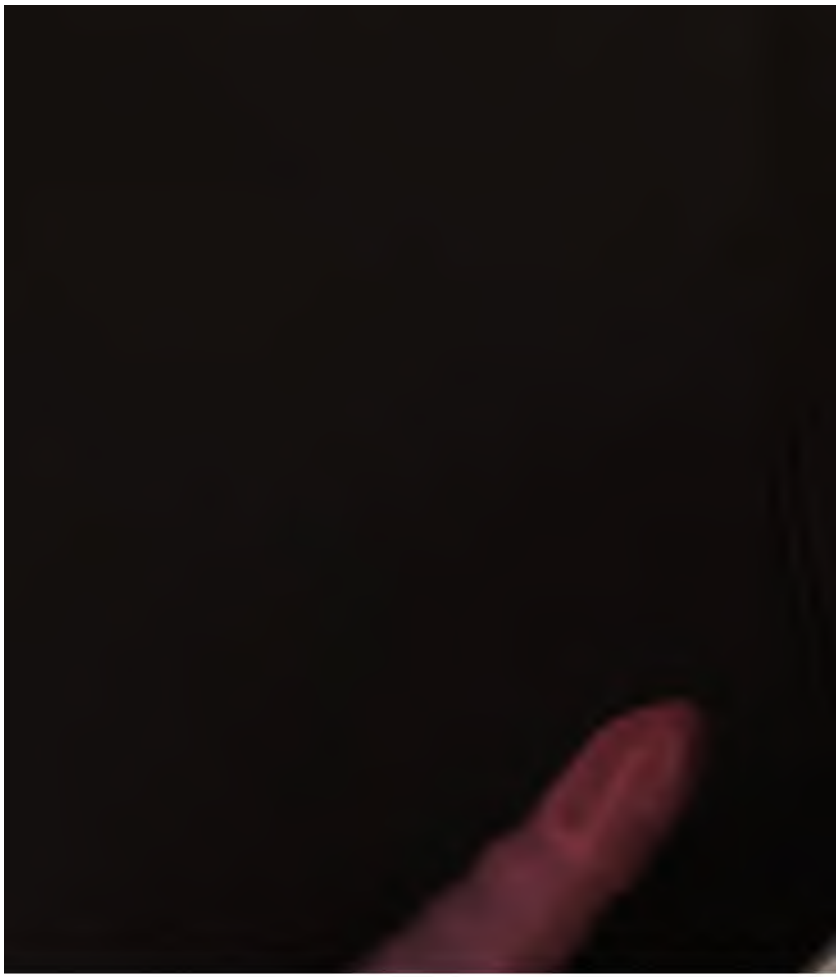
AMBULANCE WORK

R. LAWTON ROBERTS, M.D.



ILLUSTRATED LECTURES

ON

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BY

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ETC.

London

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TO

SAMUEL NOBLE BRUCE, Esq., M.R.C.S.,

THIS LITTLE BOOK IS DEDICATED

AS A TRIBUTE OF LONG PERSONAL FRIENDSHIP,

AND IN REMEMBRANCE OF MANY VALUABLE SERVICES AND

MUCH KINDNESS RECEIVED,

BY

THE AUTHOR.

PREFACE.

THESE lectures were originally delivered to ambulance classes held in connection with the Wynnstay Colliery, the New British Ironworks, and the Plaskynaston Colliery.

The members of these classes consisted chiefly of colliers, furnace-men, fitters, carpenters, blacksmiths, puddlers, brickmakers, and other representatives of the working portion of the population ; and, like their brother workmen in other parts of Britain, they showed great eagerness and displayed remarkable aptitude in the pursuit of their ambulance studies.

It is with pleasure, therefore, that—in compliance with the request of several of my enthusiastic (and, I may add, uniformly successful) pupils—I have written out my lectures for publication ; and, with the view of rendering them more interesting and intelligible, I have endeavoured to provide suitable diagrams illustrative of some of the more important points.

I have been fortunate enough to obtain (with the permission of Messrs. Sampson Low and Co.) the use of, amongst other illustrations, twenty-six admirable woodcuts—showing the methods of applying the triangular bandage, arresting hæmorrhage, and giving first aid in cases of fracture—from Professor Esmarch's [1] celebrated work on *The Treatment of Wounded in War.*

The rules given, in the fifth lecture, for the safe conveyance of the sick and injured on stretchers; the methods of making two-handed, three-handed, and four-handed seats; and (with few exceptions) the plans for giving assistance by means of only one helper, are those laid down by Deputy Inspector-General T. Longmore, C.B., in his exhaustive *Treatise on the Transport of Sick and Wounded Troops.*

The four stretcher exercises or drills detailed in the final lecture are those arranged and advocated by the St. John Ambulance Association: and I am much indebted to Mr. John Furley, of the Ambulance Association; to the Manager of the Lowmoor Ironworks; and particularly to Mr. S. C. Wardell, of the Babbington Coal Company, for special information relative to wheeled stretchers, the Lowmoor Jacket, and the Tibshelf Ambulance Tram.

[1] Professor of Surgery to the University of Kiel, and Surgeon-General to the Prussian Army.

The lectures embrace all the points laid down in the Syllabus of Instruction issued by the St. John Ambulance Association, and I trust that, with the additional information now contained in them, and with the aid of the diagrams accompanying them, they may prove useful, not only to my old friends connected with the neighbouring large works, but also to many others who are anxious to do what they can in alleviating the sufferings and (when possible by giving *immediate* help) saving the lives of their fellow-creatures; to those who are exposed to continual danger in the routine of their daily employment; to the members of the Volunteer Force, of which until recently I was a commissioned officer; and to the other branches of the Auxiliary Forces.

R. LAWTON ROBERTS, M.D.

RUABON, NORTH WALES,
May 1885.

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AMBULANCE LECTURES.

LECTURE I.[1]

The St. John Ambulance Association—Its origin, objects, and progress —A general description of the structure and functions of the human body—The Triangular Bandage—First dressing of wounds.

THE course of five Lectures which I commence this evening is given on behalf of the St. John Ambulance Association; and first of all, I must tell you a little about the Association itself—its origin, objects, progress, and manner of working. The Association was established in the year 1877, and it was formed for the purpose of spreading sufficient instruction among people of all classes of society, to enable them to give *immediate* help in cases of injury or sudden seizures of illness.

In the presence of some great catastrophe, such as a terrible railway accident, a violent explosion, a large fire, or other misfortune that results in the maiming and wounding of our fellow-creatures, all are naturally eager to render help to the sufferers. Every one, indeed, is prompted by the ordinary feelings of humanity to give what assistance he can in such emergencies; but too often those who are present

[1] In these Lectures I have as far as possible avoided the use of hard and puzzling terms, as being unsuitable for my purpose, as well as confusing and unintelligible to my listeners; but I have, in connection with Figs. 1, 3, 4, and 5, given, *simply for the sake of reference*, the technical names of some of the more important structures of the body.

at the scene of an accident are unable to bestow any help on account of pure ignorance—they do not know *how* to give aid. Others again there are who, more confident in their own powers, but equally uninformed, try boldly to render assistance, and consequently, from their want of skill and careless or rough handling, cause increased suffering to those injured, and may even jeopardise their lives. Now the object of the St. John Ambulance Association is to do away with this lamentable and often fatal ignorance, and to show all who will accept of their teaching how they may best render help to those injured or taken suddenly ill *until medical assistance arrives.*

The aims of the Association appeal so powerfully to our best feelings, and are, from whatever aspect we regard them, of such supreme and vital importance that the enthusiasm with which they have been supported by the people of this nation, and the eagerness with which they have been imitated by the inhabitants of foreign countries, since the establishment of the Association in 1877, can scarcely be wondered at. During the few years the Association has existed as many as 70,000 people have received its certificates of successful instruction; and the movement has extended to Gibraltar, Malta, Australia, New Zealand, Canada, and the East and West Indies. The great German surgeon—Esmarch—was so impressed, when staying in this country, by the good work done by the ambulance classes of the Association, that on his return to Germany he instituted similar classes under the title of Samaritan Schools. In the same way the system of our Association is imitated in Russia. Dr. Karl Reyher, of St. Petersburg, delivers courses of five ambulance lectures to classes of from twenty to twenty-five men, and has had the *Aid-Mémoire* and the *Handbook* (written by Surgeon-Major Shepherd) of our Association translated into the Russian language for pur-

poses of instruction.[1] In the United States, too, ambulance work has been commenced on the same plan as that adopted in this country.

Bear in mind that the Association is not represented by any one class of society, neither is it the offspring of any one political party, nor the work of any one religious denomination or sect. People of all ranks, from members of the Royal Family[2] down to the most humble workmen, are among its pupils. Men holding the most different political opinions are all alike among its supporters; and churchmen, nonconformists—persons indeed of every religious denomination—alike approve of its work and encourage its progress. The Association also enjoys the highest approval and the most cordial co-operation of the entire medical profession: for when engaged in ambulance work you are rendering immediate help before it is possible for a medical man to arrive; you are not "doctoring" at all, but merely giving such assistance (often of the highest value) as is possible by due attention to the common sense rules taught you by the Association. "When I look back on my career as a surgeon," writes Professor Esmarch,[3] "I can with truth say that many and many are the times I have deplored that so very few people know how to render first aid to those who have suddenly met with some injury. This specially applies to the field of battle: of the thousands who have flocked thither in their desire to help, so few have understood how to render aid. But my remark equally applies to the circumstances of daily life. How many there are every year who die a miserable death, and who might have been

[1] "The Red Cross Society and Ambulance Work in Russia," Captain Dalton, *Brit. Med. Journal*, Dec. 2, 1882.

[2] The Princess Christian holds both the Preliminary and Nursing Certificates, having passed the required examinations.

[3] *First Aid to the Injured*, Esmarch. Translated from the German by H. R. H. Princess Christian.

saved by prompt aid, had any one been near who knew how to give it. It is a terrible position to stand beside some accident, to see the red blood pouring unceasingly from the wound, to see death every moment approaching nearer and nearer, and not know how to avert the evil. The desire to help a fellow-creature when injured exists in most of us, but people shrink from giving aid because they do not know how to do so, and are afraid of doing more harm than good." These words represent the general experience of the whole medical profession. Esmarch refers to cases where you may save life by stopping bleeding; but there are many other ways in which an ambulance pupil can give valuable help. Thus, if a limb is broken, you may, by the proper use of temporary bandages and splints, fix and steady the injured arm or leg so as to prevent the broken ends of the bone from piercing the flesh and skin during the removal of the patient; and by so doing you certainly lessen his pain and shorten the duration of his illness, and in many cases you are even the means of saving either his limb or his life. Again, when a person is pulled out of the water apparently dead from drowning, you may, by vigorous and persevering efforts to restore natural breathing, not unfrequently have the satisfaction of bringing about his complete recovery. You may also give valuable and immediate help in cases of burns, scalds, the bites of mad or venomous animals, and in sudden and unexpected seizures of illness, such as fits, fainting, and "strokes"; you may act promptly and efficiently in accidental or suicidal poisoning, in cases of suffocation from poisonous gases; and last, but not least, you may be enabled, after receiving proper instruction, to convey the sick and injured to their homes or the nearest hospital without increasing their pains or aggravating their injuries.

I have told you what medical men think about the Ambulance Association: but you have only to consider

the events of everyday life, and the risks attending the various occupations by which men earn their daily bread, in order to understand for yourselves the necessity that exists for every one to be able to give aid in cases of serious injury or sudden and alarming illness. In military campaigns enormous numbers of sick and wounded troops are constantly demanding immediate attention and proper conveyance from the scene of action to places where they will be subjected to skilled treatment; and it is perfectly impossible for the medical men present to give succour to all requiring it, when there are perhaps several thousands requiring their services at the same instant. Turning to civil life, it is stated that in one year alone 1121 persons were killed and 4601 injured by accidents on the different railways of the United Kingdom, and that about 3000 people are drowned annually in our rivers, lakes, canals, and other inland waters alone—that is, not counting similar losses at the seaside and the mouths of rivers.[1]

But I need not dwell longer on statistics. You have only to consider your own experiences. There are some among you who work in coal-pits, and others in brickworks, ironworks, and chemical works; and you know how, in spite of the utmost care, accidents will every now and then occur. One man gets burnt, it may be by hot metal, an explosion of gas, or some powerful chemical agent, as oil of vitriol or carbolic acid; another gets scalded by hot water or steam; another falls suffocated by some poisonous gas; and another gets badly hurt, a large blood-vessel being opened, perhaps, or a bone factured. You know also that it is impossible always to obtain *at once* skilled assistance in cases of emergency. A medical man in active practice is a very busy and hard-worked individual, and he can seldom be got hold of at a minute's notice. I say that you are,

[1] Reference No. 50, St. John Ambulance Association, Feb. 1884.

from your own experience, perfectly aware of all this, and therefore you are in a position to appreciate fully the desirability of becoming acquainted with the readiest methods of giving *immediate* help to a suffering comrade until the arrival of your doctor; and also of carrying him, if necessary, to his home or the nearest hospital in such a way that his suffering will not be rendered more acute nor his injury aggravated by the process of removal.

You have received from the Ambulance Association a number of triangular bandages, wooden splints, one or two elastic bands called tourniquets, and a very convenient stretcher. These articles will prove of the greatest possible service for purposes of instruction during the lectures, for practice when you meet together to go over what you have heard in the lectures, and also for use in any actual cases of emergency; but still you must not get in the way of depending solely upon them. One never knows when an accident is about to take place; and it will probably happen that when you want to give aid to an injured comrade you will have neither triangular bandages, splints, tourniquets nor stretcher at hand for use. So you must always be prepared, if necessary, to improvise these articles—to use, for example, scarfs, handkerchiefs, or straps of any kind, for bandages; folded newspapers, cardboard, rolls of straw, sticks, or pieces of wood, for splints; a shutter, a door, a flour sack with two poles fastened to it one on each side, for a stretcher; in fact, you must always be on the alert, in an emergency, to utilise any materials that are at hand and suitable, including your own garments as well as those of the patients, for the purpose of making temporary bandages, splints, or whatever other form of appliance you may require. You will be unable, however, to use these different articles, such as bandages, tourniquets, etc., with any good effect, and, indeed, you will altogether fail to understand the methods

of giving first aid, unless you are acquainted in a general way with the formation of the body. I will therefore now endeavour to give you a very brief description of the structure and functions of the human body.

The Human Body may be looked upon as a complicated and beautifully-constructed piece of machinery. Like other machines, it has its props and supports, its joints, its levers, its pipes and conduits, and its valves. It is provided with a powerful pumping apparatus—the heart, and is supplied with a number of whitish strings or cords—the nerves, which pass from one part to another and act as telegraph wires. As other machines are supplied with fuel and water, so the human machine derives sustenance from food that is swallowed and wholesome air that is breathed; and as other machines get rid of their ashes, so the body throws off its waste materials by means of its organs of excretion.

The Bones (Fig. 1).

These form the props, supports, stays, and levers of the body. They vary much in shape and size, according to the particular purpose for which each is adapted, and are fastened or *jointed* together so as to make one powerful framework—the *skeleton*, about which the remaining and softer parts of the body are arranged and securely fixed. The skeleton or bony framework of the body therefore serves to support or carry the flesh, arteries, nerves, and other soft tissues; and in addition, the different bones serve various purposes, according to their situation. Thus, some are firmly united together in such a way as to enclose and protect from external violence certain delicate and all-important organs; for example, the bones of the skull form a strong case in which the brain is securely placed; the bones of the pelvis join to make a powerful and deep ring of bone

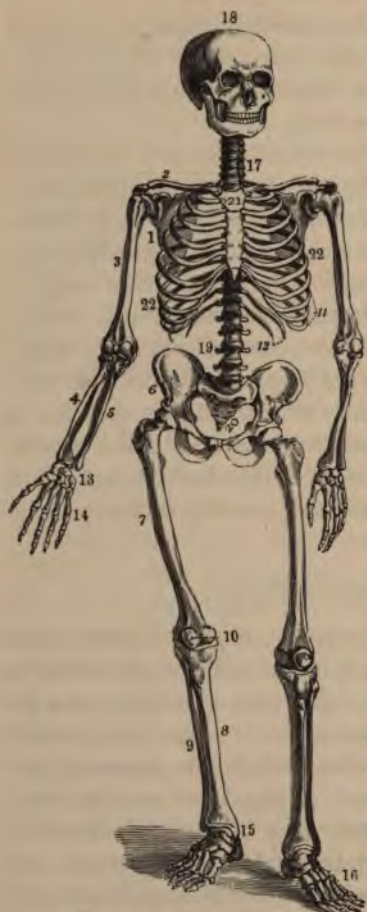

Fig. 1.—THE SKELETON.

which surrounds and shelters the bladder and other vital parts; the numerous bones composing the spine are so arranged one above the other as to lodge and give protection to the spinal cord; and the breast-bone, ribs, and a portion of the spine are connected together in such a beautiful manner that they encircle and guard the lungs and heart at the same time that the movements of breathing are regularly continued.

