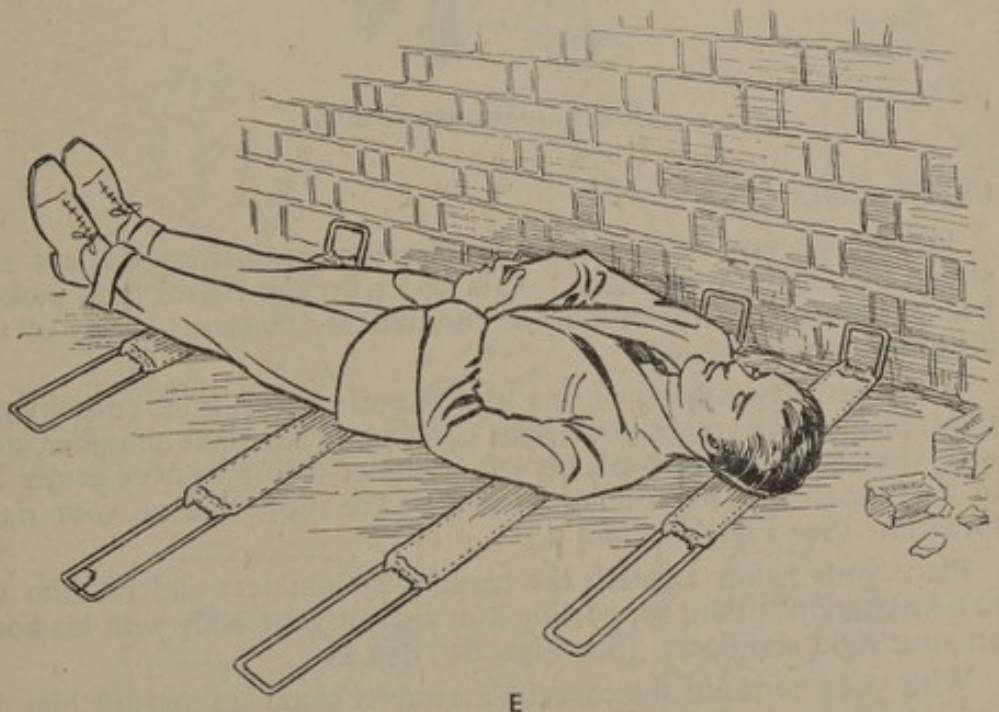

E

Fig. 62

A—Webbing Bands
B—Placing Under Casualty
C—Lifting Casualty
D—Webbing Bands as Applied near Wall—Placing Band under Casualty
E—Bands Correctly Placed for Lifting

(ii) *Human Crutch*

Where the casualty can help himself the rescuer stands at his injured side and places the casualty's arm round his shoulder grasping the wrist with his hand. At the same time he passes his other hand round the casualty's waist gripping his clothing at the hip, and thus assists him by acting as a crutch. (See Fig. 63.)

Fig. 63—Human Crutch

(iii) *Fireman's Lift*

This is one way of carrying a helpless or unconscious patient and allows the bearer a free hand. It is easier for the bearer than pick-a-back, but not so comfortable for the patient. Various stages of the lift are shown in Fig. 64.

If the casualty is lying on his back, kneel on one knee (usually the right) at his head, place your right hand upon his right shoulder, and with your left hand beneath his left shoulder turn him over gently on to his face so that his forehead and face are supported on your right forearm. (See Figs. 64A and B.)

Place your hands beneath the casualty's shoulders and lift him up to a kneeling position, supporting him against your body with his head on your right shoulder. (See Figs. 64C and D.)

With your hands in the casualty's armpits stand up and lift him on to his feet, pressing his body close to yours ; shift your hands from his armpits and clasp them together round his waist. (See Figs. 64E and F.)

Keep your right arm round the casualty's waist and grasp his right wrist with your left hand carrying the limb away from the body. Stoop and place your head beneath his right arm and hoist him up on to your right shoulder, still retaining hold of his right wrist with your left hand. Pass your right arm between the casualty's thighs and grip

his right wrist with your right hand at the same time remove your left hand which becomes free. (See Figs. 64G and H.)

Shift the weight of the casualty well on to the centre of your back and rise to the erect position. (See Fig. 64I.)