Other bones, again, act as pillars of support: for instance, the various bony fragments or *vertebræ* of which the spine is built up go to form the chief pillar of support of the body; the thigh bones and the bones of the legs also serve as powerful pillars of support, which sustain the weight of the body in

Head, 18; spine or back-bone, 17, 19; chest, 22, 22; sternum or breast-bone, 21; pelvis or haunch, 6; sacrum or rump-bone, 20; scapula or blade-bone, 1; clavicle or collar-bone, 2; humerus or arm-bone, 3; radius or outer fore-arm bone, 4; ulna or inner fore-arm bone, 5; carpus or wrist, 13; metacarpus or hand proper, 14; femur or thigh-bone, 7; patella or knee-cap, 10; tibia or shin-bone, 8; fibula or splint-bone, 9; tarsus or heel and instep, 15; metatarsus or foot proper, 16.

the erect position. Some bones also serve as levers, such as the long bones of the upper and lower limbs, by means of which (when the muscles act on them) the position of the body is altered, weights are lifted, or other movements executed. Just as the bones vary in shape and size according to the work they have to perform, so the way in which they are fastened, coupled, or *jointed* together differs in different parts of the body. Thus, the bones of the skull are securely and rigidly fastened together, so as not to admit of any movement, and the *joints* between them (or their points of union) are *fixed*. On the other hand, the bones of the limbs are united together by *movable joints*, as it is necessary for the use of the arm and leg that the bones should move freely one on the other at the points where they are coupled together. The construction of one of these movable joints is well worthy of your attention: the ends of the bones are covered with a layer of gristle, so that they move smoothly one on the other, and are bound securely together and enclosed by a strong fibrous bag or capsule, which is lined by a delicate membrane that pours forth an oily liquid into the joint, causing it to work smoothly and easily.

THE HEAD (Fig. 1—18).

The head is formed of twenty-two bones, which are all (with the exception of the lower jaw) closely united and immovably locked together by fixed joints. By far the greater portion of the head—all the rounded upper and hinder part—consists of a strong hard case, which encloses, supports, and protects the brain. The brain is not only a very important organ, but is also an exceedingly tender and delicately-constructed one; and it derives additional security from the arched form of the case containing it, as well as

from the beautiful manner in which the eight bones forming the case are securely dovetailed, so to speak, together at their edges. The remaining fourteen bones unite at the fore and under part of the head to form the sockets of the eyes, the cavities of the nose, the cheeks, and the mouth; in fact, taken together, they constitute the *face*. All the bones of the face and the brain case are very firmly and fixedly jointed together, with the exception of the lower jaw, which is movable for the purpose of eating. Both upper and lower jaws are also provided with exceedingly hard, durable, and useful little chisels and wedges, in the form of *teeth*, for the purpose of cutting, breaking down, and grinding our food. Four of the organs of the senses are also situated in the head, and are to a certain extent afforded protection from external violence by the arrangement of the bones: thus, the tongue, or organ of taste, lies in a position of safety in the mouth between the jaws; the eyes, or organs of sight, recline snugly in their bony sockets; the nose, or organ of smell, is lodged securely between certain bones of the face; and the ears, or organs of hearing, are deeply buried in bone, one on each side of the head.

The Spine (Fig. 1—17, 19).

The spine, or back-bone, does not consist of only one piece, but is composed of twenty-four bony fragments—segments—or, as they are called, *vertebræ*, placed one above the other. These vertebræ are, however, not placed next to each other, but have interposed between them firm but elastic indiarubber-like pads of gristly substance. It is to this peculiar construction that the spine owes its remarkable elasticity and flexibility—qualities which allow of turning and bending movements of the body, and at the same time prevent undue shock or jarring from the acts of jumping or

falling. The spine is the principal and central pillar of support of the body, sustaining the weight of the head, chest, and upper limbs, and gradually increases in size, in due proportion to the load it has to bear, towards its lower end. I have already told you how securely the tender brain is encased in the head, but it is none the less necessary that such a delicate and important organ should be preserved from any shock during movements of the body. The peculiar construction of the spine does away with this risk, for the head rests upon the summit of the back-bone very much as a carriage rests upon its springs. The spine also lodges, encloses, and protects the spinal cord (or spinal marrow), which is a continuation of the brain.

THE CHEST (Fig. 1—22, 22).

This is a spacious cavity, formed by the junction of the ribs, breast-bone, and spine, which contains and protects the heart, the two lungs, and certain important blood-vessels, nerves, etc. The ribs, twelve in number on each side, are united behind by movable joints to the back-bone, while in front they are connected with the breast-bone by means of firm but pliable gristle.[1] By this admirable arrangement the chest, besides encircling and protecting the vital parts already mentioned, is exceedingly springy and elastic, and so can better withstand severe squeezes, blows, or shocks; and at the same time it admits of the movements of breathing—that is, the regular rising and falling of the fore part and sides of the chest corresponding with an alternate increase and diminution of its cavity, as air is drawn into and

[1] The seven upper ribs on each side are joined by pieces of gristle (or *cartilage*) directly to the breast-bone, and are called *true* ribs. The remaining five are termed *false* ribs (Fig. 1—11, 12); of these, each of the upper three is united by gristle to the rib immediately above it (Fig. 1—11); but the two lowest are altogether unattached in front, and are therefore named *free* or *floating* ribs (Fig. 1—12).

driven out of the lungs. I shall have to refer to this later on in connection with breathing, so I need only add that the chest is bounded below and separated from the belly by a fleshy or muscular partition—the *midriff*.

The Pelvis (Fig. 1—6).

This is a very strong, irregular-shaped, and deep ring of bone, which encloses a large basin-shaped cavity. It is formed at the sides and fore part of two large haunch-bones, which are united firmly together in front and immovably jointed behind to the triangular-shaped rump-bone. The last-named bone supports the spine by its broad upper end, and has attached to its narrow lower end the small and comparatively unimportant tail-bone. The pelvis, therefore, consists of four bones immovably fixed together so as to form a very powerful, deep, and somewhat irregular bony ring, which contains and protects the bladder and various other vital parts; sustains the weight of the chief pillar of support of the body—the spine; supports the intestines, and indeed the whole trunk; and connects the body with, and transfers the burden of it to, the lower limbs through the medium of the two powerful but freely movable hip joints.

The portion of the trunk known familiarly as the *belly* consists of the large and roomy cavity which lies between the chest (from which it is separated by the midriff) and the pelvis, and it contains the stomach and intestines, the liver, the pancreas (or sweetbread), the kidneys, the spleen, and many very large blood-vessels and important nerves.

The Upper Limbs (Fig. 1—1, 2, 3, 4, 5, 13, 14).

These are capable of very great freedom and variety of movement on account of the manner in which the bones of the shoulder are shaped and arranged.

The *shoulder* consists of the blade-bone and the collar-bone. The blade-bone is of a triangular shape, rather light, and is placed so as to lie movably on the upper and hinder part of the chest. The collar-bone marks the line of division between the neck and chest in front, and is united to the upper part of the breast-bone by its inner end, and to the blade-bone by its outer end: it serves the purpose of supporting the shoulder, and also of keeping it at its proper distance away from the chest. When a collar-bone is broken the shoulder of the same side sinks downwards and inwards towards the chest.

The *arm*, or the portion of the upper limb between the shoulder and the elbow, is possessed of one bone. This is connected at its upper end with the blade-bone by a very movable joint of the character of a "ball and socket." The "ball" of the joint—the upper end of the arm-bone—is large and rounded, while the "socket" of the blade-bone is comparatively small and shallow; and this arrangement of the joint, together with the movable position of the blade-bone, accounts for the extraordinary freedom and variety of movement possessed by the upper limb. In the *fore-arm*, or the part of the upper limb extending from the elbow to the hand, there are two bones—an inner and an outer one—of about the same size. At the elbow these bones are connected with the lower end of the arm-bone by a movable joint, which possesses all the characteristics of a true "hinge." The chief peculiarity of this portion of the upper limb is the arrangement between its bones by which the outer one (that on the *thumb* side) is capable of rolling around the inner one, thereby enabling the fore-arm to be twisted at will, so that sometimes the palm and at other times the back of the hand may be uppermost.

The *hand* is united to the fore-arm by a movable joint between the wrist and the lower large end of the outer bone

of the fore-arm. The *hand* includes the wrist, consisting of eight small bones placed in two rows; the hand proper, made up of five bones which constitute the palm and the ball of the thumb, and which support the fingers; and the fingers, comprising fourteen bones, three in each finger and two in the thumb.

The Lower Limbs (Fig. 1—7, 8, 9, 10, 15, 16).

In the upper limbs, which serve the purpose of lifting, seizing, or carrying objects, of using the hands in fact in any way desirable, the bones are, comparatively speaking, lightly formed, and are so arranged as to allow of great and varied movement. In the lower limbs, on the contrary, by means of which we stand, walk, and run, and which serve as pillars of support to the entire weight of the body, the bones, though arranged much on the same plan as those of the arms, are much stronger, more massive, and are connected together by joints of much greater strength in such a way as to render the lower limbs exceedingly powerful, but less capable of extensive and varied movements.

The *thigh*, like the upper arm, possesses one bone; but this is the longest and most powerful in the body, and is connected with the pelvis by a movable "ball and socket" joint of immense strength. The lower end of the thigh-bone is united to the upper end of the large bone of the leg by the large and complicated knee-joint, at the front of which (forming the prominence of the knee) lies a small oval bone called the knee-cap. By the term *leg* I mean that portion of the lower limb which extends from the knee to the ankle. There are in the leg, as in the fore-arm, two bones: one is much larger than the other, occupies the inner and fore part of the leg, enters by its upper end into the knee-joint, and goes by the name of the shin-bone; the smaller bone, which lies

on the outer side of the leg, is called the splint-bone. These two bones are firmly united together, forming a strong pillar of support, and are connected with the foot at the ankle by a powerful joint of the "hinge" type. The *foot* includes the heel and instep, which are made up of seven bones of various shapes and sizes; the foot proper, consisting of five bones; and the toes, containing fourteen bones, three in each toe, and two in the great toe.

THE MUSCULAR SYSTEM.

By the term *muscle* I mean flesh—lean red flesh: and the expression muscular system refers to all the flesh contained in the body. The flesh clothes the skeleton, forms a great proportion of the body, and gives shape to the limbs; but it is not scattered about, so to speak, without any plan. It is beautifully divided and arranged into separate masses or *muscles*, each of which during life has its proper work to perform. Some of these masses of flesh or muscles are attached by their ends to different bones, as in the limbs; and when they contract (that is to say, when at our wish they *shorten* and thicken) one or other of the bones to which they are attached is moved; if one of the bones is fixed, the other bone is drawn towards it. Thus it is that when we wish to walk, run, jump, carry a weight, or perform any other act, a number of muscles are instantly thrown into contraction, the levers or bones to which they are attached move, and the particular movement we desire is at once gone through. In some parts of the body the muscles are placed at a distance from the bones on which they act: thus, for example, the muscles which bend and straighten the fingers are situated in the upper portion of the fore-arm. In such cases as these each muscle terminates in a long fibrous cord, sinew, leader, or *tendon*, which is attached to the distant bone on

which the muscle acts. In movements of the hand and fingers you can, particularly in a thin person, perceive these tendons working at the back of the hand and the front of the wrist. In other parts of the body the muscles are very delicate, and are attached to the skin, and communicate with each other, as well as being connected with the bones. So it is in the face, all the varied expressions of which are due to the contractions of the different muscles in that situation. Now, all these muscles that I have been speaking of act when we *wish* them to do so. If we *wish* to walk, run, put on a certain expression of face, raise a biscuit to our lips, and so on, certain groups of muscles contract at once and bring about the desired movement in obedience to our *wish* or *will*. Such muscles are described as *voluntary muscles*, or muscles that act in obedience to the will. Other muscles there are, however, that are termed *involuntary*, because they act quite independently of our wish or will. These are not attached to the bony levers of the body, but are connected with important vital internal organs, the working of which if dependent on our will would be speedily deranged. The heart is a powerful muscle of this description: it goes on working as long as life lasts, day after day, night after night, no matter in what state we are—sleeping, or wide awake, insensible, delirious, or in convulsions. Where should we be if the action of the heart depended on our will? Again, in the coats of the stomach and intestines there are delicate involuntary muscles by which those organs contract on to the food, churn it up, and drive it onwards. What a mess we should make of our digestion if the action of those organs depended on our will! In the coats of some of the blood-vessels also (the arteries) there are delicate involuntary muscles, which have an important effect on the circulation of the blood; if the action of these depended on our will, one of the most important parts of the mechanism of the

body (the circulation) would be continually neglected and out of gear. I might give other examples, but I have afforded you sufficient illustrations to show that of the red lean flesh or muscle of the body, one portion acts in obedience to, and another independently of, the will: and that all movements of the body, or its internal organs, are due to the contraction of one kind of muscular tissue or the other.

THE NERVOUS SYSTEM.

This refers to the structures you know by the names of the *brain*, *spinal cord* or *spinal marrow*, and the *nerves* (Fig. 2), and also includes something else you probably have never heard of, viz. the *sympathetic nervous system.*

The brain is, as I have already explained, supported, enclosed, and protected from external violence by the bones of the skull. It consists of two portions, one of which—the brain proper or the large brain—occupies by far the greater part of the cavity of the skull, and is much larger than the other—the little brain or small brain—which is situated in the hinder and lower part of the head. The large brain is the seat of the intelligence, the emotions, and the will: the small brain serves to regulate the movements of the body, maintaining the balance or equilibrium between the two sides during our different actions. The brain, together with its continuation—the spinal cord—which is enclosed and protected by the spine, forms the central portion of the nervous system, from which a number of white cords—the nerves—branch off (nine pairs from the brain, and thirty-one pairs from the spinal cord), and after dividing into smaller and smaller cords and threads finally terminate in the various voluntary muscles and the organs of the senses—ears, eyes, nose, tongue, and skin. Now, the nerves serve much the same purpose as telegraph wires.

Fig. 2.—THE NERVOUS SYSTEM.

This figure shows the general arrangement of the nervous system—the brain proper or large brain, 1, and the small brain, 2, in the head ; the

When we wish to perform any movement, as biting, walking, running, or lifting, orders are flashed along them by the will from the brain to the different voluntary muscles that are required to act; if to the muscles of the head, along the nerves which course directly from the brain itself through apertures in the skull to their destination; if to the muscles of the trunk or the upper or lower limbs, down the spinal cord and along the nerves that proceed from *it* to the different parts of the body; and the muscles on receipt of the orders telegraphed to them immediately contract, act on the bones or levers to which they are attached, and the desired movement is at once executed. Nerves along which orders are thus transmitted from the brain to the voluntary muscles with the result of bringing about movements of the body are called *nerves of motion* or *motor nerves*. But messages are also sent along nerves in a contrary direction, viz. from the delicate extremities of the nerves to the brain: thus, for example, when we cut or scald one of our feet, a message is telegraphed up along a nerve to the spinal cord and along the cord up to the brain, and we feel pain; when we are examining some object with our hands the tender ends of the nerves in the skin receive certain impressions of touch that are in a similar way flashed up along nerves and spinal cord to the brain; when we look at a picture, listen to music, or taste a strawberry, the impressions received respectively by the ends of the nerves of the eyes, ears, and tongue are transmitted direct to the brain with the result that we see, hear, and taste. Nerves along which impressions or sensations are transmitted from their terminations to the brain are called *nerves of sensation* or *sensory nerves*. Nerves which are both motor and sensory are spoken of as *compound*.

spinal cord or spinal marrow—a continuation of the brain—along the back; and the nerves, 4, 5, 6, 7, 8, etc., coursing from either brain or spinal cord to all parts of the body.

You can now understand how it is that in those terrible cases of severe injury to the spine which you occasionally meet with, the patient loses all power and all feeling in his lower limbs; in such accidents the spinal cord itself is injured, the telegraphic communication between the brain and the ends of the nerves is cut, no order from the brain can reach the lower limbs, so there is loss of power to contract the muscles, or paralysis, and no impressions can be conveyed from the legs to the brain, so there is complete loss of sensation. Similarly, when a motor nerve is cut by an accident, there is loss of power or paralysis of the voluntary muscles which it terminates in; when a sensory nerve is injured or diseased, there is loss of sensation in the part which *it* ends in; and when a compound nerve is severed, there is loss of both power to move, and also of sensation in the portion of the body to which it is supplied.

While describing to you the action of the brain, spinal cord, and nerves, you will doubtless have noticed that I spoke only of the *voluntary* muscles as acting in obedience to the mandates of the will transmitted to them along the nerves. The *involuntary* muscles, such as the heart, etc., act quite independently of the will, are quite uninfluenced by it, and are kept working regularly, and properly fulfilling their functions by another portion of the nervous system termed *sympathetic* or *ganglionic*. It is called ganglionic because it consists of a double row of small masses of nervous tissue or *ganglions* connected with each other by delicate branches or threads, and is situated along each side of the spine. From the little masses or ganglions branches are distributed to the heart, to the muscular tissue of the stomach, intestines, arteries, bladder, and other important parts; and—whereas our sensations and the action of our voluntary muscles depend on the brain, spinal cord, and nerves —the proper working of the organs of circulation, respiration,

digestion,—in fact the due maintenance of the vital functions of the body from the beginning of life until death,—during periods alike of insensibility, sleep, and wakefulness, entirely depends on the sympathetic or ganglionic nervous system.

THE BLOOD AND THE ORGANS OF THE CIRCULATION (Figs. 3, 4, and 5).

The length of time that an ordinary machine will last in working order depends on the durability of the materials of which it is constructed, and the power they have of resisting the effects of wear and tear; and, as you well know, machinery built up of very strong and hard substances, as steel, iron, and oak, will, if properly looked after and cleaned, prove useful for a great number of years. It is very different, however, with the mechanism of the human body. The wear and tear caused by the due performance of the different vital functions, and the waste resulting from the regular working of the various tissues and organs, is so excessive, especially in the nervous and muscular systems, that the human machinery would speedily stop — the span of life would

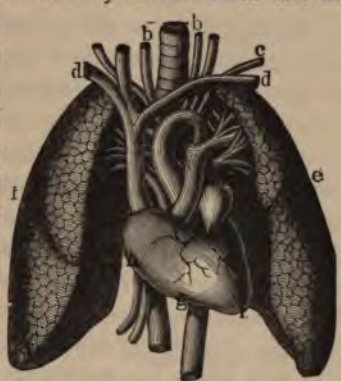

Fig. 3.—HEART, LUNGS, AND LARGE BLOOD-VESSELS.

The figure shows the heart, *h*, *g*, *i*, in its position between the two lungs. *f*, *e*. *d*, *d* are the veins from the upper portion of the body, and the tubes below *h* are the veins from the lower part of the body, conveying dark impure blood to the right side of the heart. *b*, *b*, *c* are branches from the large main artery, or aorta, which springs upwards from the left side of the heart in the form of an arch and curving backwards courses down behind the heart near *g*. Running upwards from the right side of the heart, and branching off to both lungs, is seen the pulmonary artery. Between *b* and *b* the windpipe is represented.

indeed be short—were there not a beautiful provision by which all the structures of the body constantly received materials for their growth, sustenance, and repair. This arrangement, by which every tissue and every organ of the body is continually provided with suitable nourishment, and by which, moreover, at the same time, all the different structures regularly get rid of the products of waste, wear and tear, and decay—the ashes of the human machine—is the *circulation of the blood.*

All of you know the general appearance and character of *blood*, its colour—either bright red or dark purple, and its property of clotting or coagulating—that is, of separating (after death, or when escaped from the body during life) into a clot and an almost colourless fluid. There is a considerable quantity of blood in the body—about 12 or 15 lbs. in a man of ordinary weight; and there need be, for remember that it serves as a carrier *to* all the different tissues and organs of materials for their growth and repair, and *from* all the various structures of products of their waste and decay. All this quantity of blood is not accumulated in any one tissue or organ, nor does it lie stationary or stagnant; but, on the contrary, it is diffused through all parts of the body, and is in perpetual movement, being regularly and continually driven through a complete system of tubes, called *blood-vessels*, by the pump action of the *heart.* The heart is a very powerful muscular organ, about the size of a man's fist, situated in the cavity of the chest between the lungs (Fig. 3). It would take much too long to describe to you fully the wonderful construction of the heart and its beautiful valves. It is sufficient for you to know that it is shaped like a hollow bag; that it is divided into two parts, a right side and a left side; that it works with a pumping action, contracting and dilating regularly about seventy or eighty times in a minute; and that the left side contains bright scarlet blood, full of nutri-

ment derived from the food we swallow, and of oxygen gas derived from the air we breathe; and the right side dark purple or blackish blood, charged with carbonic acid gas and other products of decay and wear and tear of the different parts of the body. From the right side of the heart the dark impure blood is pumped into the lungs to be purified (Figs. 3 and 4); but from the left side the brilliant scarlet healthy blood is driven into a large tube which gives off numerous branches that course in different directions through the body, and in turn split up into smaller and smaller divisions until every tissue and organ is reached by them. These tubes, along which the bright red blood is driven by the pump action of the heart to every part of the body, are called *arteries* (Fig. 4, *a*, and Fig. 5); they are strong and elastic, and are for the most part placed deeply under cover of the flesh or in other positions of safety. In some parts of the body, however, notably at the wrist, upper arm, temples, and neck, the arteries run so near the surface that their beating, pulsation, or *pulse* (caused by the successive waves of blood being driven along them by the pumping of the heart) can be easily felt, and in many instances seen. The arteries of different regions of the body are called by various names, such as Carotid,

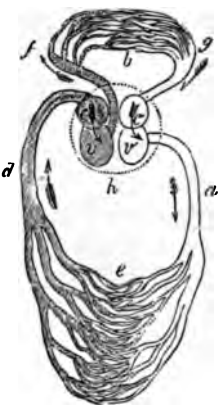

Fig. 4.—PLAN OF THE CIRCULATION.

h, Heart, divided into a right and left half, each consisting of an upper cavity, called an auricle, *c* and *c'*, and a lower cavity called a ventricle, *v* and *v'*. *a*, Arteries, conveying bright scarlet blood from left side of heart to all parts of body. *e*, Capillaries. *d*, Veins, carrying dark impure blood from all parts of body to right side of heart. *f*, Pulmonary artery conveying dark impure blood from right side of heart to lungs. *b*, Pulmonary capillaries. *g*, Pulmonary veins carrying bright scarlet purified blood from lungs to left side of heart. *a*, *e*, *d*, The greater or systemic circulation. *f*, *b*, *g*, The lesser or pulmonic circulation.

The arrows show the direction of the current of blood.

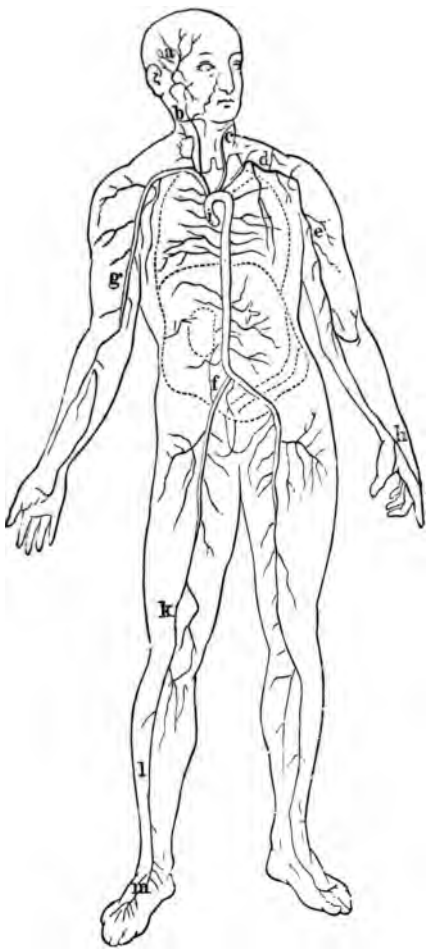

Fig. 5.—THE ARTERIES.

This figure is intended to give a general idea of the position of the chief arteries. The main artery, *i*, called the aorta, springs from the left side of the heart, and arching backwards courses down close to the spine as far as *f*, where it divides into two large branches. From this main arterial

Brachial, Femoral, etc., for the sake of more conveniently distinguishing one from the other; but there is no reason why you should confuse yourselves by trying to remember a number of hard words, providing that you know the situation of the more important arteries, and I shall point out to you in the next lecture the position of most of the larger vessels. The arteries divide into smaller and smaller branches until they finally end in a gigantic network of extremely minute and delicate tubes—so small that they can only be seen with the microscope—which pervade all the different

tissues and organs of the body. These tender tubes are called *capillaries* (Fig. 4, *e*); into them the bright red healthy blood pours from the arteries, and as it flows along them the blood gives up the oxygen and the nutriment which it contains to the surrounding structures for their growth, repair, and functional requirements. But as it courses along the capillaries the blood does something more than supply nourishment to the neighbouring parts; it absorbs and takes up from the adjacent tissues the results of decay and of the wear and tear of work, such as carbonic acid and other useless and noxious matters that it is necessary for the system to get rid of. Following the plan of the circulation (Fig. 4) the capillaries join again together into larger tubes, and these unite again and again until at last they terminate in *veins* (Fig. 4, *d*). The blood enters the capillaries pure and bright scarlet in colour, but during its passage through them it gives up its oxygen and its nourishment, and becomes charged with carbonic acid and other hurtful materials, so that it flows from the capillaries into the veins a dark purple or blackish impure stream. The

trunk branches are distributed to all parts of the body. Two large vessels, named the carotid arteries, *b*, *c*, run upwards, one on each side of the neck, and divide into branches which supply the brain and head; of these, the figure shows the temporal artery, *a*, running upwards in front of the ear; and the facial artery, near *b*, which winds over the lower jaw to the face. Each of the upper limbs is supplied by a large artery which passes under the collar-bone, over the first rib, down through the armpit and along the inner side of the arm to a little below the front of the elbow, where it divides into two branches—one of which runs down the outer part, the other down the inner part, of the fore-arm, as far as the hand, where they unite to form two curves or arches in the palm, *d*, *e*, *g*, *h*; the artery is called subclavian, *d*, when near the collar-bone; axillary, when passing through the armpit, *e*; brachial, when between the armpit and elbow, *g*; and in the fore-arm the outer artery is called radial, *h*, the inner one the ulnar; and the curves formed by the two vessels in the hand are named palmar arches. Each of the lower limbs is supplied by a large artery which enters the thigh at the centre of the fold of the groin, and coursing downwards passes back, about the lower third of the thigh, into the ham; a little below the knee-joint it divides into two branches, one of which runs down the fore-part, the other down the hinder-part, of the leg to the foot, *f*, *k*, *l*, *m*; the artery of the thigh is called the femoral artery; that of the ham the popliteal artery; that of the fore-part of the leg the anterior tibial artery; and that of the hinder-part of the leg the posterior tibial artery.

veins are the tubes along which the dark impure blood flows from all parts of the body to the heart—to the *right* side of the heart; they are thin-walled and flabby, and are provided with valves, so that the blood which flows along them in a sluggish *continuous* stream, cannot move backwards when acted on by gravitation, as in walking, standing, and other positions. Some veins are situated deeply, accompanying the arteries in their course; but many are quite superficial, and so close to the surface that they can be seen through the skin in some parts of the body as dark blue lines or cords, more especially in thin people. You may frequently notice them on the backs of the hands, and the front of the fore-arm and elbow, especially after manual exertion, or when the arms have been held down for some time; also the tops of the feet, and the back and sides of the legs, particularly after much standing, or a long walk; you may often notice also little swellings like knots in the course of the dark blue lines, and these indicate the points where valves are placed. The different veins unite together to form larger veins, and terminate at last in two main trunks which pour the dark impure blood, collected from all parts of the body, into the right side of the heart. Now you may ask, How is this dark impure blood, charged with carbonic acid and other effete materials, purified and reddened? It is pumped by the right side of the heart away along a tube (called the pulmonary artery (Fig. 4, *f*)—the only artery in the body which contains dark blood) into the lungs, where it passes from the branches of the pulmonary artery into a network of those delicate little tubes called capillaries (Fig. 4, *b*). While flowing through these capillaries, which permeate the lungs in all directions, and indeed constitute a considerable portion of them, the blood *gives up its carbonic acid* (together with some watery vapour) *to the air* which is drawn into the lungs by the process of breathing; and at the same time

takes up oxygen from the air in the lungs, and so flows on, purified and bright scarlet once more, into the veins (called pulmonary veins (Fig. 4, *g*)—the only veins in the body which contain bright red blood) along which it pours again into the *left* side of the heart.

Such, then, is the general plan of the circulation: bright red blood is pumped by the *left* side of the heart to all parts of the body, from which it is returned dark and impure to the *right* side of the heart; the *right* side of the heart pumps the dark impure blood to the lungs, from which it is returned bright red and pure to the *left* side of the heart. The current of blood which passes from the left side of the heart through all the structures of the body to the right side of the heart is sometimes spoken of as the *greater* or *systemic circulation* (Fig. 4, *a*, *e*, *d*), whereas the flow of blood from the right side of the heart through the lungs to the left side of the heart is called the *lesser* or *pulmonic circulation* (Fig. 4, *f*, *b*, *g*).

If the heart or any of the blood-vessels fail, from injury or disease, in performing the work allotted to them, then results of a more or less serious character soon follow: for instance, when the heart acts very feebly in consequence of over-exertion and fasting, an insufficient supply of healthy blood is pumped up to the brain and head, the patient turns deathly pale and falls insensible—in a word, he *faints;* in another case a small blood-vessel gives way in the head, the blood accumulates, and by pressure on the brain causes loss of power or paralysis of one side of the body—in other words, the patient has a *stroke;* again, a man meets with an accident by which the chief blood-vessels of one of his limbs are injured so seriously as to arrest the circulation, and as a consequence the limb (or a portion of it) is deprived of its proper supply of blood, and it dies, or, as it is called, *mortifies;* a smart blow with a stick, though it does not break the skin,

ruptures the small blood-vessels underneath it, blood escapes under the skin and causes swelling and discoloration—in fact, a *bruise;* or a man tumbles on some sharp instrument, a large artery is cut open, bright red blood spurts violently and profusely from the wound, and if help is not rendered speedily death results from *bleeding* or *hæmorrhage.*

Respiration or Breathing (Fig. 3).

This is the process by which the dark impure blood gets rid of its poisonous carbonic acid, and at the same time becomes reddened, purified, and charged with wholesome oxygen. The organs of breathing are the *lungs*—right and left—and they are safely lodged in the cavity of the chest. When we draw in a breath, or *inspire*, the air rushes in through the mouth and nostrils and down a tube which you know by the expressive name of *windpipe.* The upper end of the windpipe is enlarged, and contains the organ of the voice; the lower end divides into two smaller tubes, one of which enters each lung, splitting up into smaller and smaller branches, like the twigs of a tree, until finally all the little minute tubes end in a multitude of very small pouches, sacs, bags, or *air-cells.* The two tubes into which the lower end of the windpipe divides, together with all their smaller branches and divisions, go by the name of *bronchi* or *bronchial tubes;* and when we inspire, or take a breath, the air rushes down them into the air-cells. The little air-cells are surrounded by, or rather imbedded in, a close network of capillary blood-vessels; and while the blood flows along these capillaries (from the pulmonary artery to the pulmonary veins, as previously described) it gives up its carbonic acid to, and at the same time takes oxygen out of, the air in the little air-cells. When we breathe out, or *expire*, the air, rendered in its turn impure by the carbonic acid derived from the

blood as well as by the loss of its oxygen, is driven out of the air-cells along the bronchial tubes, windpipe, and through the mouth and nostrils clear of the body. You may now realise how important it is that we should have good wholesome fresh air to breathe; and you can understand the evil of overcrowding, whereby the air becomes charged with an excess of poisonous carbonic acid, and deficient in that which is essential to life, viz. oxygen; and you can appreciate the danger of croup and other diseases affecting the upper portion of the windpipe and tending to block it.

I must now tell you a little about the *mechanism of breathing*. You remember that the chest is formed, as regards the skeleton, by the ribs on each side, which are connected by pieces of gristle with the breast-bone in front, and jointed to the back-bone behind: the chest is bounded below, and separated from the belly, by a powerful muscular partition arched upwards, which is termed the *midriff* or *diaphragm;* and the cavity is further enclosed all around the sides by muscles which pass from one rib to another. It must also be borne in mind that the lungs themselves are extremely elastic. During *inspiration*, or the act of drawing air into the chest, the midriff descends at the same time that all the fore portion of the ribs and the breast-bone are drawn upwards; the cavity of the chest is thus much enlarged, and the air rushes down the windpipe into the lungs to fill the vacuum. During *expiration*, or the act of forcing the air out of the chest, the midriff ascends, the ribs and breast-bone are depressed, and the diminution of the cavity of the chest thus caused, together with the contraction of the lungs from their great elasticity, drives the air forcibly out of the chest along the windpipe. During health a person breathes or *respires* (that is, goes through the movements of inspiration and expiration) from fifteen to eighteen times a minute.

The lungs are never completely emptied of air, even after very forcible expirations; but at every inspiration there is free mingling of the fresh air with that already in the chest.

The Organs of Excretion.

A portion of the waste materials, the hurtful and useless *débris* (the ashes, so to speak, of the human machine) that result from the wear and tear of the different structures of the body, is got rid of, in the form of carbonic acid and some watery vapour, by the lungs. A good deal more of these waste and effete products of the different tissues and organs is got rid of by means of the skin and also by the kidneys; and for this reason the lungs, skin, and kidneys are spoken of as organs of excretion,—they get rid of or throw out from the body those various impurities which result from the waste, decay, wearing out, or habitual work of all the different tissues and organs.

The Skin.

A continual evaporation of water is going on from the surface of the body during life; and at different times, from great exertion, intense heat, or other causes, more water is poured out by the skin than can at once evaporate, so that it forms in drops and beads, as in *sweating* or *perspiration*. This water is separated from the blood by great numbers of little sweat glands that exist in the skin. When I say great numbers I mean millions. One authority calculates that two and a half millions, another that seven millions, are contained in the skin of an ordinary-sized man; but, however that may be, the skin pours out on the average in twenty-four hours, between sweating that you notice and constant evaporation that does not attract your attention,

about two and a half pounds of water, and with this water is got rid of at the same time carbonic acid and a noxious substance called urea. You can now appreciate the great danger of an extensive burn from, for instance, an explosion of gas. The injury may not be deep, but if a large surface of the body is scorched just sufficiently to arrest the usual evaporation, then the system is unable to clear itself of the impurities that are constantly accumulating in the blood, and most serious illness, indeed often death, is the result.