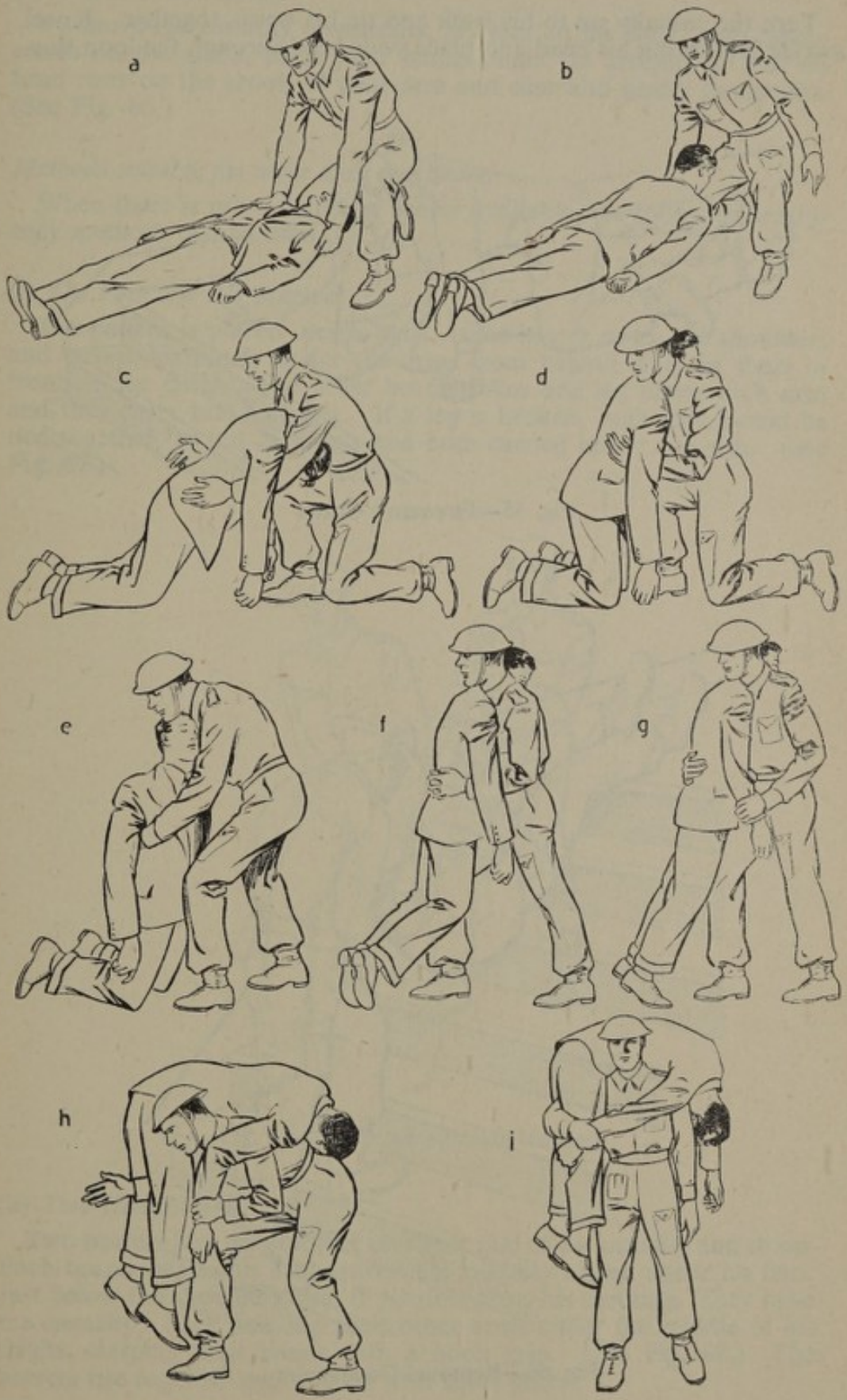

Fig. 64—Fireman's Lift

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(iv) *Fireman's Crawl*

If a rescuer finds an unconscious casualty, or one who is unable to help himself, or who is too heavy for one of the above three methods to be applied, the Fireman's Crawl can be used as follows:—

Turn the casualty on to his back and tie his wrists together. Kneel astride him facing his head and place your head through the loop thus

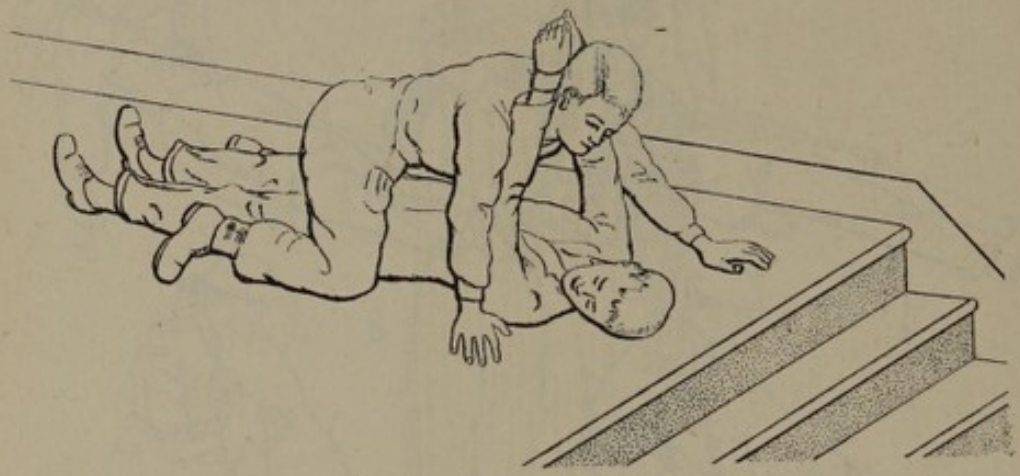

Fig. 65—Fireman's Crawl

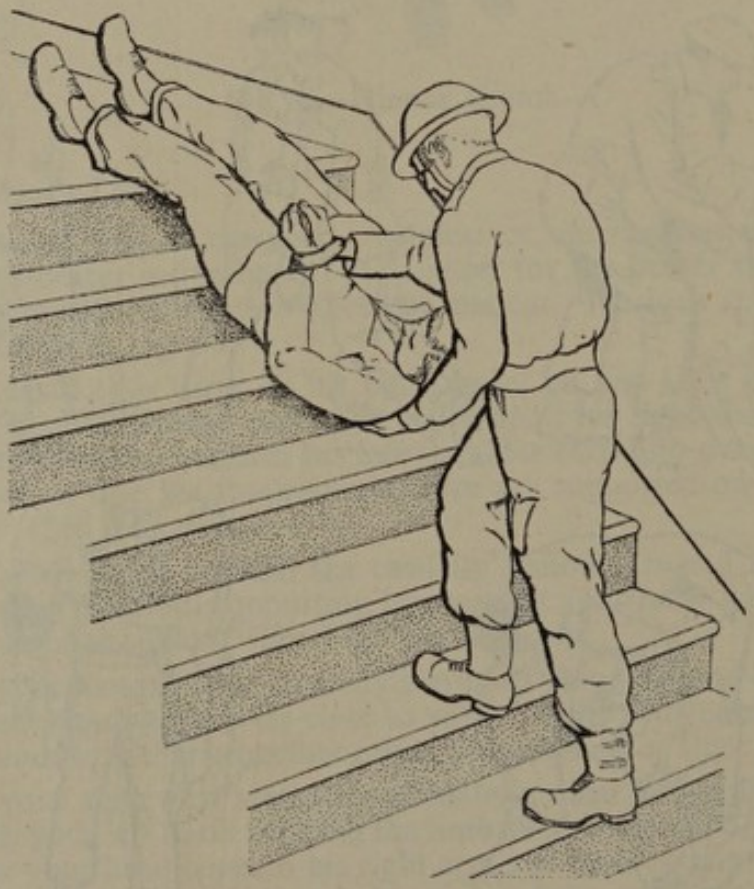

Fig. 66—Removal Downstairs

formed by his arms. By crawling on your hands and knees you can then drag him with you, even though he may be heavier than you are. (See Fig. 65.)

(v) *Removal Downstairs*

To move the casualty downstairs, lay him on his back, head downwards on the stairs, place your hands under his armpits so that his head rests on the crook of your arm and ease him gently downstairs. (See Fig. 66.)

Methods suitable for more than one Bearer

When there is more than one bearer available, the following emergency methods can be used :—

(i) *The Fore and Aft Method*

The patient is placed on his back. One bearer raises the shoulders and passes his hands under the arms from behind clasping them in front of the chest. The other bearer takes one leg under each arm and they carry him feet first. If a leg is broken, both legs should be tied together, or put in splints and both carried under one arm. (See Fig. 67.)

Fig. 67—The Fore and Aft Method

(ii) *Two-Handed Seat*

Two bearers face one another on either side of the casualty and stoop. Each bearer passes his arm nearest the casualty's head under his back just below the shoulders and, if possible grips his clothing. They raise the casualty's back and slip their other arms under the middle of his thighs, clasping their hands with a hook grip. (See Fig. 68.) The bearers rise together and step off with short paces.

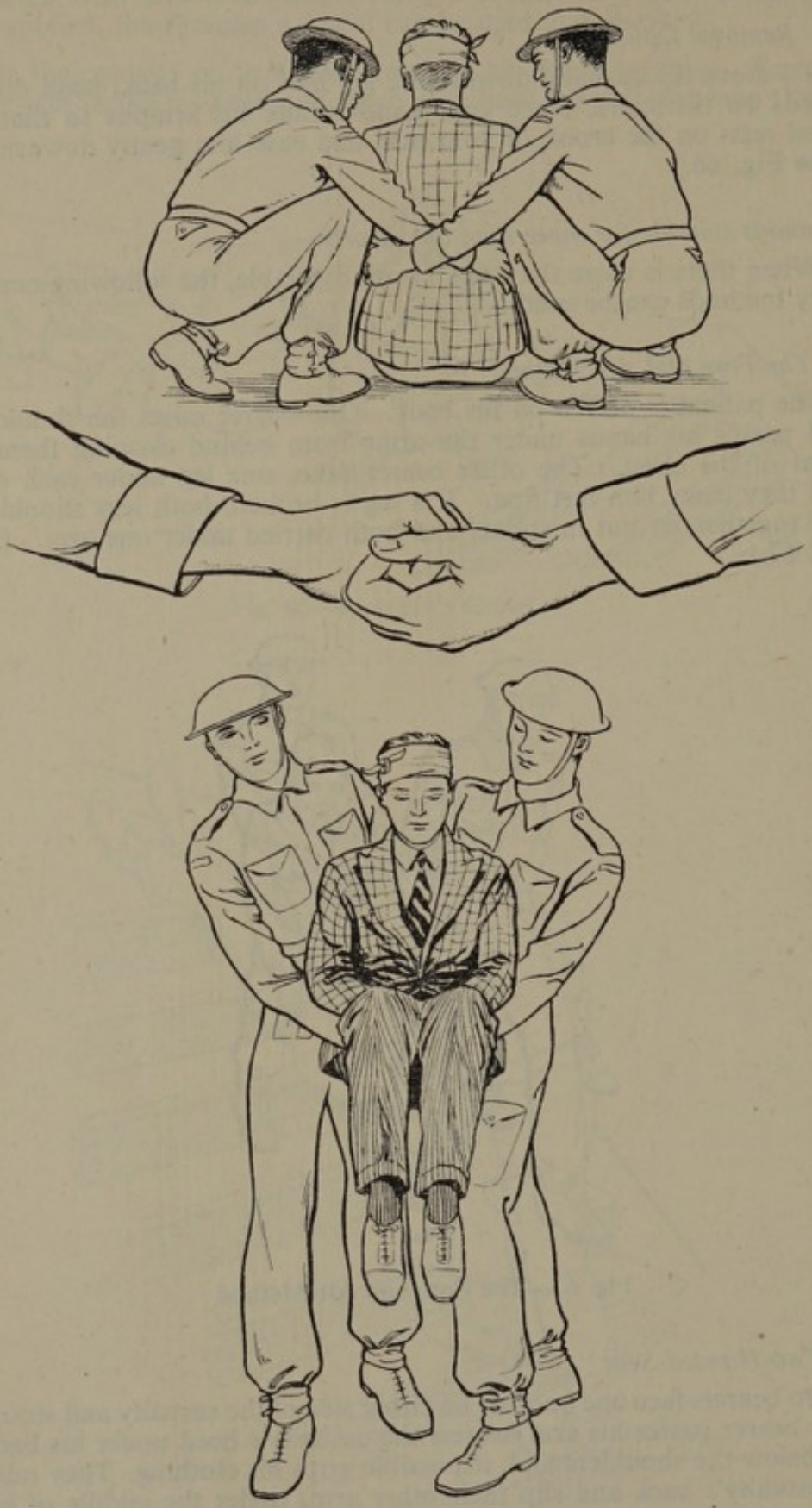

Fig. 68—Two-Handed Seat

(iii) *Four Handed Seat*

The bearers face each other and each grasp their own left wrist with their right hand. Their hands are then put together, the free left hand grasping the right wrist of the man opposite. The casualty puts one arm or both round the necks of the bearers. (See Fig. 69.)

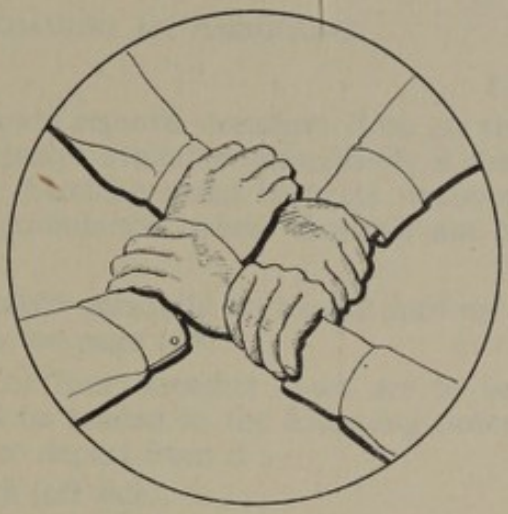

Fig. 69—Four-Handed Seat

CHAPTER XXII

TRANSPORT OF CASUALTIES FROM AN INCIDENT

Loading and Unloading an Ambulance

General Principles

(1) Personnel should remove stretchers from an ambulance so that an empty rack is always available immediately a casualty is brought to the ambulance. Stretchers and blankets removed will be placed at the side of the ambulance, where they will not be in the way of loading.

(2) Casualties should generally be loaded into an ambulance head first (for exceptions see page 124).

(3) When three or four stretcher cases are to be carried in one vehicle they should be loaded in the following order, unless there is any special reason to depart from it :—

(*a*) Upper berth (off side).
(*b*) Upper berth (near side).
(*c*) Lower berth (off side).
(*d*) Lower berth (near side).

Unloading will take place in the opposite order.

Loading with Four Bearers

(1) The stretcher is brought to the ambulance by four bearers (see Training in the use of Stretchers, Chapter XIX), and lowered to the ground one pace from and in line with the vehicle, the patient's head to the front.

(2) No. 1 bearer having satisfied himself that the ambulance is ready for loading will take up his position and give the command " Load ".

(3) All four bearers turn inwards, lift the stretcher together and, taking a side pace to the ambulance, raise the stretcher gently and evenly to the level of the berth to be loaded (for an upper berth the " shoulder carry " may be used).

(4) Nos. 1 and 2 bearers place the front runners of the stretcher on the tracks and then assist No. 3 and 4 bearers to slide the stretcher into its place.

(5) The ambulance attendant enters the ambulance to guide the stretcher and secure it in position.

Unloading with Four Bearers

(1) On the command " Unload " given by No. 1 bearer, the ambulance attendant unfastens the steadying straps of the stretcher. Nos. 3 and 4 bearers take hold of the rear handles of the stretcher and gently withdraw it, raising the handles slightly in doing so. Nos. 1 and 2 bearers take up their position on either side of the stretcher and close to the vehicle.

(2) As soon as the stretcher is sufficiently withdrawn, Nos. 1 and 2 bearers grasp the front handles and remove the stretcher from the ambulance.

(3) All four bearers, turning inwards, take the weight and holding the stretcher as before lower it to the full extent of the arms. They then move by side paces clear of the ambulance and on the command " Lower stretcher " lower the stretcher to the ground.

(4) All four bearers then take up their original position and await further instructions.