But the skin is not merely an organ of excretion. It serves as a covering for the whole body, and to a certain extent protects from external violence the structures underneath it. It is so remarkably elastic, tough, and pliable, that it is admirably adapted for its office of shielding the deeper tissues from harm, at the same time that it admits of the greatest freedom of movement. It also helps, as it conducts heat badly, to maintain the warmth of the body; and last, not least, it is the principal organ of touch.

THE KIDNEYS.

There are two of these organs—a right and a left—situated in the cavity of the belly, and placed one in each loin. They act as organs of excretion, and get rid of, on the average, about forty or fifty ounces of water in the twenty-four hours, together with certain impurities and waste materials, such as urea and uric acid. The water, with the urea and other products of the wear and tear of the tissues dissolved in it, goes by the name of *urine*, and runs down from each kidney along a narrow tube into a reservoir situated in the pelvis and called the *bladder*, from which it is expelled as occasion requires.

Food and the Organs of Digestion.

Food may be looked upon as the fuel of the human machine. The blood, as you know, during its circulation through the body, not only serves to convey oxygen derived from the air we breathe, but also nutriment extracted from our various eatables to all the tissues and organs for their growth and repair. But our different articles of diet are not in their natural state fit to enter the blood direct, and it is the business of the organs of digestion therefore to extract all the suitable nourishment from the food which we swallow, and to render it into such a condition that it may be fit to pass into the blood and be carried all over the body to make up for the constant loss from waste, wear and tear, and decay.

The food is first of all subjected, in the mouth, to the action of the teeth, and also of a liquid that is poured into the mouth by some neighbouring glands, and which is called *saliva* or *spittle.* The food is cut up, broken, crushed, and ground down by the teeth, and at the same time being mixed up with the saliva is formed into a pulp which is suitable for swallowing. The saliva, moreover, serves the purpose of keeping the mouth moist, preventing particles of food continually sticking to the teeth, rendering the movements of the tongue easy, of dissolving portions of the food (so that we are enabled to taste them), and also of exerting a chemical action on certain parts of our diet.

The food is next, by the act of *swallowing*, forced by muscular action down the back of the throat along the gullet into the *stomach.* This is a bag of considerable size, which pours forth into its cavity from a multitude of little glands an acid liquid called the *gastric juice.* The food on reaching the stomach is subjected to the action of this fluid, and it is

so churned up by the movements of the stomach (which, as you may remember, contains involuntary muscle in its walls) that every portion of it becomes thoroughly mixed up with, and subjected to the action of, the gastric juice. A portion of the food is indeed straightway dissolved, and absorbed or taken up by the minute blood-vessels (capillaries) in the walls of the stomach; the remainder—converted into a thickish liquid called *chyme*—is forced on by the muscular action of the stomach into the *intestines*. These consist of a tube about 26 feet in length, along which the remnant of the food is gradually forced by the muscular action of the bowel itself, for *it* also has involuntary muscle in its walls. During its progress the food meets with, and is acted upon by, different juices or secretions; thus soon after it enters the intestine it becomes mingled with the *bile*, which is poured into the bowel from the *liver*, and with the *pancreatic juice*, which in the same way streams into the bowel from the *pancreas* or *sweetbread*; and as it passes onwards it mixes with the secretions of large numbers of minute glands that line the intestine itself. In this way the remainder of the nutritious portion of the food is dissolved or digested, and is taken up by the minute capillaries, or by other special delicate tubes for conveyance to the blood, which exist in the walls of the intestines. The unnutritious, indigestible remnant of the food is passed on and got rid of through the bowels.

Organs of Secretion.

The different liquids and juices that I have been speaking of in connection with the digestion of our food are of quite an opposite character to the fluids poured out by such organs as the kidneys and skin. The saliva, which is manufactured by the salivary glands; the gastric juice, which is poured forth from the numerous gastric glands that are lodged in

the lining membrane of the stomach; the bile, which is produced by the liver; the pancreatic juice, a product of the pancreas; and the intestinal juice, which streams from the numberless minute glands of the intestine, are all liquids which are expressly formed in their special glandular manufactories (from materials extracted from the blood as it circulates through them) for the purpose of performing some special service in the interior of the body. The organs which produce these important and serviceable liquids and juices—such as the salivary glands, liver, pancreas, etc.—are termed *organs of secretion*, as distinguished from the organs of excretion, viz. the lungs, skin, and kidneys, which separate the noxious products of wear and tear and decay from the blood in order to get rid of them and throw them out of the body.

When considering the different parts of the body,—the skeleton with its joints, the muscular system, the nervous system and the organs of the special senses, the organs of circulation, the organs of breathing or respiration, and the organs of secretion and excretion,—remember that all these different portions of the human machine work beautifully together; that all the various structures of the body, though perfectly distinct, are fitted and arranged so exquisitely one with the other that each system serves its special purpose with regularity and exactitude without interfering with the work of the others; and yet at the same time all the different parts are so beautifully adapted, or blended, so to speak, one with the other, that there are no rough irregular corners or jagged edges, and in the movements of the body—either of the limbs or trunk, or of the internal organs—the different structures glide smoothly and noiselessly one on the other.

Fat fills up the interstices or odd spaces of the body. It forms a layer underneath the skin which does away with any

angularity of form, causes the main outline of the body to be made up of smooth and gentle curves, and assists very materially in preserving the heat of the body. It moreover serves in certain parts to diffuse pressure; thus there are pads of fat on the palms of the hands, the buttocks, and the soles of the feet.

The skin pours forth on its surface some material of an oily or greasy nature, which serves to keep it soft and supple, to protect it against the effects of prolonged moisture, and to check undue evaporation.

The various important organs which move during the performance of their functions, such as the lungs, heart, intestines, etc., are provided with a beautiful arrangement by which they glide smoothly and easily over the parts next to them; thus each lung has a closed but flattened delicate membranous bag interposed between it and the wall of the chest, one side of the bag being attached to the chest and the other to the surface of the lung; the two layers of the bag, being moistened with an oily material, glide over each with the utmost smoothness during the movements of breathing. In the belly there is a similar contrivance, one side or layer of the bag being attached to the wall of the belly, the other being reflected over and attached to the intestines and other organs in the cavity; the heart is enclosed in a tough fibrous case, and its movements are facilitated by a similar arrangement, one layer of the membranous bag being attached to the heart itself and the other to the fibrous case.

I might dwell much longer on the wonders of the human machinery, but time will not allow me to pursue further this portion of my subject. I can only hope that my brief description of the structure and functions of the body may be of service in enabling you to understand and appreciate the different methods of rendering first aid in cases of emergency.

The Triangular Bandage.[1]

Bandages—of which there are two kinds, the *roller bandage* and *Esmarch's triangular bandage*—are used for the purpose of covering wounds, and so protecting them

Fig. 6.—THE REEF-KNOT.

from dirt and dust, the hot rays of the sun, flies and other insects, etc.; also for affording support to different parts of the body that may be injured, as, for instance, the slinging of a wounded arm; for applying pressure in order to arrest bleeding; for binding on and maintaining in their proper position dressings to wounds and splints to fractured limbs; and for checking undue muscular action.

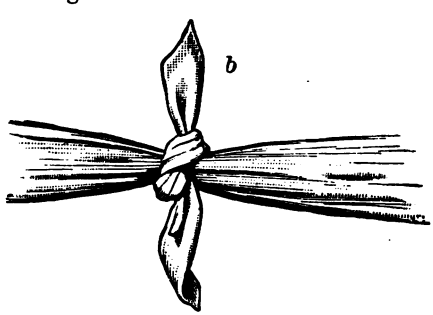

Fig. 7.—THE "GRANNY."

Roller bandages consist of long strips of unbleached calico, linen, flannel, or some special material, and they vary in length and breadth according to the part of the body for which they are to be used; thus for the chest a

[1] Introduced by Professor Esmarch, and described in *The First Dressing on the Battle-Field.* Translated from the German by Dr. Thomas Guy.

large roller is required, about 4 or 5 inches wide, and 6 or 8 yards long, while for a finger a strip $\frac{3}{4}$-inch wide and about a yard long is sufficient. It requires considerable practice to apply these bandages smoothly and evenly, and if they are not put on properly much harm may ensue from undue pressure or constriction by the tightening of some of

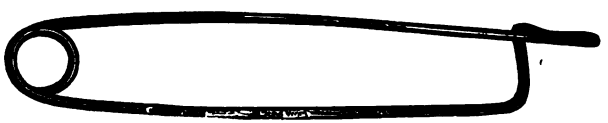

Fig. 8.—THE SAFETY-PIN.

the folds. Mortification of a limb may even result—indeed it has actually occurred—from this cause, the bandage being applied unevenly, and some of the upper folds fixed so tightly as to arrest the circulation. It follows from all this that roller bandages are more especially adapted for the use of professional men or trained nurses. For ambulance work

Fig. 9.—BANDAGE FOR HEAD—FROM BEFORE.

Fig. 10.—BANDAGE FOR HEAD—FROM BEHIND.

Esmarch's triangular bandages are much more suitable; they answer all requirements; they can be applied to any part of the body as a covering and protection for wounds, and are extremely convenient for making arm-slings, fixing on dressings, rapidly binding splints on to injured limbs, using as temporary tourniquets (in the manner described in the following lecture), and in fact for all purposes to which

bandages of any kind can be turned. The triangular bandage is nothing more than a triangular piece of calico or linen, measuring about 4 feet at its lower border, and 2 feet 10 inches at its sides. It can be quickly and easily applied; there is not the same risk in using it as I mentioned in connection with the roller bandage, and, above all, the manner of applying it can be learnt with the greatest facility. The Ambulance Association supplies these bandages (of unbleached calico) with illustrations stamped on them, showing the different ways of applying them; and accompanying each bandage are printed instructions for its use. These illustrated bandages, with the accompanying instructions, only cost sixpence each, and by means of them you can readily acquire a thorough knowledge of the various methods of applying them. When you once know your work you can easily provide yourselves with any number of triangular bandages made out of ordinary unbleached calico, or you may use neck-handkerchiefs or pocket-handkerchiefs in the same way by folding them across. The triangular bandage is used either *folded* or *unfolded*, according to the purpose for which it is required. A *folded* bandage—that is, a bandage folded like an ordinary neck-handkerchief or cravat, by doubling the point down to the lower border and refolding it until the required width is obtained—makes a very convenient *small* arm-sling (Fig. 11), serves to bind on splints, temporary or otherwise, for the support of broken limbs (Figs. 26, 27, 29, 30, 31), is useful for fastening compresses securely and tightly in their places in order to stop bleeding, is suitable for making an improvised tourniquet (Fig. 24), and is well adapted for bandaging wounds of the forehead, back and sides of the head, eye, ear, cheek, chin, jaw, as well as the upper and lower limbs (Figs. 11 and 17). The ends of the bandage may be either tied or pinned—if tied, the reef-knot (Fig. 6) should be used

(because more secure) in preference to the "granny" (Fig. 7); if pinned, safety-pins (Fig. 8), if handy, should be chosen before ordinary pins, as they are more likely to hold fast without slipping during the movements of the patient. An *unfolded* bandage makes an admirable *large* arm-sling[1] (Fig. 12), and is specially adapted for bandaging the head for scalp wounds (Figs. 9 and 10), the chest (Figs. 13 and 14), back, hand (Fig. 11), foot (Fig. 16), and (if used with a second bandage) also the shoulder (Fig. 11) and hip (Fig. 15). If a portion of a limb is torn or blown away by an accident, or on the battlefield, an unfolded bandage may be applied as shown in Fig. 14.

The First Dressing of Wounds.

Wounds vary considerably in character according to the way in which they are caused; thus, some are clean cut, or *incised*, as the gashes made by razors, knives, swords, and other sharp-bladed instruments; others are torn, or *lacerated*, the edges of the wound being jagged and irregular; or they are accompanied by much crushing or bruising of the parts, and so are called *contused* wounds; or they are deep, out of all proportion to their breadth, such as the injuries caused by stabs, sword-thrusts, blows from picks, etc., and are termed *punctured* wounds.

You never know where you may be, or under what circumstances you may be placed, when called upon to give assistance in cases of wounds; you may be at home, with plenty of clean water, sponges, towels, and sticking-plaster at hand; you may be down a coal-pit, with nothing by you suitable or convenient; or you may be in all the turmoil and excitement of the battlefield. But in any case your

[1] When putting on a sling, always arrange it so that the hand lies at a *higher* level than the elbow.

attention should be directed to the proper and efficient cleaning of the wound; the arrest of bleeding; the replacing of the edges of the wound as nearly as possible in their natural position; and finally, the dressing or bandaging of

Fig. 11.—BANDAGES FOR SHOULDER, HAND, ELBOW; AND A SMALL ARM-SLING.

the wound so as to make the patient as comfortable as you can until he has the benefit of skilled aid.

Cleaning of the Wound.—Wounds should always, when practicable, be thoroughly washed and cleaned, care being taken to remove any pieces of glass, splinters of wood, bits

of coal, or dirt of any kind that may be sticking in them. The water used should be *clean*, and—if the wound is a recent one—it should be *cold*, for the purpose of arresting the bleeding. A clean-cut incised wound may often be readily cleansed; but it is astonishing how difficult it is often to free a contused or lacerated wound from the grit and dirt which are imbedded in the raw surface and edges. If the wounded part is hairy—as, for example, is the case in

Fig. 12.—LARGE ARM-SLING.

scalp-wounds[1]—all the hair immediately around the injury should be clipped off with scissors, or shaved off with a razor. If you happen to be at home, or anywhere near houses, you will be able to procure a basin, sponges, clean water, and anything else you may require; and the wounded part should be held over the basin, and the water sponged freely over it. Under less favourable circumstances, when nothing is handy, you must do the best you can, and use the cleanest water possible—from neighbouring pools, brooks, reservoirs, taps, or other sources.

[1] The skin covering the upper portion of the head is termed the scalp.

Arrest of Bleeding.—Should a large blood-vessel be injured—the bright red blood spurting violently out (as in bleeding from an artery), or dark purple or blackish blood flowing down in a continuous stream (as in bleeding from a vein)—then all your efforts must be promptly and vigorously directed to stopping the bleeding. In such an emergency your entire and undivided attention must be given to the arrest of the bleeding, in order to save the patient's life; the

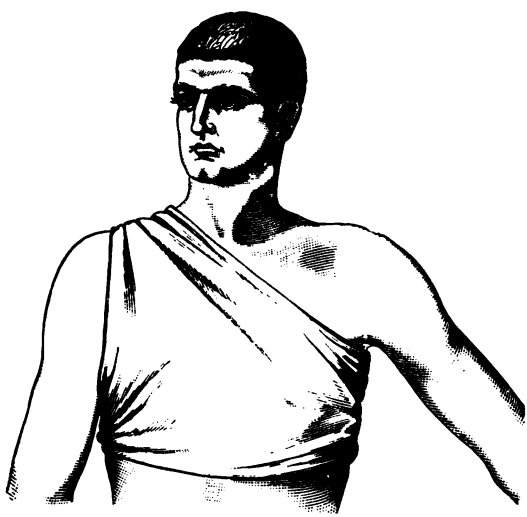

Fig. 13.—BANDAGE FOR CHEST—FROM BEFORE.

methods of doing this will be explained to you in the next lecture. In the generality of wounds, however, such as you so frequently meet with, the bleeding is not profuse; the red blood oozes, drops, trickles, or runs off from the entire raw surface of the wound (bleeding from the capillaries), and the bleeding is readily checked by cold water, the pressure of the dressings or bandages, and a raised position of the injured part.

Replacing the edges of the wound in their natural position.—In wounds of the head a portion of the scalp sometimes is found hanging down; and in other injuries, particularly of the lacerated or torn variety, there is often considerable displacement of the skin. I need hardly say that, after cleaning them, the injured parts should be put back in their proper position as quickly as possible; this

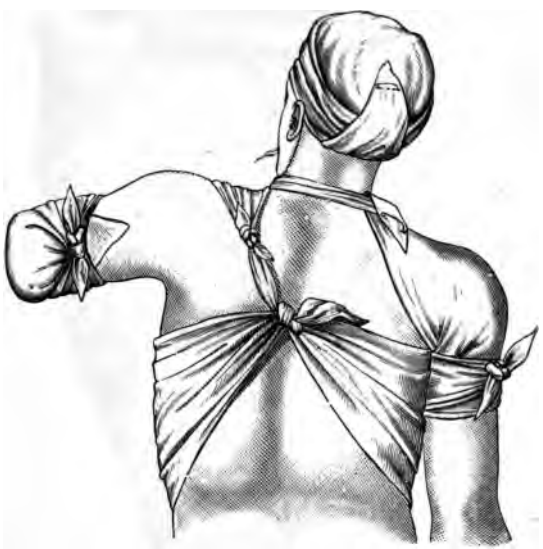

Fig. 14.—BANDAGES FOR CHEST, SHOULDER, HEAD, AND STUMP OF ARM—FROM BEHIND.

specially applies to wounds of the face, so as to avoid, as far as you are able, the risk of disfigurement. In incised wounds the edges should be brought together as closely as possible, and kept in position by strips of sticking-plaster placed across the wound, or if plaster is not available, by the application of a folded piece of lint, linen, or soft rag, and a bandage. If strips of plaster are used it is well to leave spaces between them, so as to allow room for any

discharge to escape. In incised wounds, if there is much gaping, and difficulty in keeping the edges together, the sooner the aid of a surgeon is procured the better, so that the wound may be stitched; thereby rapid healing of the wound will probably follow, and disfigurement will be lessened or

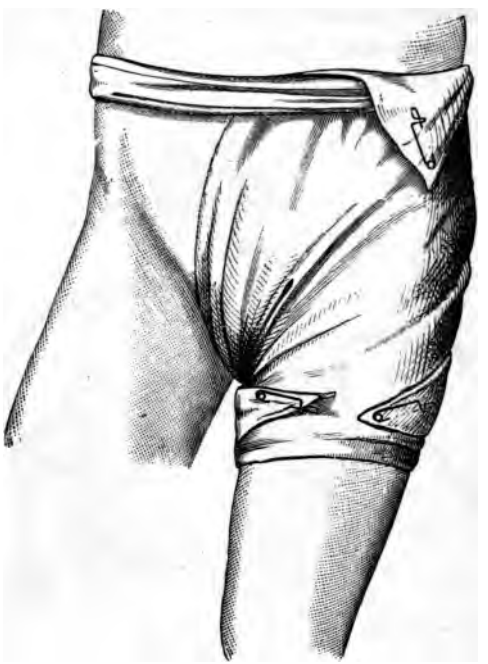

Fig. 15.—BANDAGE FOR HIP.

altogether avoided. In wounds of the important cavities of the body, such as the belly, accompanied by the protrusion from them of a portion of their contents, as, for instance, a part of the intestine, the protruded parts should be washed with warm water, and carefully pressed back into their place, the patient should be placed in a comfortable lying-down position, and medical aid procured as speedily as possible.