Loading an Ambulance with only Two Bearers

Two persons should not normally attempt to load or unload an ambulance. There is, however, an emergency method of loading stretchers into the lower berth of an ambulance when only two persons, usually the driver and attendant, are available. This is described below.

(1) The stretcher is placed at the rear of the ambulance in line with the lower berth selected for loading and with the head of the patient towards the ambulance.

(2) The patient is secured to the stretcher by means of two triangular bandages forming arm slings to prevent him from sliding when the stretcher is tilted during loading.

(3) The bearers A and B then take position at opposite sides of the head end of the stretcher and draw the handles forward until they rest on the floor of the ambulance.

The handles are again lifted and the foot of the stretcher drawn forwards until the ends of the handles rest against the tracks of the lower berth.

The patient is comfortably held in position on the stretcher by the arm slings referred to above.

(4) One of the bearers now moves to the foot of the stretcher sliding his hands along the side nearer to him to prevent it from slipping, the other remains at the head of the stretcher holding it in position.

(5) Bearer A at the foot of the stretcher now lifts that end and pushes it forward so that the handles slide along the tracks of the berth, guided by the bearer B at the head of the stretcher.

(6) This having been done, the bearer B joins his colleague A at the foot. Both now raise the foot of the stretcher above the level of the berth so that the weight of the stretcher is supported on the tips of the handles at the head end and the runners of the stretcher will slide easily on to the tracks. When the runners of the stretcher are engaged in the tracks the stretcher is brought level and pushed home slowly into position.

Unloading the Ambulance

(1) Arm slings are adjusted as shown in method for loading.

(2) The stretcher is drawn out until the runners of the stretcher at the head end are almost at the end of the tracks.

(3) The foot is now tilted upwards until the weight is supported by the handle ends at the head of the stretcher and then drawn slowly outwards until the runners of the stretcher have just cleared the ends of the tracks.

The stretcher is then lowered at the foot end until the rear handles rest on the ground while those at the head end remain against the ends of the tracks of the berth.

Bearer A on the side of the stretcher nearest the ambulance goes to the head of the stretcher and holds it securely ; bearer B takes up a position opposite to him.

(4) Bearer A now assists bearer B in lifting the head of the stretcher from the tracks and at the same time moves slowly backward, pivoting the foot end of the stretcher on the handle farthest away from him. When the head of the stretcher is clear of the rear of the ambulance, A and B gently lower it to the ground.

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CHAPTER XXIII

REMOVAL OF CASUALTIES AND DISPOSAL OF THE DEAD

Labelling of Casualties

It is not necessary for all casualties to be labelled, nor invariably for particulars of their names and addresses to be taken, but certain types of casualty, as mentioned below, as well as all unconscious casualties and all dead bodies should be labelled before being removed from the incident.

Tie-on casualty labels, with a symbol written on them, should be used; failing this a piece of paper attached to a button or pinned to the clothing will serve. If possible, the forehead of the casualty should also be marked with indelible pencil with the same symbol.

The symbols used for marking casualties and their interpretation are as follows :—

Symbol on label and/or forehead	*Interpretation*
X	Requires priority of removal from the incident and of examination when reaching hospital. This is used mainly, but not exclusively, for wounds of the chest and abdomen, for internal hæmorrhage, and for *all* unconscious casualties.
T	A tourniquet has been applied. The time of application of the tourniquet and subsequent releases should also be indicated on the label.
H	Severe hæmorrhage has occurred.
M	Morphine has been given. The time of administration and dose should be written on the label.
C	Contaminated or suspected of having been contaminated by PERSISTENT GAS.
XX	Poisoned by Nerve Gas or Non-Persistent Gases or suspected of having been so poisoned.
P	Burnt by Phosphorus.
R	Radioactivity.

Diagnosis of Death

In the absence of a doctor the Rescue Party Leader should take the responsibility of diagnosing death in clear cases, but where there exists any doubt as to whether life is extinct the advice of a doctor should be obtained on the spot.

If no doctor is available, to avoid delay the casualty should be sent direct to a hospital and not to a First Aid Post.

Collection of Bodies

When dead bodies are recovered they should be deposited in the nearest convenient building and some suitable covering placed over them, pending removal ; they should not be left on the highway or in an open space. The public and all persons not directly concerned should be kept away whilst bodies are being recovered.

Standard Casualty Label
Front Side

Strike out if not needed { UNCONSCIOUS CASUALTY / DEAD BODY } SYMBOL ON OTHER SIDE

ADDRESS WHERE FOUND.....

.....

POSITION IN BUILDING.....

TIME AND DATE WHEN FOUND.....

APPARENT CAUSE OF DEATH OR INJURY.....

NAME AND ADDRESS, OR OTHER AID TO IDENTIFICATION.....

.....

SIGNED ..... Leader or Deputy ..... Party

Reverse Side

DATE..... TIME.....

CRUSH INJURY
LIMB COMPRESSED for .....
(period if known)

SYMBOL

If MORPHINE has been given—
Time .....
Dose .....

LIMB RELEASED at.....
(time)
BAKING SODA, etc., given—
.....teaspoonfuls
TOTAL FLUID GIVEN BEFORE RELEASE
.....pints

If TOURNIQUET has been applied—
Time applied.....
Time Released .....
.....

SIGNED ..... Leader or Deputy .....Party

Labelling of Bodies

In addition to the details on the casualty label the following information should be given where possible.

1. If the body is contaminated by Blister Gas, or is suspected of being contaminated, the label should be clearly marked with a " C".
2. For those suspected to have died from the effects of poisoning by Nerve Gas or Non-Persistent Gases, the label should be clearly marked " XX ".
3. For those suspected to have died from Radioactive Effects the label should be clearly marked " R ".

Removal of Bodies

Recovered bodies should be removed to the mortuary as soon as possible, after labelling.

(S.23935) 3729/163 K160 12/50 K.H.K. Gp. 519.

CIVIL DEFENCE—FIRST AID MANUAL

Amendments No. 1

(Nos. 2-7 and No. 9 are included in the 1952 reprint of the Manual.)

1. Page iv Contents Chapter xv. *Amend* to read . . . Artificial Respiration—Holger Nielsen Method; Schæfer's Method; Silvester's Method.

2. Page 36 (ii). The Roller Bandage. *Insert* full stop after . . . " static first aid posts " in line 2 and *Delete* the remainder of the sentence.

3. Page 50. By Antiseptics. First sub-paragraph line 5. *Delete* sentence starting " Euflavine will be " . . . and remainder of sub-paragraph, i.e. to sentence ending . . . " of boiled water."

4. Page 82. (*b*) In the Stomach. Line 2 *Delete* (*e*) and *Insert* (*b*).

5. Page 142. *Delete* page and *Insert* new page attached hereto.

6. Page 158. *Delete* (iv) No. 9 Cream and all existing information, i.e. *from* " Towards the end " . . . to . . . " carried out later."

7. Page 159. *Delete* (*e*) Directions for the application of No. 9 Cream and all existing information, i.e. *from* "The Cream may". . . to . . . " reveal phosphorescence."

8. Pages 175-180. *Delete* and *Insert* new pages attached hereto.

9. Page 252. Standard Casualty label (Front side). *After* POSITION IN BUILDING . . . *insert* TIME AND DATE OF DEATH.

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Symptoms and Signs

(1) Severe pain over the front of the knee, made worse by any attempt at movement.

(2) Shock—usually worse when the bone is broken by direct violence.

(3) Marked tenderness and swelling over the knee-joint. Bruising occurs almost at once if the bone is broken by direct violence, somewhat later if by muscular action.

(4) If there is wide separation of the fragments, a space can sometimes be felt between them by gently placing a hand over the knee-cap before the joint becomes swollen ; a grating of the fragments together can occasionally be felt when there is no separation.

(5) When the bone is broken right across, the patient is quite unable to straighten the lower limb ; if there is no separation of the fragments he may be able to do so a little, but this causes great pain and increases muscular spasm.

(6) Blood and fluid collect rapidly within the joint which becomes very swollen.

(7) There may be a wound if the fracture has been caused by direct violence.

First Aid Treatment

A mechanical splint *must always be applied* behind the injured knee to prevent it from bending and, to relax the muscles on the front of the thigh. If this is not done and the knee is bent, possibly while the patient is being moved, spasm of the muscles will increase, the gap between the pieces of broken bone will widen, and if there is not already a gap the bending is likely to cause one.

(1) Prop the patient up in a semi-sitting position and support the head and shoulders on pillows or folded blankets in order to relax the muscles on the front of the thigh. At the same time an assistant will gently straighten and raise the limb, placing a blanket pad or clothing beneath the lower part of the leg so that the heel is about 12 inches off the ground. This will further relax the thigh muscles. Dress any wound which may be present.

(2) Place a padded flat splint, as wide as the patient's knee, along the back of the limb, extending from the upper part of the thigh to just beyond the heel. Fasten this to the limb by three narrow-fold triangular bandages :—

(i) Twice round the splint and upper part of the thigh and tied off in front ;

(ii) A double figure-of-eight round the splint, foot and ankle ;

(iii) The centre of a bandage is laid just above the knee-cap, its ends carried to the back and crossed over on the splint, then brought forward and tied below the knee-cap. This bandage should be applied firmly so as to draw the fragments of the broken bone together as much as possible.

(3) Treat for Shock.

(4) The patient should be kept in the semi-sitting position with his leg raised whilst being carried on a stretcher and in the ambulance. Care must be taken that the limb is not moved by jolting or when going round corners. (See Fig. 49.)

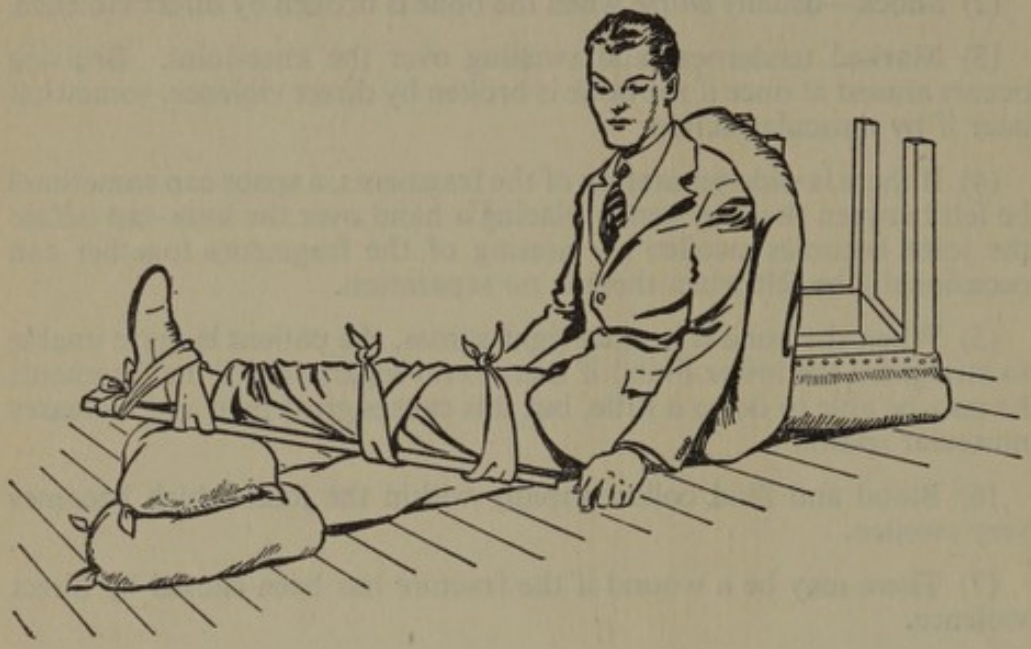


Fig. 49—Treatment of Broken Knee-Cap by Back Splint and Raising of Limb

(*b*) *Crushing by Debris, Furniture, etc.*

When breathing is obstructed by debris, furniture, beams, etc., pressing on a person's chest, they must be removed as soon as possible and artificial respiration started on the spot if the casualty has stopped breathing.

(*c*) *Electric Shock*

Contact with an electric circuit may produce very severe burns and shock, in addition to causing a casualty to stop breathing. He will probably be unable to free himself owing to the current depriving him of all power of movement, so he must be removed at once or the current cut off. His rescuer *must*, however, protect himself before he touches the patient, otherwise he will also become a casualty.

(i) He must stand on a substance which does not allow a current to pass through it ; this is known as a non-conductor. Amongst such easily available substances are a piece of wood, straw, a brick, a piece of linoleum, a rubber mat or rubber-soled shoes, a sheet of glass or china plate. Whatever substance is used, *it must be dry*, since even a trace of moisture will conduct electricity.

(ii) The hands of the rescuer must be protected from the injured person and from the current by covering them with such things as dry clothing, an india-rubber tobacco pouch, a rubber hot water bottle, a pair of rubber gloves or a thick bundle of dry newspaper. The patient may be dragged away from the electric contact by means of a dry loop of rope, a dry bandage, or a dry walking stick with a crooked handle, *not on any account* an umbrella, as this contains metal ribs and *all metals are conductors of electricity*.

Artificial respiration, if necessary, must be started as soon as the sufferer has been freed ; burns are treated in the same way as ordinary burns.

(*d*) *Choking*

The patient's mouth should be opened and a forefinger passed down the throat as far as possible to clear out any obstacle whether it be a dental plate, dust, mud or debris which is lodged there. Children, and in some cases adults, may be held by the legs head downward and thumped between the shoulder blades. To prevent the tongue of an unconscious person from falling back into his throat and choking him, he should be laid on his face, if practicable, and his head turned to one side. If it is necessary to keep him lying on his back, his head should be turned to one side and the lower jaw pressed upward and forward by a forefinger and thumb placed beneath it. Instead of this the tongue may be pulled forward and grasped by a first-aid worker with a forefinger and thumb covered with a piece of material to prevent it from slipping.