Dressing or bandaging of the wound.—In incised wounds, if sticking-plaster is available, draw the edges of the wound well together, and strap it across as already described. If you have no plaster, fold up a piece of lint, soft linen, or any fragment of rag or handkerchief that is clean and soft, wet it with cold water, apply it smoothly to the wound, and fix it on with your triangular bandage. That is called a *cold water dressing.* If water is not to be got easily, and in comparatively trivial wounds, you may use the same materials in the same way without wetting them—that is *dry dressing.* In contused and lacerated wounds you should always apply cold water dressing. Always place the wounded part in as easy a position as possible; if it is the upper limb that is injured, it should be slung. It may happen that you are unable to get any material to make a dressing of; all that you have perhaps is a triangular bandage, or a handkerchief, and even this, in a vast number of cases, will suffice, if bandaged on in a correct manner, and particularly if it is wetted before being applied.

Fig. 16.—BANDAGE FOR FOOT.

It is interesting to notice the steps that have been taken to provide soldiers with simple materials for the dressing of wounds received in military campaigns. In 1855 it was arranged that every British soldier should carry in his knapsack a First Field Dressing, consisting of a fine calico bandage, 4 yards long 3 inches wide; fine lint, 12 inches long 3 inches wide, folded flat and fastened by four pins; in 1873-74, at the time of the Ashanti War, the contents of the First Field Dressing were altered to a triangular

bandage, two *safety*-pins, a packet of ordinary pins, and a packet of lint, smeared with simple ointment, and covered with waxed paper, and the little parcel was carried in a breast pocket. In 1869 the North German troops were all provided with a First Field Dressing, consisting of a bandage, a compress of linen, and some charpie—a soft downy material, made by scraping and unravelling linen. Esmarch, in 1876, suggested a First Field Dressing made up of a triangular bandage with a safety-pin, four small packets of antiseptic charpie, one piece of antiseptic gauze bandage, and four common pins.[1] In 1882 Esmarch alludes in his Ambulance Lectures to another "bandage packet" arranged by him, containing, "besides the three-cornered handkerchief, two antiseptic balls, made with chloride of zinc, to be laid on the wound, and a gauze bandage with which to secure them."[2]

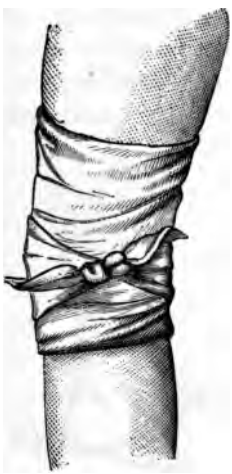

Fig. 17.—BANDAGE FOR KNEE.

In conclusion, remember to completely expose a wound before dressing it. Lay the injury bare, so as to see it at its worst at once, and so that you can understand what to do for the best. If the lower limb is injured, cut or rip up the seam of the trousers, and, if necessary, cut open the boot and stocking—do *not pull* them off. If the upper limb is wounded, cut or rip up the seams of the sleeves of the coat and shirt; and if it is the trunk which has sustained injury, you can generally expose the part by unbuttoning the coat, waistcoat, shirt, or trousers.

[1] *Gunshot Injuries*—Surgeon-General Longmore.
[2] *First Aid to the Injured*—Esmarch.

LECTURE II.

BLEEDING OR HÆMORRHAGE.

The general direction of the main arteries indicating the points where the circulation may be arrested by digital pressure or by the application of a tourniquet—The difference between arterial, venous, and capillary bleeding, and the various extemporary means of arresting it—First aid in cases of internal bleeding.

I WILL try and explain to you this evening the best ways of giving assistance in cases of bleeding or hæmorrhage: and if you will bear in mind what I told you in the last lecture about the organs of the circulation—the heart, the arteries, capillaries, and veins—you will more easily understand my remarks. Remember that the heart acts as a strong pump driving bright red healthy blood through a number of tough elastic tubes all over the body to every tissue and every organ. These tubes, or arteries, divide and branch again and again, thereby becoming smaller and smaller until they at last end in an immense network of extremely thin and minute tubes—so small that they can only be seen with the aid of a microscope—called capillaries. The blood flows on through the capillaries, and these join together and gradually unite into larger tubes which pour the blood, now dark and impure, into the thin flabby veins. The veins convey the dark blood back to the heart, whence it is sent-

warded on to the lungs to be purified before it is returned—bright red once more—to the left side of the heart to be driven again over the entire body.

Now, you observe that the circulation of the blood consists in the blood being driven through a complete system of tubes; and therefore if there is any escape of blood, or *bleeding*, one or more of the tubes must have given way. The quantity of blood lost, too, will depend on the size and number of the tubes injured, as well as the force with which the blood is driven along them; and the colour of the blood and the way in which it flows out of the wound will depend on the particular portion of the system of tubing that is injured. Thus, if an artery is opened, bright scarlet blood spurts violently out in jets for a considerable distance—the red stream rising and falling like the play of a fountain—forcibly and directly driven by the strong pump action of the heart at a pressure of about four pounds to the square inch:[1] if a number of the small capillaries only are broken, then red blood trickles or oozes out, not from any one point, but from the whole raw surface of the wound: whereas if a vein is injured, dark purple or blackish blood flows out in one steady sluggish continuous stream.

Coming to the practical question, How can you give help in cases of bleeding? you will easily understand—still bearing in mind the general plan of the circulation—that *pressure* firmly applied to the injured tube is the best way of stopping the leakage of blood—pressure applied, of course, on the side of the wound from which the blood flows. Thus, in bleeding from an artery you would apply pressure on the side of the wound *nearest the heart*—that is, in the limbs *above* the wound; in bleeding from a vein

[1] This accounts for the peculiarly violent and dangerous character of arterial bleeding. In the veins the pressure of the blood current is much less—only about a quarter of a pound to the square inch.

you would, on the contrary, apply the pressure on the side of the wound *farthest from the heart*, that is, in the limbs *below* the wound; and in bleeding from the minute capillaries, as in scratches, abrasions, and simple flesh wounds, you would apply the pressure to the whole of the raw and bleeding surface.

Second in importance only to *pressure*, as a means for the temporary arrest of bleeding, comes *position*. In health, when the heart and blood-vessels are sound, the circulation keeps steadily going on, and, no matter what position we are in—standing, lying down, or otherwise—the blood never sinks down or accumulates in the lowest or most dependent parts of the body. Thus, when in the erect position with the arms hanging down, the blood does not gravitate towards the hands and feet, because the column of blood in the arteries and the column of blood in the veins mutually balance each other, and the force that drives the blood *down* the arteries of the limbs (the pumping action of the heart) lifts *up* the column of dark blood in the veins. Once, however, let the balance of the circulation be destroyed, once let any of the blood-vessels be opened, then the blood tends to gravitate and rush down out of the wound—that is, when the injury is in a dependent part of the body; and for this reason it is always very important, in a case of bleeding, to *elevate or raise up the wounded part above the level of the trunk.*

Another resource in cases of bleeding is the application of *cold*, in the shape of cold water, ice, or cool fresh air. This acts by causing contraction and diminution in size of the arteries and capillaries at the seat of injury.

Lastly, there are certain astringent substances, or *styptics*, as alum, steel drops, and powdered galls, which have the effect of clotting the blood, and causing shrinking of the blood-vessels, when applied to the raw surface of a wound.

Your resources, then, for the temporary arrest of bleeding are, first and foremost, *pressure;* then, next in importance, *position;* afterwards, I place *cold;* and lastly, as they may occasionally be useful, *styptics.* I must now show you how to apply these different means for the arrest of bleeding; and first of all I will consider the methods of giving first aid in

Arterial Bleeding or Hæmorrhage.

If you refer to the diagrams, you will be able to follow me better as I point out the direction in which some of the more important arteries run. Commencing with the upper part of the body, you see that a large artery ascends on each side of the neck towards the head (Fig. 5). If you draw a line from the joint between the collar-bone and breast-bone to the angle of the jaw, that will show you the position of the artery. Feel for it in your own necks, and you will, after very little searching, feel it beating under your fingers. These are called the carotid arteries (you may have seen the name mentioned in the accounts of suicide by cutting the throat); and they split up into numerous smaller branches which carry blood to the brain inside the skull, and to the face, scalp, and other structures outside the skull. One branch courses over the side of the lower jaw-bone—about the middle of it—to supply the face with blood, and several others supply the scalp; one runs up the forehead above the eyebrow, another in front of the ear over the temple, another behind the ear, and yet another up the back of the head. All these spread about, dividing into smaller branches and communicating with each other and with corresponding arterial branches from the opposite side of the head so as to form a large network underneath the scalp.

Arterial Bleeding from Wounds of the Head.

We often meet with men who are badly cut and bruised about the head either by tumbling on rails or other hard material; or by dirt, rock, or coal coming down on them while working in the colliery; or by blows from sticks or stones in some drunken row, the scalp being torn, and the bright red blood spouting out for a distance of one or two feet from an injured artery. Most of you have seen such cases, and if working in the colliery have probably tried to check the bleeding by pushing tobacco into the wound, whilst in other instances the flour bag has been resorted to, and the man's head covered with flour, making a matted horrible sticky mess very troublesome to get off. Such means are dirty, unreliable, and unsafe; for, though the bleeding may perhaps be checked for a time, it will in all probability break out again, and very likely the wounded artery will begin spouting afresh precisely at the time when no assistance is at hand. I met with a case of this sort recently; bleeding recurred quite unexpectedly a week after the accident. Now, you can easily render valuable help in these accidents. You can at once stop the bleeding completely by pressing firmly with your finger on the spot from which you see the blood spouting, for by so doing the wounded and bleeding artery is quite compressed, squeezed, and closed between your finger and the hard skull of the patient, and any escape of blood from it is quite impossible so long as the pressure is kept applied. Here then you stop the bleeding by *pressure with the finger*, or, as it is sometimes called, *digital compression;* and if the doctor happens to be close at hand you can keep the bleeding under in this way until he takes charge of the patient. But if, as is usually the case, the patient has some little distance

to go home, or he has to be assisted or carried to the neighbouring hospital or surgery, then it becomes—to say the least—irksome and inconvenient to keep on pressing his head with your finger. Pressure must still be kept on the wounded blood-vessel, but in another way. You must make a pad of something—whatever is at hand—a folded handkerchief, a piece of torn clothing doubled up, wadding, tow, linen, lint, flannel, or hay rolled up hard, a piece of smooth stick, or a cork, or anything else suitable, and fix it firmly and securely on the wound by means of a bandage, so that it presses on the injured artery and keeps it from spouting. If you have time, and the material at hand is suitable, you should make your pad of a somewhat conical shape, and press the narrow part of it direct on to the wound: you can do this by doubling up a small piece of the lint, or whatever substance you are using, and pressing it firmly down into the wound, then putting a larger piece on the top of it, a broader bit still over that, and so on until your pad reaches about an inch in thickness, and lastly you fix it tightly and securely in its place by bandaging. It does not very much matter how you put on the bandage, providing you so arrange it as to keep the pad firmly and tightly in its proper position, and maintain constant strong pressure on the wound. But it requires a little tact and care frequently to fix the pad on safely, more particularly if the wound happens to be on the side of the head: in this case lay the centre of your triangular bandage (folded narrow) on the opposite side of the head to the wound, bring it round and cross it over the pad, bringing one end up towards the top of the head and the other below the chin—much as if you were tying up a parcel—and tie the ends together at the sound side; or you may twist the bandage over the pad, turn the ends back, and tie on the sound side; or simply carry the ends over the pad and fasten as before; or if you have two

bandages, you can carry the first one around the fore and back parts of the head, and the second one over the top of the head and under the chin, crossing or twisting them both over the pad. Similarly, in bleeding from the forehead, top and back part of the head, you had better place the middle of the bandage on the part of the head opposite the wound, then carrying the ends towards the wound either twist them on the pad, turning them back again, or merely cross them over the pad carrying them forward, and tie them on the sound side of the head. In this way, if the wound is on the top of the head, the knot as well as the middle of the bandage is under the chin; if it is the forehead that is bleeding, the knot and middle of the bandage lie on the back of the head; and if the injured artery is at the back of the head, the knot and middle of the bandage are placed on the forehead.

I wish you to practise the making of small pads and the fixing of them on different parts of the head with your triangular bandages. But accidents always happen unexpectedly, and when your help is wanted in earnest you are not likely to have an illustrated triangular bandage, with a paper of instructions neatly folded and pinned, in your pocket. You must use your wits in such a case, and make anything that is most handy and suitable do duty as a bandage—a pocket-handkerchief, a scarf, or neck-handkerchief would do; or a brace, a garter, or a leather strap might serve the purpose.

You see that in the way I have described bleeding can be checked by *pressure with a pad and bandage;* and if you do your work properly a man dressed in this way can with perfect safety wait a long time for his medical attendant, or be conveyed either to his home or a neighbouring surgery.

Arterial Bleeding from Wounds of the Face.

You may be called upon to give assistance in cases of injuries of the face, such as cuts and lacerations of the lips and cheeks, accompanied by smart arterial bleeding. Now remember that the artery which supplies the face with blood runs (one on each side) over about the middle of the lower jaw; if you try and find it you will easily feel it beating on yourselves. You can check the bleeding in such cases by squeezing and pressing the artery firmly against the jaw-bone with your finger or by means of a pad and bandage. If you use a pad be careful to fix it on securely, the bandage being carried from under the chin to the top of the head, crossed, and brought down to be tied beneath the chin. You may also apply pressure at the spot where the injured artery is spouting by putting your forefinger inside the cheek or lip, as the case may be, and your thumb outside, and squeezing the wounded vessel firmly between them. Here again always use your fingers first, and then think how you can best make and apply your pad.

Arterial Bleeding from Wounds of the Neck.

I have already described to you the position of the carotid arteries which run one on each side of the neck up towards the head. Wounds of these large vessels are generally fatal at once from loss of blood, and, excepting on the battlefield, are usually the result of attempts at suicide or murder. If any of you should ever happen to be at hand in such a terrible emergency, you must do your best to check the bleeding by pressing the injured artery with all your strength backwards against the spine. You can do this either by pressing with your thumb or fingers on the

side of the wound nearest the heart (that is, in this case, *below* the wound, Fig. 18), or by pressing on the broken spouting blood-vessel *in* the wound. In either way your object is to compress the artery firmly against the spine until medical assistance arrives. It is, of course, plainly impossible to fix on a pad and bandage in an injury of this kind. Your only chance of stopping the bleeding is by

Fig. 18.—DIGITAL COMPRESSION OF THE CAROTID ARTERY.

digital compression, and to apply it with any chance of success you must act with the greatest promptitude, coolness, determination, and courage; and you must apply very strong and continued pressure, or the blood will be forced by the heart's action through the large wounded artery.

I now come to the upper limbs. Referring to the diagram (Fig. 5) you see that each arm is supplied with blood by a large artery which lies deep behind the collar-

bone, and crosses over the first rib down into the armpit. You can, by pushing your fingers firmly down behind the middle of the collar-bone, feel the beating of the artery; and you can find it also lower down in its course by pushing your fingers up into the armpit and pressing towards the upper end of the arm-bone. From the armpit the vessel can still be felt in its position along the inside of the arm, its direction corresponding pretty closely with the seam of the coat sleeve. It lies close along the inner edge of the large muscle of the arm, and reaches to a little below the front of the bend of the elbow, where it divides into two branches, one of which extends down the outer side, the other down the inner side of the fore-arm. You can feel both these arteries beating above the wrist, particularly the one situated on the outer side of the fore-arm, for it comes so close to the surface in this part of its course that its beating can be easily felt, and, indeed, often as easily seen. Wherever an artery is sufficiently near the surface of the body, its beating, pulsation, or pulse, may be readily felt and in many instances seen, but the expression *the pulse* is generally applied to the beating of the artery situated on the outer or thumb side of the fore-arm just above the wrist.