ARTIFICIAL RESPIRATION

This, as its name implies, is a means of restoring natural breathing, when it has ceased, by reproducing the normal movements of expiration and inspiration, and is carried out by squeezing air out of the lungs and then allowing the atmospheric pressure to fill them up again ; in the Holger Nielsen and Silvester method this filling is aided by a positive expansion of the chest.

Of the many methods which have been devised it will suffice to describe three here, of which the first is the method of choice. Both the Holger Nielsen and the Schæfer method have the advantages that they can be carried out by one person, need no equipment other than the operator's hands and can be begun without delay. The patient lies face downwards, a position which facilitates the drainage of water and other fluids from his mouth ; this is particularly valuable in treatment of the apparently drowned.

(*a*) *Holger Nielsen Method.*

Experiments have shown that this method provides a more efficient ventilation of the lungs than others. It can be carried out for long periods without fatigue.

Instructions to Operator. (Reproduced by kind permission of the Royal Life Saving Society.)

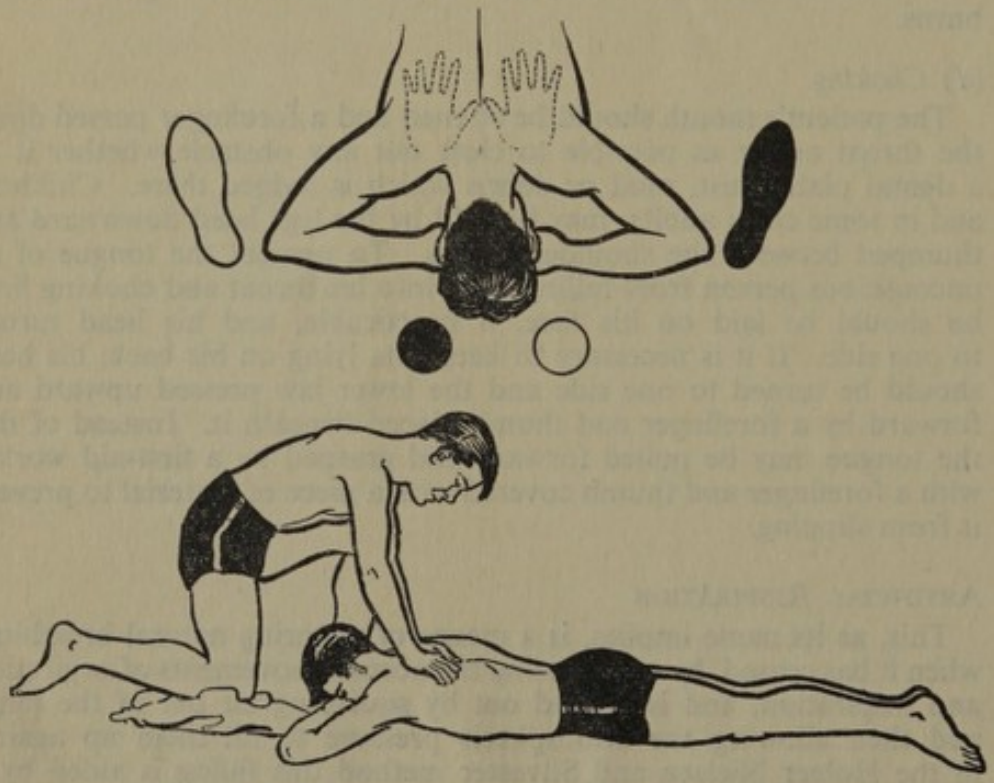
(1) Begin immediately, every second counts.

(2) Place the patient face-downwards, with forehead resting on hands placed one over the other. The mouth and nose must be kept free of the ground.

(3) Bring the patient's tongue forward by firm blows between the shoulders with the flat of the hand.

(4) Kneel on one knee a little in front of and to the side of the patient's head, with the other heel at the side of the patient's elbow. The operator's mid-line should then be in the same line as the patient's and his extended arms should slope obliquely forward so that his hands lie on the patient's shoulder blades and his wrists over the spines of the shoulder blades.

This is the starting position (See Figs. 53A and 53B).



Figs. 53A and 53B

(5) Rock forward on the outstretched arms until they are vertical. The pressure should be light, without force—about 22-30 lbs. is sufficient. This induces expiration (Fig. 53C), approximately 2½ seconds.

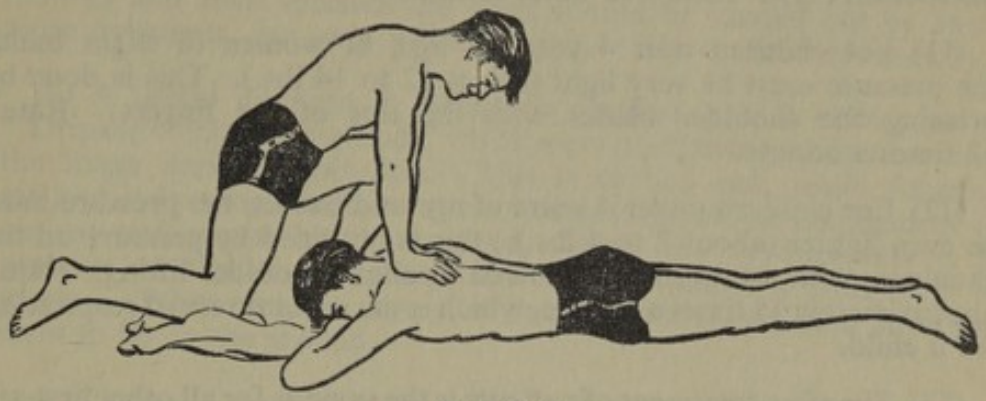


Fig. 53C

(6) Let the hands slide down the patient's arms to the elbows (approximately 1 second), then raise his arms and shoulders slightly pulling at the same time by swinging backwards. This induces inspiration (Fig. 53D), approximately 2½ seconds.

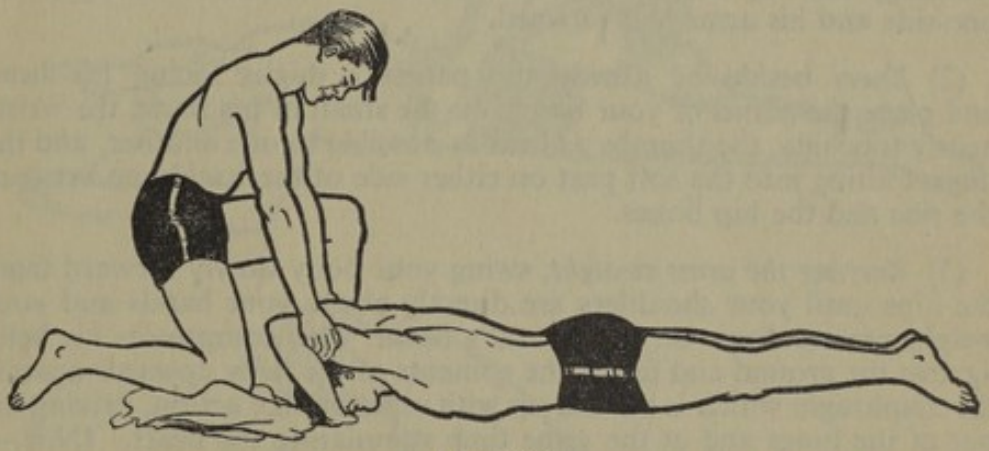


Fig. 53D

(7) Lower the patient's arms and return the hands to the shoulder blades, ready to resume pressure—in all approximately 1 second.

(8) Repeat the movements described in instructions (5), (6) and (7), taking about 7 seconds in all. This gives about 9 complete respirations a minute, counting from 1 to 8, or: 1-2-3- change, 5-6-7- change. If the patient shows no sign of revival, continue for 5 to 6 hours, until unmistakable signs of death appear or until a doctor has certified the patient to be dead.

(9) In cases where the thorax is injured, pressure is omitted and raising and lowering of the arms is performed the whole time.

(10) If there is injury to the arms only, the patient's shoulders are lifted after the pressure movement; but if there is injury to the chest or back the pressure movement is omitted and raising and lowering of the shoulders alone is used; the rate for this is about 12 to the

minute. If the patient's shoulder is dislocated the raising should be done at the armpits. If necessary, the patient's arms can be extended outwards or downwards along his sides, as for very small children (see instruction (11)). Rate : 12 times a minute.

(11) For children over 4 years of age, or women of slight build, the pressure must be very light (about 12 to 14 lbs.). This is done by pressing the shoulder blades with the tips of the fingers. Rate : 12 times a minute.

(12) For children under 4 years of age and babies, the pressure must be even lighter (about 2 to 4 lbs.) ; this is obtained by pressure on the shoulders with the thumbs, followed by slight shoulder lifting. Rate : approximately 15 times a minute, which is the natural rate of respiration for a child.

(13) The after-treatment of patients is the same as for all other first-aid methods of resuscitation.

(*b*) *Schæfer's Method*

Instructions to Operator

(1) *Make certain that the air passages are free*, loosen all tight clothing, then lay the patient face downward with his head turned to one side and his arms laid forward.

(2) *Kneel* beside or astride the patient's thighs facing his head and place the palms of your hands on the small of his back, the wrists nearly touching, the thumbs as near as possible to one another, and the fingers fitting into the soft part on either side of the backbone between the ribs and the hip bones.

(3) *Keeping the arms straight*, swing your body slowly forward from the hips until your shoulders are directly above your hands and your weight presses down on the patient's back. This compresses his belly against the ground and forces the contents of the belly upwards against the diaphragm which is pushed up with a piston-like action, driving air out of the lungs and at the same time stimulating the heart. (N.B.—Do not press too hard ; remember that an unconscious person's muscles do not resist as they do in a conscious person, so heavy pressure may rupture the liver, or even break one or more ribs.) As soon as you swing forward count slowly, one, two (or to obtain the correct timing of seconds " twenty-one " " twenty-two "), then :—

(4) *Without removing the hands*, swing your body slowly backward to its original position, thus relaxing the pressure on the back. The contents of the belly now fall back into their normal position, the diaphragm descends and air re-enters the lungs. During this part of the operation count slowly, one, two, three (or " twenty-one," " twenty-two," " twenty-three ").

(5) Repeat this forward and backward movement 12 times a minute, without any marked pause (two seconds for pressure, three seconds for relaxation). (See Fig. 54.)

(6) *When natural breathing reappears*, regulate the movements to correspond with it.

(7) *While artificial respiration is in progress*, and without interfering with it in any way, it is important that the circulation should be restored and maintained by means of blankets and hot water bottles. Rubbing the legs and arms towards the heart should be carried out by one or more assistants, *but only when the patient shows signs of recovery*.

(8) A useful addition to Schæfer's method is that known as the " Drinker combined method " which aims at allowing more air to enter the lungs during inspiration. This is carried out, while Schæfer's method is in progress, by an assistant who kneels at the head of the patient and grasps his upper arms. When the operator relaxes his pressure on the loins, this assistant lifts the patient's arms from the ground. When pressure is applied to the loins the assistant allows the arms to lie on the ground.