The two arteries of the fore-arm pass on into the hand, where they end by communicating with each other in such a way as to form two curves or arches, one deeper than the other, across the palm, from which smaller branches are distributed to the fingers.

I advise you to study the position of the different arteries with the aid of the diagram before you, and also to feel, whenever you have the opportunity, for the beating or pulsation of the vessels themselves in your own arms or in the arms of your comrades. The practical knowledge gained in this way will enable you to understand and to practise

the methods that I shall now explain to you for checking arterial bleeding in the upper limbs.

Arterial Bleeding from Wounds of the Armpit.

In this case your only resource is digital compression; and you can apply this in two ways:—either by boldly

Fig. 19.—DIGITAL COMPRESSION OF THE SUBCLAVIAN ARTERY.

pushing your fingers into the wound and jamming the injured artery tightly against the upper part of the arm-bone, or by pressing strongly with your thumb or fingers down behind the collar-bone (about its middle), so as to squeeze the artery against the first rib (Fig. 19). In this way you put pressure on to the artery above and away from the wound, on the side of the wound nearest the heart. It is often recommended that a door-key wrapped

up and padded should be used to press the vessel behind the collar-bone; but when an accident happens you have no time to run about looking for a key, and still less time for wrapping it up and padding it. You have always got your hands with you, and, if you are to give any help in a case of this sort, you must use them immediately and determinedly, forcing the artery with your thumb or fingers tightly down against the first rib. Practise this when you meet amongst yourselves; you will always know if you are pressing the artery effectually, as the pulse at the wrist will then stop.

Arterial Bleeding from Wounds of the Arm.

There are several plans by which you can check arterial bleeding from wounds of the upper arm and elbow, but they are really only different ways of doing the same thing —that is, applying pressure to the main artery on the side of the wound nearest the heart. The readiest method, and the one you should adopt in an emergency, is digital compression; and you do this by grasping the arm in the manner shown in the diagram (Fig. 20), so as to squeeze the artery tightly with your fingers against the arm-bone. You can stop the bleeding in this way *at once*, and then you have a little time to think what you had better do next. If a doctor is close at hand you can of course hold on to the patient's arm until the injury is attended to; but otherwise you must use some additional means to maintain pressure on the wounded artery until professional help is procured. You have received from the Ambulance Association a flat elastic band to which a small piece of tape is attached. This goes by the name of *Esmarch's elastic tourniquet.* It is an appliance, invented by Professor Esmarch, for checking

bleeding by pressure on the blood-vessels.[1] To fix it on the arm all you have to do is to stretch it well out and then bind it tightly round and round the arm above the wound, taking care that each fold corresponds exactly with the one underneath it, and finally tying the tape over it to prevent it unlapping. If this is put on properly no bleeding can take place, and the patient can be safely carried to his home or the hospital. But you may not have this useful little elastic band with you when it is most needed, and then you will have to improvise a tourniquet, or, in other words, make one out of whatever materials are most convenient and handy. Esmarch recommends that braces and soldiers' belts should be made always of some elastic material, so that they may be used as tourniquets in case of need.[2] This suggestion seems a good one, more particularly in connection with military service, as it is calculated that one-fifth of those who die on the battlefield lose their lives from bleeding.[3] The chief advantage of

Fig. 20.—DIGITAL COMPRESSION OF THE BRACHIAL ARTERY.

[1] Several different tourniquets, varying much in shape and construction, are used by surgeons; but all these instruments are simply mechanical contrivances for the arrest of bleeding by pressure which can be regulated—that is, increased or diminished—as occasion requires.

[2] Tourniquet braces, invented by Esmarch, were exhibited at the Health Exhibition, and are now supplied by the Ambulance Association, together with a sheet of diagrams and instructions illustrating their use.

[3] *Manual of Instruction for Attendants on Sick and Wounded in War*—Staff-Assistant-Surgeon A. Moffitt.

having elastic bands, tubing, or cord available is that it does not require any knowledge of the position of the arteries to enable you to fix such appliances on the limb, all you have to do being to wind your indiarubber band or cord several times tightly around the arm or leg *above* the wound.

Fig. 21.—COMPRESSION OF THE BRACHIAL ARTERY BY A TOURNIQUET.

But there are other ways of improvising a tourniquet. You can make a very good one by means of a *pad*, a *triangular bandage*, or *pocket-handkerchief*, and a *stick*. Place the pad over the artery, and fix it by winding the handkerchief (folded narrow) around the limb and tying it on the opposite side—not tightly, but sufficiently slack to allow of the stick being pushed under it. Thrusting the stick under the handkerchief, twist it vigorously round; the handkerchief of course tightens, and the artery is jammed between the pad and the arm-bone (Fig. 21).[1] You can practise making this kind of tourniquet with your folded triangular bandage, a roller bandage for a pad, and your walking-stick or an office ruler. But you must not expect to have these particular articles always about you. You must be prepared to act independently in any emergency, and be quick to utilise any materials, no matter what, so that they are close at hand and suitable to your requirements. Thus you may make a pad of a wine-cork or a bung, a smooth stone, a

[1] In this figure the artery is compressed by means of an ordinary surgical tourniquet; but an improvised tourniquet—as shown in Fig. 24—acts exactly in the same manner.

billiard, bagatelle, or racket ball, a ball of worsted or a reel, a piece of wadding, tow, lint, linen, flannel, or cloth rolled up tightly, or a knot on the bandage around the limb will suffice. Instead of the triangular bandage a handkerchief or scarf,

Fig. 22.—COMPRESSION OF THE BRACHIAL ARTERY BY VÖLKER'S STICK TOURNIQUET.

a belt, brace, or strap of any kind, would do. On a battle-field there are always plenty of straps, belts, and pieces of accoutrements, etc., suitable for the purpose. To tighten

your tourniquet you could use on the battlefield bayonets, scabbards, rifle-cleaners, and fragments of lances, etc.; while in civilian life there are usually available such articles as sticks, parasols, umbrellas, pencils, wooden measures, knife-handles, large keys, rulers, pieces of wood, or branches of trees. The police could use their truncheons, cricketers their wickets, billiard-players their cues, and tennis-players their racket handles. Should you be unable in a case of emergency to improvise a pad, you must not lose time, but at once tie your scarf or handkerchief round the arm, and twist it tighter and tighter with your stick until the bleeding is stopped. You may improvise a tourniquet in another way, viz. by taking two pieces of stick about eight inches long and placing one across the inside and the other across the outside of the arm, and tying them tightly together by a couple of handkerchiefs or straps (Fig. 22). By this plan the artery is compressed between the inside stick and the arm-bone. This arrangement goes by the name of *Völker's stick tourniquet.* The same result is attained by placing one stout stick between the chest and arm and binding the latter tightly to the side.

Now you must practise the application of digital compression and the making of improvised tourniquets frequently amongst yourselves; but, should an accident happen, do not let the injured man die from loss of blood while you are hunting about for an Esmarch's tourniquet, or feeling in your pockets for a handkerchief. Remember that whatever else may be missing you always have your hands, and act at once by flattening the artery against the arm-bone (at the *upper* and *inner* part of the arm) with your fingers, and then having arrested the bleeding, think how you may best improvise a tourniquet.

Arterial Bleeding from Wounds of the Fore-arm.

You can stop arterial bleeding in the fore-arm by arresting the current of blood in the main artery higher up. You may either apply digital compression, an Esmarch's elastic band, or an improvised tourniquet to the upper arm, in the manner I have already explained; or you may forcibly bend the patient's elbow, tying the fore-arm tightly with a handkerchief, triangular bandage, scarf, or anything else suitable to the upper arm. In this way the artery is so much bent that the current of blood is arrested. If there is anything handy with which you can make a pad, fix it in the hollow of the elbow before you bend the arm, and then you will have, as an additional safeguard, pressure on the artery as it lies in front of the lower end of the arm-bone. Should one of the arteries of the fore-arm be injured where it comes close to the surface just above the wrist, you can apply strong digital compression to the wound itself, or fix a pad and bandage tightly on. Not so long ago a man's wrist was laid open by the bursting of a steam gauge; many in this room must recollect the case, and must also remember how well and effectually a comrade checked the violent bleeding by twisting and tying a knotted handkerchief tightly round the wrist, arranging it so that the knot acted as a firm pad, pressing strongly on the wounded artery, and squeezing it against the hard bone underneath. But if you have any difficulty in a case of this description, remember you can always arrest the bleeding at once by pressure on the main artery in the upper arm, or by placing a pad in front of the elbow and forcibly bending the fore-arm against the arm.

Arterial Bleeding from Wounds of the Palm.

You can check arterial bleeding from wounds of the palm of the hand either (*a*) by direct pressure on the injured vessel at the seat of injury, or (*b*) by arresting the arterial current higher up in the arm. (*a*) The readiest method is digital compression, and the best way to apply this is to press firmly down on the bleeding point with your thumb. If professional aid is near at hand this will be sufficient; but if the patient has to be taken some distance to his medical attendant, then you must apply pressure to the wounded vessel by a good strong pad placed on the palm. The pad should be made of a conical shape, the point of the cone to be thrust into the wound right down on to the injured artery. Pads should, when possible, always be arranged in this form when applied directly to a wound for the purpose of arresting arterial bleeding, as they are much more effective than an ordinary-shaped flat pad. I have already told you how to make a conical pad, or, as it is sometimes called, a *graduated compress*, when speaking of arterial bleeding in cases of scalp wounds. To keep the pad firmly in its place, you double the fingers over it, and tie them tightly down by bandaging round the closed hand with your handkerchief, triangular bandage, or scarf. You will find this plan of applying direct pressure to the wounded artery suitable in most cases of arterial bleeding from the palm; but if the injury to the hand is extensive, then you can easily arrest the arterial circulation higher up—just above the wrist, at the elbow, or at the upper arm. (*b*) You can apply digital compression above the wrist to the two arteries of the fore-arm where they run close to the surface just before they enter the hand: and you do this by tightly squeezing the

vessels with your thumbs against the bones of the fore-arm, but to act effectually you will have to press very hard and perseveringly, and the probability is that your hands will soon get wearied. If you can manage it, therefore, it is better to apply pressure to the two arteries by fixing two firm pads tightly on them by means of a bandage or strap. You will have to use your ingenuity in making suitable pads—very good ones can be made of a cork cut down the middle, or of pieces of a penholder or pencil, placed lengthways. But if you get nervous, or if you bungle over your efforts to stop the bleeding by pressure at the seat of injury and at the wrist, never forget that you can at once control bleeding in the hand, as well as in the fore-arm, by either forcibly bending the elbow, or by compressing the artery in the upper arm with your fingers or a tourniquet.

There is one very important point to which I have not yet alluded in connection with the rendering of first aid in cases of arterial bleeding from wounds of the upper limb. I mean the *position* of the limb. Always keep it *raised.* No matter what else you are doing to staunch the bleeding, —whether you are applying digital compression, or pressure by a pad and bandage, or an improvised tourniquet—always remember to keep the arm raised. If the injured man is lying down, keep the arm lifted up yourself, or prop it at a higher level than the body on cushions or folded clothes. If he walks home or to his doctor, see that the arm is slung up well before he starts—don't merely talk about it and leave others to do it, but sling it for him yourself high up so that the fingers of the injured limb are close to his opposite shoulder. If it is required to sling an arm (in a case of bleeding, fracture, or any other injury) and there is no bandage, handkerchief, or scarf available, you may either utilise the patient's clothing or you can make a *pin sling.* Thus, you may turn up the skirt of the coat and pin it in

proper position to form a support for the arm; or you may cut up the coat and shirt sleeves and pin them up so as to make a sling;[1] or in some instances you may bend the patient's elbow, raise his hand well up, and pin the coat sleeve *at the wrist* firmly to the coat, fixing as well a fold of the sleeve *under the elbow* tightly to the coat in the same way—additional security being attained by the use of a third pin to fix the *inside of the arm* sleeve to the body of the coat.[2] In these kinds of improvised slings it is of course much better to use safety pins when they are available in preference to ordinary pins. If the patient is carried off on a stretcher it is the business of one of the bearers (as I shall explain in the final lecture) to specially attend to the injured limb, and see that it is supported in a proper position.

I now come to the lower limb. This is supplied with blood by a large artery which crosses from the trunk of the body over the fore part of the haunch-bone into the thigh (Fig. 5). The artery enters the thigh at the centre of the fold of the groin, and for the first three or four inches runs near the surface and can easily be felt pulsating; it courses downwards and inwards, finally passing backwards on the inner side of the thigh-bone towards the ham.[3] The position of the artery is shown when the knee is partly bent and the thigh twisted a little outwards, by a line drawn from the middle of the fold of the groin to the inner side of the knee. Reaching the back of the thigh about its lower third, the artery runs down the middle of the ham at the back of the knee-joint, and a little below the joint it divides into two branches. One of these runs down the fore part

[1] *The Treatment of Wounded in War—Esmarch.* Translated by Clutton.

[2] "A pin sling," Sampson Gamgee, *Lancet*, September 22, 1884.

[3] The part of the lower limb behind the knee, between the thigh and leg, is termed the *ham.*

of the leg, but is deeply placed until it gets near the ankle, when it comes close to the surface and can be felt beating as it courses along the front of the instep towards the back of the foot. The other branch descends the back part of the leg, and it also is deeply placed at first, but as it approaches the ankle it comes near to the surface, and can be felt pulsating as it passes behind the inner ankle to the sole of the foot. Both these arteries terminate in smaller branches that go to supply the different parts of the foot.

Fig. 23.—DIGITAL COMPRESSION OF THE FEMORAL ARTERY.

You see that the plan of the arterial circulation in the two limbs is somewhat similar. The blood is conveyed to both arm and leg by means of one large main artery which courses along, in both cases, the entire upper part of the limb, dividing—below the elbow-joint in the arm, below the knee-joint in the leg—into two branches. These branches in both limbs are more or less deeply seated in the first part of their course, but come close to the surface as they approach the wrist and ankle joints respectively. In the palm of the hand there are two arterial curves or arches; in the sole of the foot there is one arterial arch. Again, the methods of checking arterial bleeding in the lower limb are very similar to those I have acquainted you with for stopping hæmorrhage in the upper limb. You

resources are the same, viz. digital compression, Esmarch's tourniquet, improvised tourniquets, and the pad (graduated compress) and bandage. The application of them only is different.

Arterial Bleeding from Wounds of the Thigh.

Strong and immediate pressure must be applied to the main artery above the wound in case of arterial bleeding from the thigh. To give effectual aid you must act at once, and with great determination. If you lose your head and hesitate, the patient will be dead from loss of blood before you have decided what to do. In a case of this kind you must resort immediately to digital compression, and the way to do this is to press with your two thumbs as forcibly as you possibly can (in the manner shown in the diagram Fig. 23) down on the artery at the centre of the fold of the groin. In this way you compress the vessel against the fore part of the large ring of bone called the pelvis; and this is the best and safest place to use digital compression. If the wound is not too high up to allow of it, you can, it is true, compress the artery with

Fig. 24.—COMPRESSION OF FEMORAL ARTERY BY AN IMPROVISED TOURNIQUET.

your thumbs against the thigh-bone for three or four inches lower down (that is, in the upper and inner part of the thigh), where the vessel lies near the surface; but you are not so sure of your grip in this position, more especially if the patient is stout. But whether you apply digital compression at the centre of the fold of the groin (flattening the artery against the fore part of the pelvis) or in the upper and inner part of the thigh (flattening the vessel against the thigh-bone), your hands will soon get tired—such is the force and persistency with which you have to press. While you hold on, then, one of your comrades must get your Esmarch's elastic tourniquet, or, if that is not available, he must improvise one, in the way that I have already explained, and fix it tightly on the upper part of the thigh above the wound, taking care that the pad is placed correctly over the artery (Fig. 24). By means of a tourniquet you can bring enormous pressure to bear on the injured artery, and can easily arrest the bleeding until the arrival of professional aid.

Arterial Bleeding from Wounds of the Ham.

In this case, you can either apply pressure to the artery of the ham above the wound by means of a tourniquet, or you can arrest the arterial current higher up (and this is the readiest way) by digital compression of the main vessel at the centre of the fold of the groin or in the upper third of the thigh, and then with the aid of a comrade apply a tourniquet.

Arterial Bleeding from Wounds of the Leg.

Here, again, you can stop arterial bleeding from wounds of the leg by compression of the artery of the ham or the

artery of the thigh, or—just as you can check bleeding in the fore-arm by forcibly bending the elbow—you can arrest the hæmorrhage by forcibly bending the knee and tying the leg tightly to the thigh. "This treatment," writes Esmarch, "can be successfully practised in cases where other means of arresting hæmorrhage are not at hand. It is, however, to be observed that a position sufficiently flexed to completely arrest hæmorrhage cannot be long tolerated."[1] In this way the artery of the ham is bent at such a sharp angle that the flow of blood through it is stopped. You can apply compression to the vessel as well by placing a pad in the hollow of the ham before you bend the knee. The artery of the front of the leg is liable to be injured at the lower part of its course where it comes near the surface, as it runs down in front of the lower portion of the large leg-bone over the ankle-joint to the top of the foot; but the bleeding can be easily stopped by pressure on the vessel above the wound. Use digital compression to stop the bleeding until you can get a good pad fixed tightly on.