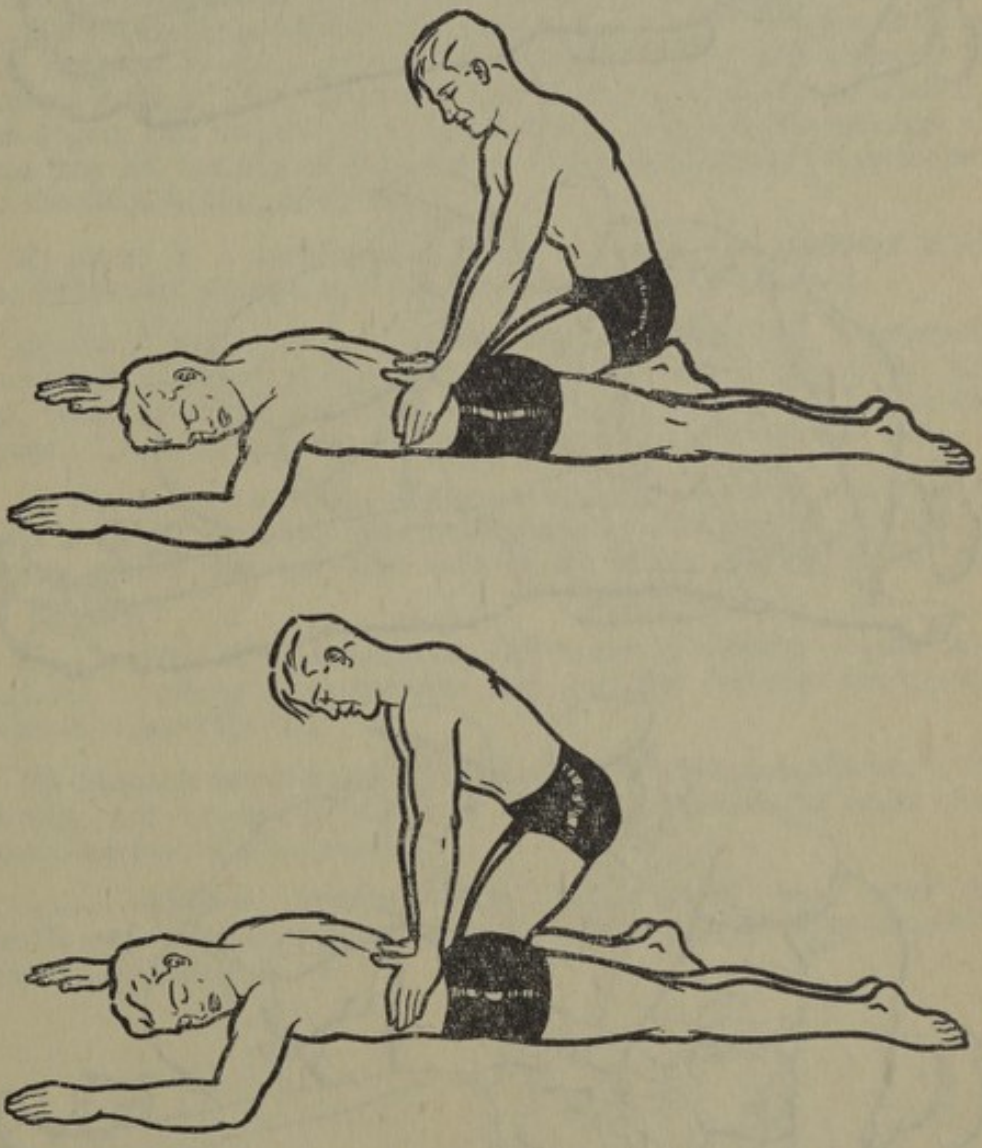


Fig. 54—Schæfer's Method of Artificial Respiration

Caution

Schæfer's method must not be used where there is a severe injury, possibly a fractured backbone or an injury to the abdomen. In such cases Silvester's method described below must be used.

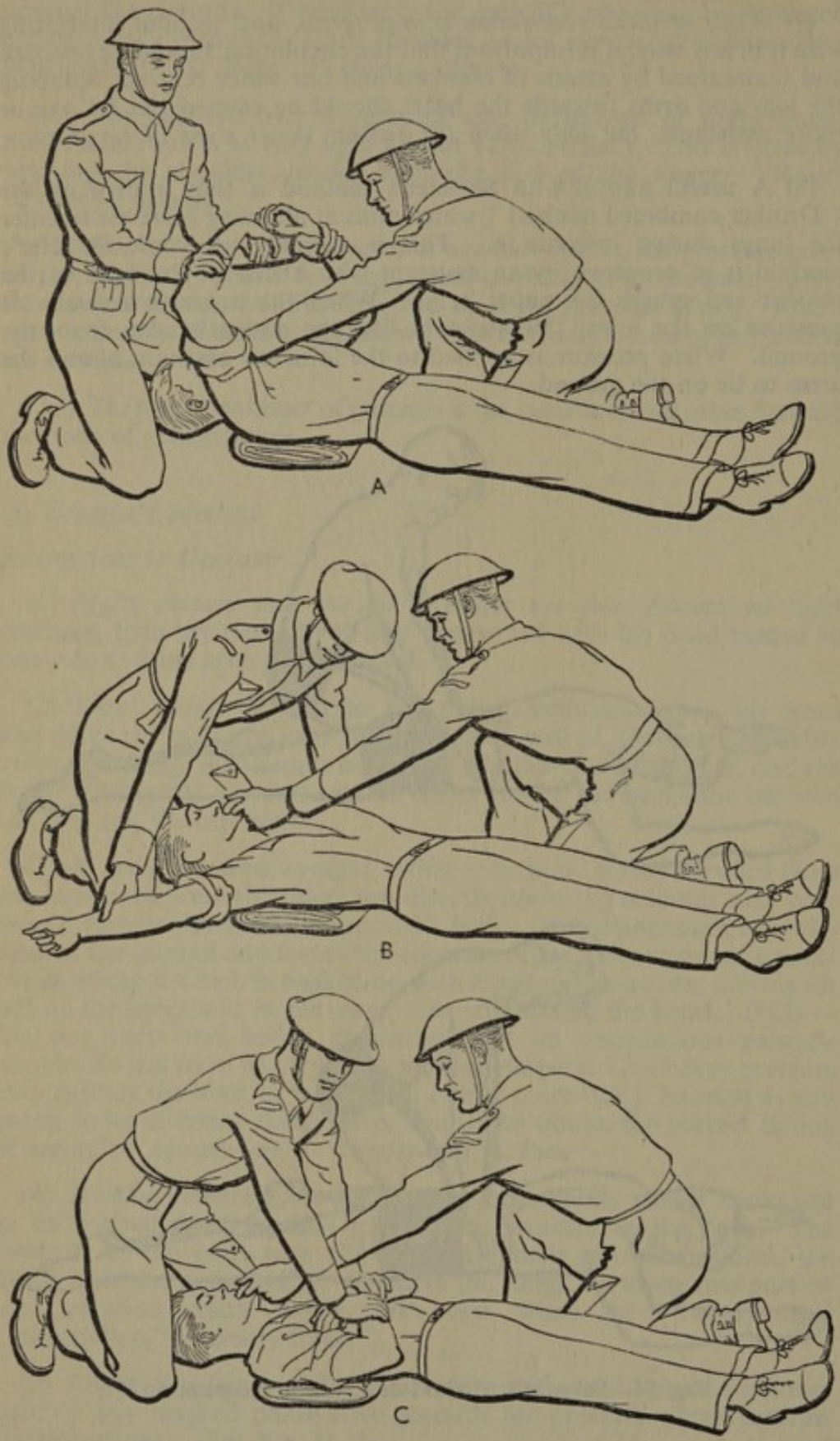


Fig. 55—Silvester's Method of Artificial Respiration

A—Inspiration
B—Inspiration
C—Expiration

(*c*) *Silvester's Method*

This method is used for patients who cannot be placed face downward (e.g., on account of a wound on the front of the body). It cannot be employed when the ribs or arms are injured.

At least two persons are necessary to carry out this method, one to perform the artificial respiration and one to hold the tongue forward, as the patient is placed lying on his back. It is more tiring for the operator than the two methods described above and frequent reliefs of operators may be required.

Instructions to Operator

(1) *Clear the nose and mouth* of the patient of any obstruction and place him on his back upon a flat surface, with a folded blanket or a bundle of clothing beneath his shoulders. Undo all tight clothing. The assistant must catch hold of and draw the tongue forwards to prevent it from falling backwards and blocking the windpipe, covering his fingers and thumb with a handkerchief or triangular bandage so that they will not slip off the tongue. If a second assistant is available, he should hold the patient's feet.

(2) *Kneel* in a comfortable position behind the patient's head, facing his feet, and grasp his forearms just below the elbows.

(3) Draw the forearms upwards and outwards with a sweeping movement over and above the head towards you, as far as they will go, until the elbows touch the ground. This allows air to enter the lungs. Count slowly, twenty-one, twenty-two, twenty-three ; then :—

(4) *Carry* the bent arms slowly forwards, downwards, and inwards with a similar sweeping movement, pressing the forearms and elbows firmly against the front and sides of the chest. This drives air out of the lungs.

(5) Continue these movements alternately 12 times a minute until natural breathing recommences, then regulate them to correspond with it. (See Fig. 55.)

(6) Promote warmth and circulation by warm blankets and hot water bottles, and by rubbing the limbs vigorously towards the heart *when breathing has re-commenced.*

Caution.—Artificial respiration by any method *must never* be performed on persons poisoned by lung irritant gases, or on casualties caused by blast.

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