Arterial Bleeding from Wounds of the Sole.

To check arterial bleeding from wounds of the sole of the foot you can—as in hæmorrhage from the palm of the hand—either apply (*a*) direct pressure at the seat of injury, or (*b*) arrest the arterial current higher up. (*a*) If you try the first method thrust your thumb down into the wound right on to the spouting blood-vessel,[2] and then

[1] *The Treatment of Wounded in War*—Esmarch. Translated by Clutton.

[2] "Several military surgeons think that, on the battlefield, the best plan for the bearers, attendants, and troops to adopt for the arrest of bleeding—from any part of the body—is to thrust their fingers into the wound and press directly on to the injured vessel. The Russians in the Crimean War, and the Austrians in the campaign of 1859, adopted this plan with success. It is on record that a young Austrian soldier arrested the bleeding from an

with the assistance of a comrade proceed to apply a good firm graduated cone-shaped pad tightly on with a handkerchief, scarf, or strap of some kind. (*b*) If you try the second method (and should the wound be an extensive one and the bleeding profuse, it is the best) apply firm pressure to the artery which supplies the sole of the foot where it lies near the surface *behind the inner ankle.* Examine your own lower limbs and you will easily feel the artery pulsating in this position, and you will also notice that it can be easily compressed with the fingers or by a pad fixed on with a handkerchief. If after fixing on your pad there is still some bleeding, place a second pad in *front* of the ankle, and a third *behind the outer ankle*, and bind all three pads tightly on with your handkerchief, scarf, or a strap. The purpose of the two additional pads is to compress the artery supplying the back of the foot and a small artery that lies behind the outer ankle, because both these communicate with the arterial branches of the sole. If you put on your pads properly the bleeding must cease, as the supply of arterial blood to the foot is quite cut off; but always remember that if you are in any difficulty you can at once arrest bleeding in the lower parts of the limb by compression of the artery of the ham, or artery of the thigh.

Lastly, in all cases of arterial bleeding from wounds of the leg, as in all similar injuries of the arm, always be very careful to see to the position of the limb. Always keep it raised. If the injured man is lying down or being carried on a stretcher, the limb must be lifted up or propped up on cushions, pillows, folded clothes, or anything else suitable, at a higher level than the body. In *all* cases of arterial bleeding from the lower limb, place the injured man *at once*,

injured femoral artery (*of his own left thigh*) for four hours by forcibly thrusting his left thumb into the wound, and so preserved his own life until treated by the surgeon."—*Gunshot Injuries:* Surgeon-General Longmore.

when you can, in the lying-down position, and if possible, have the limb elevated while you apply compression above the wound.

I think I have now told you all that is most important in connection with arterial bleeding. It remains for you to practise the application of improvised tourniquets, digital compression, etc., amongst yourselves; and I hope you will seize frequent opportunities of examining yourselves and each other, and trying to feel the beating of the different arteries in those positions where they run near to the surface, and where they can be compressed, for it is by such kind of practice that you will acquire practical knowledge. When practising digital compression, and the application of Esmarch's elastic band and improvised tourniquets to the larger arteries, you should always test your work by feeling for the pulsation of smaller vessels lower down in the limb—such as the arterial branches near the wrist and ankle joints. If the pressure you apply to the main arteries is effective, all pulsation lower down the limb ceases; on the other hand, if the pulsation continues, you are either applying insufficient pressure or you are applying it at the wrong spot.

Capillary Bleeding or Hæmorrhage.

The bright red blood is pumped by the action of the heart through the arteries into the capillaries, and it is during its passage through these little delicate tubes that the blood gives up the nourishment it contains to the surrounding tissues. To be healthy, all the different parts of the body must perpetually receive sustenance from the blood, and this is ensured by all the tissues and organs being pervaded throughout by a complete network of the small capillary tubes. You can understand, therefore, that when any part of the body is wounded, numbers of the capillaries are

necessarily broken, and there is a leakage of blood from them, or, as it is termed, capillary bleeding or hæmorrhage. In *all* wounds there is capillary bleeding, and should an artery or vein be injured, it is accompanied of course by arterial or venous bleeding, as the case may be. But in many wounds, particularly in slight ones, as scratches, abrasions, trivial cuts, etc., and also in ordinary flesh wounds, there is only capillary bleeding. This kind of bleeding is trivial compared with arterial and venous bleeding. In cuts from sharp substances, as bits of glass, razors, etc., and in extensive flesh wounds, the bright red blood may flow off pretty sharply, but there is no spouting from an opened artery, nor any dark stream pouring continuously down from an injured vein, but simply oozing—rapid, it may be, for a short time—from the entire raw surface of the wound. Capillary bleeding is easily stopped by *pressure* applied to the *whole of the bleeding surface*—pressure with your finger or thumb; or by means of a soft piece of linen, lint, or any clean rag wrapped around the part; or by the application of a pad and bandage. A piece of ordinary sticking-plaster strapped tightly across the wound is frequently sufficient. *Cold* is another remedy. It can be used by washing with cold water, exposing the wound to the cool air, or by the application of ice. You can combine pressure with cold by fixing on a pad that has been soaked in cold water. *Styptics*, such as alum, steel drops, powdered galls, and tannin, cause clotting of blood, and are occasionally useful for checking troublesome oozing.

Venous Bleeding or Hæmorrhage.

The different tissues of the body not only receive nourishment from the blood during its passage through the capillaries, but also give up to it certain hurtful and useless

materials which they must necessarily be rid of, and so the blood is rendered impure, and as it flows on from the capillaries into the veins becomes of a dark purple or blackish colour. The dark impure blood is carried from all parts of the body by the veins back to the heart, the direction of the blood current being exactly opposite to that in the arteries. The veins vary a good deal in position, some lying deep under the flesh, and others being quite close to the surface and often visible through the skin as dark blue lines or cords. It is these superficial veins that are more liable to injury. In thin people you can easily see them, particularly after exertion, on the backs of the hands, the front of the fore-arm and elbow, the top of the foot, the back and sides of the leg, and often in the neck.

The veins of the neck are sometimes cut in suicidal attempts, those of the arm may be injured by the slipping of a knife, and those of the leg by the careless use of a scythe. A more frequent occurrence is the rupture or bursting of one of the veins of the leg as a result of disease. This is an occurrence which it is by no means unlikely that you will meet with, and it is precisely one of those cases where you can give the most valuable assistance, even to the extent of saving life.

Many persons, especially women, suffer from an enlarged and diseased condition of the veins of the leg. The veins are seen to be swollen, knotted in appearance, and gorged with dark blood; and there is frequently, as a result of this state of the veins, dark red discoloration, swelling, and, it may be, ulceration of the limb. These people are suffering from *varicose veins* of the leg, and it is not at all an uncommon occurrence for one of these swollen diseased veins to give way with profuse—sometimes fatal—bleeding as the result. A pint or more of dark venous blood may be in this way lost in a few seconds; and yet, if you only know

how, you can immediately stop the bleeding with the greatest possible ease.

To arrest the bleeding from an injured vein you must—as in the other varieties of bleeding—resort to *pressure*, but in this case the pressure must be applied to the wounded vessel on the side of the wound *farthest from the heart*—that is, in the limbs *below the wound*. The readiest plan is to press your finger or thumb, whichever happens to be most convenient, on to the hole in the vein, and you can easily stop the bleeding in that way until you have time to make a pad and fix it firmly on to the wound by means of a triangular bandage, handkerchief, or scarf. If the wound is large and gaping, then of course you must apply pressure to the injured vein on the side of the wound farthest from the heart.

There is a point of importance in connection with bleeding from a ruptured varicose vein of the leg that I must explain to you. You are aware that veins, unlike arteries, are provided with valves, and these valves when they are in working order allow the blood in the veins to flow in its proper direction *to* the heart, but arrest it at once if, from certain movements or positions of the body, it tends to flow the opposite way *from* the heart. Thus it is that when a vein is cut the dark blood only wells up from the cut end farthest from the heart, escape of blood from the cut end nearest to the heart being prevented by the valves (that is, with the exception of the small quantity of blood in the vein between the cut end and the nearest valve). Now, veins that have become diseased and varicose are unnaturally and permanently enlarged, stretched, and swollen, and consequently the valves in them are rendered useless, so that if a varicose vein of the leg is accidentally cut across, bleeding not only occurs from the cut end farthest from the heart, but also is profuse from the cut end nearest to the heart, the

blood rushing copiously down through the wound direct from the trunk. This is the reason why, in a rupture or injury of a varicose vein of the leg, the bleeding is so profuse and dangerous; it also explains why, in order to stop the bleeding, it is necessary to apply pressure on *both sides* of the opening in the vein. If a varicose vein gives way, or if the wound is small, then by pressing on the bleeding point with your thumb or finger, or by means of a pad, you do actually apply pressure on both sides of the opening in the vein; but if the wound is large and gaping, and particularly if it is vertical in direction, slitting the vein up, then you must be very careful to apply pressure both above and below the wound.

Next to *pressure*, your chief resource in venous—as in other severe bleeding—is *position*. Always keep the wounded limb *raised*. In the case of a varicose vein of the leg bursting you can at once arrest the bleeding by pressing with your finger on the hole in the vein, at the same time placing the patient in a lying-down position with the leg well raised.

Lastly, always be careful to remove any article of clothing that is at all tight and worn anywhere on the side of the wound next the heart, as any constriction in such a position interferes with the flow of blood through the veins, and tends to increase the bleeding. Thus, in the case of a ruptured varicose vein always remove the garter; in venous bleeding from the neck loosen the collar and necktie; and in other cases loosen the braces, belt, waistband of trousers, etc., according to the position of the wound.

Internal Bleeding or Hæmorrhage.

Bleeding, when the blood escapes directly outside the body, is called *external*. And I have shown you how by the proper application of *pressure*, due attention to *position*,

the use of *cold*, and occasionally of *styptics*, you may generally give most valuable assistance in cases of external bleeding. Bleeding is called *internal* when it occurs inside the body. The blood-vessels inside the head, chest, and belly may be ruptured either from disease or injury, the blood escaping into one of the cavities, organs, or passages of the body. Thus, as a result of disease, blood-vessels may give way in the brain, the lungs, and the stomach; and any of the deeply-placed blood-vessels may be opened by such injuries as bullet wounds and stabs. Internal bleeding is sometimes the result of a bone being broken; for instance, bleeding inside the head may be caused by a broken skull, or bleeding inside the chest by a broken rib. In many cases of internal bleeding you never see any blood at all; in other instances the blood escapes from the body in one way or another; thus the patient may cough up blood if there is bleeding in the lungs, or vomit blood if a blood-vessel in the stomach has ruptured.

You cannot give so much assistance in cases of internal as in external bleeding, because you cannot get at the wounded vessel to apply pressure to it. But you can attend to the *position* of the patient, and resort to *cold*, and you can give him astringent drinks. You should place the patient in a comfortable lying-down position, with the head slightly raised, and, above all things, let him rest as quietly as possible. Do not allow bystanders to worry and excite him with talk. Keep people from crowding around him, and if in a room open the window so that there shall be plenty of cool fresh air. If there is any spitting or vomiting of blood get ice if possible, and give small pieces of it to suck. If ice is not available give small quantities of cold water or vinegar and water for the patient to drink, and apply cloths steeped in cold water, or ice in a bladder, to the chest, or as near as possible over the spot where bleeding is going on.

Lastly, you can give the patient astringent drinks, such as alum and water, or cold strong tea (which contains tannin). Of course all tight clothing should be removed.

Bleeding from the nose is occasionally very severe and troublesome, whether it be the result of accident or disease. To check it keep the patient's head raised, *not hanging forward*, and apply cold—in the shape of ice, iced water, or sponges, cloths, or handkerchiefs steeped in cold water—to the root of the nose and to the back of the neck. If the bleeding is obstinate make the patient stand up, then suddenly lift his arms straight above his head, and keep them up for a few minutes. If he only lifts one arm up it should be the one on the same side as the bleeding nostril, and with the disengaged hand he should squeeze the nostril. Dr. Negrier of France and others have used this plan with the greatest success, and it has also been successfully adopted in cases occurring among the men of the 104th Regiment.[1] If you happen to have a syringe, you can syringe the bleeding nostril with cold water, or alum and water; but the application of cold, and the plan of raising the arms, is usually sufficient.

For *bleeding from the tongue* wash the mouth out well with cold water, or alum and water. If ice is available small pieces should be sucked. The collar and all other parts of the clothing about the neck should be loosened. The patient should breathe through the mouth, and he should be placed so as to get the benefit of as much cool fresh air as possible.

[1] *Diseases of the Nose*—W. Spencer Watson.

LECTURE III.

Broken Bones or Fractures.

The methods of rendering first aid in such accidents—The application of splints and bandages—The signs of fracture—The difference between fractures and dislocations—First aid in cases of sprains and contusions.

When a bone is broken it is said to be *fractured.* Any of the bones of the skeleton may be injured in this way. Sometimes a fracture is caused by direct violence, such as a kick from a horse, or a fall of rock, the bone being broken at the seat of injury. In other instances a fracture is caused by indirect violence, as when a man jumps from a great height and has his legs broken, and this though he alights on his feet. Similarly many a collar-bone has been broken by heavy falls on the shoulder, elbow, or outstretched hand. More rarely a bone is fractured by violent action of the muscles. The most familiar example of this is fracture of the knee-cap by a desperate effort to recover oneself after slipping. When a bone is fractured by very great violence, as in gunshot wounds, railway accidents, etc., the flesh at the seat of injury is often torn and lacerated, so that there is a wound right down to the broken ends of the bone. Such a fracture is said to be *compound.* When a bone is broken, and there is no accompanying injury to the flesh or any other

of the neighbouring parts, then the fracture is a *simple* one. Now a simple fracture can be made into a compound one very easily by the struggling and efforts to rise of the patient himself, or by the rough and careless handling of the injured part by the bystanders. If the patient struggles or attempts to move himself, or if others try to carry him away from the scene of the accident without the injured limb being properly supported, the broken ends of the bone are liable to be pushed through the skin, making the fracture a compound one. Such a mishap is most serious, for it not only adds to the pain and suffering of the patient, but it, at the best, delays his recovery, and too often either his limb or his life is sacrificed. Even if—in spite of incautious movements of the patient, or careless handling of him by his helpers—the broken ends of the injured bone do not actually penetrate through the skin, they may nevertheless tear open a large blood-vessel or wound some important nerve. It is a well-known fact that many a limb, and, alas, many a life, has been lost by the unskilful, careless, or rough handling of well-meaning but ignorant friends, who in their attempts to give help in cases of fracture have forced the broken ends of the bone either through the flesh and skin, into some large blood-vessel, or into some other important neighbouring structure. When any of the bones of the trunk are fractured, one or other of the important internal organs are often injured, or if these escape at the time of the accident they will certainly be torn or crushed by the broken edge of the fractured bone should any carelessness or unskilful handling be displayed in carrying the patient from the scene of the accident. Thus great care must be taken in the transport of a man who has had two or three ribs fractured, or the rough jagged ends of the broken bones will be pressed against the lungs.

Now comes the question, How can you give help in cases of fractured bones? You can render most valuable assistance

by supporting the injured part so as to prevent the fragments of the broken bone from moving about and tearing the surrounding tissues. By so doing, in all instances you can relieve pain; in the case of an injured limb you can prevent a simple from becoming a compound fracture, or the jagged end of the bone from wounding some important blood-vessel or nerve; in the case of an injury to one of the large cavities of the trunk, such as the chest or pelvis, you can hinder the rough edge of the broken bone from penetrating some important internal organ, and even if there is some internal injury resulting from the accident, you can at least prevent further mischief during the conveyance of the patient to his home or the hospital.

In fractured limbs you can best support and fix steadily the broken fragments of the bones by means of splints and bandages, and you should apply these, if possible, *before the patient is moved.* It may be necessary, however, to get the injured man away from the place where he was hurt immediately; for example, he may be in a position of great danger, and you have no time to provide or apply splints before removing him to a place of safety. Frequently too, especially in coal-pits and other large works, accidents happen in spots where, from overcrowding, want of room, and bad light, it is practically impossible either to examine the patient or to apply splints until he is removed, at all events, a short distance. It is very important, therefore, that you should know how to hold a fractured limb so as to properly support it during the removal of the patient. A person cannot well apply splints single-handed, so it is equally desirable that you should be able to grasp and steadily raise a fractured limb while a comrade binds on the splints. Now, in handling a fractured limb—whether you have charge of it during the removal of a patient, or are assisting to apply splints—you must hold it firmly and fixedly in as natural a position as possible, taking

particular care that there is no bending of the limb at the point where the bone is broken; and to accomplish your object you should place one hand underneath the limb above the fracture, the other underneath the limb below the fracture, and grasp the limb with sufficient firmness to prevent it slipping or rolling. In this way the limb rests upon, and is well supported by, the palms of the hands, and can be held safely in position without risk of the fragments of the bone being displaced until splints and bandages are put on.

You have received from the Ambulance Association several wooden splints, some of which are provided with a metal socket at one end. These are for use in cases of fractured limbs; and you are able by means of the sockets to fit two or three splints together, so as to form, if you require it, one long support—such as would be needed, for example, in the case of a fractured thigh. These splints would be very useful to you in an emergency if they were close at hand, and they are invaluable for practising with amongst yourselves. But you never know where you may be, or under what circumstances you may be placed, when an accident occurs; and most probably it will happen that, when you most require them, these ready-made splints will not be available. You must always be prepared therefore in an emergency to make temporary splints out of any suitable materials that chance to be near. Thus for this purpose you can use cardboard, the backs of books, folded or rolled up newspapers, leather, guttapercha, pieces of wood (Fig. 29), trellis flower-pot covers, cigar boxes, sticks of all kinds, parasols and umbrellas, broomsticks, policemen's truncheons, laths, spokes of wheels, wickets, palings, the bark of trees, mats, baskets, rolls of straw, heather, brushwood, rushes, and small branches; and, on the battlefield, lances, bayonets (Fig. 31), scabbards (Fig. 30), rifles (Fig. 27), and carbines. Straw mats were used by the French at the last siege of Paris

as splints. Telegraph wire and wire gauze are utilised by military surgeons for the same purpose. Bundles or rolls of straw tied together make very good splints; "a pair of these are rolled in the opposite borders of a cloth, the intervening portion of which is placed beneath the wounded limb; the bundles are thus adjusted, one on each side of the limb, and can be fastened there with cords" (Fig. 28).[1] A similar arrangement can be made with straw bottle-casings, and a handkerchief, napkin, or triangular bandage. In the same manner a coat may be slipped under a fractured limb, and the borders rolled up to it on each side, the whole being secured by handkerchiefs, scarfs, or straps. When splints are made of wood or other hard material it is necessary to place some sort of soft padding between them and the injured limb, such as cotton, wool, wadding, hay, moss, horse hair, dried sea-weed, lint, linen, flannel, or parts of the clothing (Figs. 29, 30, and 31). You can bind the splints on to the fractured limb by triangular bandages, pocket-handkerchiefs, napkins, neck-handkerchiefs, scarfs, garters, braces, tape, cord, belts, and straps of all kinds. In fractures of some bones—as the lower jaw, for instance—the application of a bandage is sufficient to give the necessary support to the broken fragments until medical aid is procured (Fig. 25), while in other cases, as fracture of the back-bone, all your efforts must be directed to the conveyance of the patient—gently, carefully, and without altering the position of his body—on a stretcher either to his home or to the nearest hospital.

Having explained to you in a general way how you can render valuable first aid in cases of broken bones, I will now refer more in detail to the different fractures which you are likely to meet with, and endeavour to point out how you may

[1] *The Treatment of Wounded in War*—Esmarch. Translated by Clutton.

best give assistance in each case. I will begin with fractures of the face and trunk.

The *lower jaw* is not unfrequently broken by direct violence, such as a kick from a horse, a blow from a man's fist, or a heavy fall. You can easily recognise this: the man cannot use his jaw, the gums are torn and bleeding, and usually one or more teeth are loosened. The line of the teeth and the under margin of the jaw are irregular; and on examining the injured part you can easily feel the broken fragments of bone rubbing one against the other. This rubbing or grating together of the rough edges or ends of the fragments of a broken bone is in any part of the body a sure sign of fracture, and is called *crepitus;* it can be felt by placing the hand on the seat of fracture (and in many instances heard as well) during movement of the injured part. The patient often distinctly feels the bone give way at the time of the accident, and, finding that he has lost power over the jaw, frequently tries to support it with his hands. You can give great relief in an accident of this kind by placing the broad part of a folded triangular bandage or handkerchief underneath the injured jaw, carrying the ends up and tying them at the top of the head; or if the handkerchief is long enough you may cross the ends at the top of the head, bring them down again, and tie under the chin. In this way the broken jaw will be well supported, but you can fix it more securely still by placing the centre of another handkerchief—should you be fortunate enough to have one —on the front of the chin, and carrying the ends backwards tie them behind the neck (Fig. 25).

Fractures of the skull, spine, and pelvis are usually associated with injuries of very important internal organs, and are therefore of an extremely dangerous nature. In fracture of the skull the brain suffers; in fracture of the spine the spinal cord is injured; and in fractured pelvis the bladder and

other vital parts are endangered. If symptoms of serious brain mischief follow after an accident, such as a heavy fall or blow on the head, then you may reasonably suspect fracture of the skull,[1] even though there is no appearance of external injury. A fragment of bone may be driven inwards on to the brain, or a blood-vessel may be ruptured inside the head, as frequently happens in fractures of the floor of the skull, or, as they are termed, "fractures of the base." In such cases, usually spoken of as *compression* of the brain, the brain is pressed upon by the piece of bone or by the accumulation of blood from the injured blood-vessel; and the patient lies insensible, more or less completely paralysed, with, it may be, occasional convulsive movements, snoring loudly, the eyes being insensible to the touch, the pupils insensible to light, and one or both of them dilated; and with all this there may be bleeding either from the ear, mouth, or nose, or, more rarely, a copious watery discharge from the ear.

Fig. 25.—CHIN-SLING OF HANDKERCHIEFS FOR A BROKEN LOWER JAW.

Fracture of the spine is easily recognised on account of the accompanying injury to the spinal cord, and the paralysis of the parts of the body below the seat of the fracture. Many of you, unfortunately, have seen accidents of this description, and well remember the heavy fall of coal or dirt on your comrade's back, the tenderness and pain caused by the blow, and worst of all the loss of feeling in the sufferer's legs and his inability to move them—sure signs, you know as well as I do, of serious injury to the spine.

[1] The brain, however, is not always injured in fractures of the skull, so that this accident may be followed only by symptoms of stunning, or indeed for a time by no symptoms at all. But if symptoms of serious injury to the brain follow a blow or fall on the head—whether there is any wound of the head or not—then you may reasonably suspect fracture of the skull.

Fractures of the pelvis are the result of great violence—such as a squeeze between the buffers of two railway trucks. The patient is unable to stand, and any movement or attempts to get up cause great pain and a feeling as if the body was giving way. Sometimes you may be able to feel crepitus. The great danger in these cases is that the bladder or other vital parts may be torn.

Now, in all these serious cases of fracture you should endeavour to convey the sufferer as steadily and as gently as you can to the nearest hospital or to his home, and you must be particularly careful when lifting him on and off the stretcher that you disturb the injured part as little as possible. Medical aid should be sought for at once; but in the meantime the patient should be placed in the lying-down position with the head slightly raised. In fractures of the skull you can, before the doctor arrives, apply cold to the injured part, especially if there is any bleeding from the ears, nose, or mouth. Ice may be used for this purpose broken into small pieces and tied up in a bladder; or you can apply sponges, cloths, or folded handkerchiefs steeped in cold water. You should be careful also to remove anything tight about the neck and chest, such as the collar, necktie, and braces. The bedroom, too, should be darkened, and the patient kept as quiet as possible. Above all things, do not attempt to give any brandy or other stimulant, and keep the room clear of talkative, noisy, though it may be sympathetic and well-meaning friends.

In all these serious injuries to the head and trunk you should make a point of examining the patient's feet, and if they feel cold you should apply hot-water bottles, bladders of hot water, or heated bricks wrapped up in flannel. You must be careful, however, in cases of insensibility from a fractured skull or loss of feeling in the feet and legs from a broken back-bone, not to make your water bottles or bricks

too hot, or the feet of the patient may be severely burnt. I allude to this precaution, as not very long ago I met with a case of fractured spine in which this misfortune actually happened.

I wish once more to impress upon you, in all these serious cases, the supreme necessity of exercising the greatest possible gentleness, care, and judgment in the conveyance of the patient from the scene of the accident. The injury resulting from the accident is always very dangerous, but any roughness, careless handling, jolting, or jerking on your part, will aggravate the existing mischief and render the case positively hopeless.

Fracture of the ribs is a rather frequent accident. The patient complains of sharp catching pain at the seat of injury, greatly increased by coughing and deep breathing. He describes the pain as "catching his wind," or "catching his breathing," or he says he "cannot get his wind for it;" and in order to relieve his suffering as much as possible he takes short breaths. This kind of breathing is described as *shallow*. You may feel crepitus if you place your hand over the seat of injury when the patient coughs. Frequently, in these accidents, the lung is penetrated by the broken end of a rib, and there is internal bleeding and spitting of blood. Now, though of course the ribs must continually move in the act of breathing, you can steady and support fractured ribs and prevent undue and excessive movement of the broken fragments by applying a broad bandage over the seat of injury and carrying it around the chest. A triangular bandage, or a good-sized handkerchief, folded broad, or a scarf, would serve the purpose very well, the broad part being placed over the seat of injury, and the ends carried around the chest and securely fastened with pins or tied. Firmer and more comfortable support is afforded by binding the chest around tightly with a good flannel bandage about six

inches wide. If plenty of sticking-plaster is available, you may apply broad strips, one overlapping the other, right around the side of the chest from the breast-bone to the spine. In this way, by steadying and supporting the injured ribs, and checking undue motion of the broken fragments, very great relief is given to the patient, and the risk of the lung being wounded by the broken ends of the bone is very much lessened. A patient with broken ribs, after being bandaged, should always, when practicable, be removed on a stretcher, the upper part of his body being supported by cushions or folded clothes, so that the chest may be well raised and at the same time slightly inclined towards the injured side.

Fracture of the collar-bone is a common accident, frequently being caused by falls on the shoulder and outstretched arm. In other instances it is broken by direct violence to the bone itself. You can, as a rule, easily see what is the matter. The patient comes to you with his head leaning towards the injured side, and supporting the elbow of his helpless arm with the other hand; the shoulder is much lower down and nearer the breast-bone than is natural. On passing your finger along the collar-bone you at once notice the irregularity caused by the fracture, and can feel the broken end of the inner portion of the bone through the skin, the outer fragment of the bone being depressed. If you raise the shoulder by pushing up the elbow most of the disfigurement is removed, and if you gently twist the arm at the same time that your other hand is placed over the fracture crepitus is easily felt. There is no difficulty, therefore, in recognising a broken collar-bone, and you can give very valuable assistance to the patient. You must improvise a good pad, and push it right up into the armpit of the injured side at the same time that you raise the shoulder by pressing up the elbow, keeping the latter, however, close to

the side. You then put on a large arm-sling, so as to keep the shoulder raised to its proper height; and lastly, you bind the arm to the side with a scarf, folded handkerchief, or triangular bandage. The pad should be firm and of a fair size; it should be about three inches thick at its upper part and taper downwards, so as to be of a conical or wedge shape. When the pad is pushed well up in the armpit at the same time that the elbow is pressed against the side, the shoulder is thrown outwards into its natural position, and is kept at its proper distance from the breast-bone. The large arm-sling, which should thoroughly support the elbow, keeps the shoulder raised to its proper height.

In *fracture of the arm-bone* the arm is, of course, quite helpless; crepitus can be felt; there is often more or less deformity—or loss of the natural shape—of the arm, which is due to shortening caused by the lower fragment of the arm-bone being drawn upwards by the action of the muscles; and there is mobility at the seat of the fracture—that is to say, the arm can be bent at the place where the bone is broken. To support the injured bone, and keep the broken fragments steady in their place, you should apply three or four padded splints to the arm (Fig. 26). These splints should reach from the shoulder to the elbow; and after they have been securely bound on by means of triangular bandages, handkerchiefs, or straps, a small arm-sling should be put on. It is undesirable to use the large arm-sling in this instance, because on no account must the elbow be pushed up. In the diagram (Fig. 26) you notice that a roller bandage is applied from the hand to the elbow; but, though the fore-arm would be bandaged by the surgeon in his treatment of the case, you—in giving first aid—should at once direct your attention to putting on the splints and slinging the arm; indeed, in an emergency, you would neither have the time nor the means for anything else.

Fracture of the fore-arm is rather a common accident, and, as in the case of fracture of the upper arm, and I may add fractures of all the long bones of the limbs, you easily know it by the unnatural shape of the injured part, the crepitus, the mobility at the seat of the fracture, and the complete uselessness and helplessness of the limb. You can best support a broken fore-arm by bending the elbow at a right angle, with the thumb pointing upwards, and applying two splints—one on the inside of the fore-arm from the bend of the elbow to the ends of the fingers, and the other on the outside of the fore-arm from the elbow to the wrist. After you have securely bound on the splints you should further support the fore-arm by putting on a large sling.

Fig. 26.—SPLINTS FOR A BROKEN ARM.

For *injuries of the small bones of the hand* you bind on a splint along the front or palm side of the hand, and then put on a small sling. These fractures are not unfrequently the result of fighting, and can be usually recognised by the pain and swelling of the affected part, and crepitus. To support a broken finger you can easily fix a small cardboard splint along the front of it by means of strips of sticking-plaster, pieces of tape or ribbon, or a strip of your handkerchief; and do not forget to sling the hand. When putting on the small arm-sling in cases of this description it is better to arrange it so that the end which passes in *front* of the hand shall be carried over the *opposite* shoulder, as in this

way the hand receives the most support; and if handkerchiefs or scarfs are not available for making a sling, you may (as mentioned in the previous lecture) use either a *pin sling*, or make the skirt of the coat or the cut sleeves of the coat and shirt serve the required purpose by pinning them up over the injured arm. Men who have sustained fractures of the arm or collar-bone should not be allowed—even when first aid has been rendered to them—to walk home or to the surgery by themselves, as they may become faint or giddy on the way and fall in such a manner as to greatly aggravate (and increase the danger of) their injuries. If in much suffering, the patient should be carried either in the sitting position or on a stretcher; if on a stretcher, he should be resting on his back or on the sound side.

Fractures of the thigh are among the most important injuries for which you may be called upon to give first aid, partly on account of their frequency, but chiefly because of the extreme care, gentleness, and skill required in the conveyance of the sufferer from the scene of the accident to his home or the hospital. These injuries, I have observed, are in coal-pits frequently caused by heavy falls of coal or dirt from the roof. In some instances the patient feels the bone give way or "snap;" in others, when he is almost buried and much shaken by the fall, he is unaware that his thigh is injured until he attempts to use it, when he finds it powerless. The unnatural appearance of the limb at once shows what has occurred. There is shortening, as the lower end of the broken bone is dragged upwards by the action of the muscles; the thigh is swollen and enlarged as the lower piece of the bone is drawn up on the inner side of the upper piece, and the muscles become thicker during their contraction; and the limb below the seat of the fracture falls or twists outwards so that the foot rests on its outer side, not on the heel. If there is any movement of the limb, either through

the struggling of the patient or rough handling by the bystanders, loud crepitus, or rubbing of the broken ends of the bone against one another, may be *heard*, and should one of your hands he placed over the seat of injury, easily *felt*. Now, I need hardly remind you that in these accidents it is of the greatest importance to the patient, more particularly if he is a working man, that he should not only recover his health and strength, but also have a useful limb. An ordinary case of a simple fracture of the thigh can be successfully treated by the surgeon, but it is very different if the artery of the thigh or ham is injured by a jagged

Fig. 27.—RIFLE AS SPLINT FOR A BROKEN THIGH.

fragment of the bone, or if one of the broken fragments is driven through the flesh and skin, making the fracture a compound one. In such cases as these the patient is in danger of losing either his limb or his life; indeed, it is not at all unlikely that he may lose both, for—according to one of our most eminent surgeons—amputation for injuries of the thigh-bone itself is one of the most fatal operations in surgery. You can appreciate, therefore, the grave responsibility that rests upon you when called upon to give help in cases of broken thigh; you must surely see the necessity of acting with all the care, gentleness, coolness, and judgment of which you are possessed, so that you may give up the injured man into the surgeon's hands in the same condition, *not worse*, as when the accident occurred. If you once lose

your head, and act hurriedly, roughly, and injudiciously, you will make the injury *worse;* a large blood-vessel will be torn, the flesh lacerated, or the skin actually pierced by a broken end of the bone; and through your carelessness the limb may have to be amputated to give the unfortunate sufferer his only chance—a *small* chance—of life.

If you have splints near at hand, or there are any materials lying about with which you can make temporary splints, you should apply a long one on the outer side of the injured limb from the armpit to the lower part of the foot, and another shorter one on the inner side of the thigh from the top of the thigh to the knee. While you are fixing on these splints a friend should keep the injured limb extended to its natural length by grasping the foot and drawing steadily down until the feet are level, taking care that the foot of the injured side is in its natural position with its heel (not its outer side) next the ground. If you are unable to extemporise a long outside splint, you can apply two splints—one on the outer side, the other on the inner side —from the top of the thigh to the heel, with a third short splint on the front of the thigh. On the battlefield a rifle placed with the butt in the armpit is found to make a first-rate long outside splint (Fig. 27). When you can get them, always apply the splints as soon as possible and before the patient is moved, taking care to pad them well with hay, straw, portions of the clothing, or anything that is convenient and suitable. As an additional safeguard, you should never omit to *tie the legs together*, as still greater support is thus afforded to the injured limb. Should no splints, nor any materials from which you can improvise some, be near when you are called upon to give help for a broken thigh, you must not be disheartened, but must make the sound leg do duty as a splint. Place a little soft material, such as folded clothing, hay, or straw between the limbs

and bind them firmly together with handkerchiefs, scarfs, or straps. It is always best to tie the limbs together at several places in order to give greater steadiness and security to the injured thigh; so you should not only bind the feet to each other, but also the knees, and the thighs above the level of the fracture. I have already told you how, at the last siege of Paris, the French used straw matting to wrap around broken limbs. The same material may be used, when available, for a fractured thigh, more especially when it is required to move the patient a considerable distance.

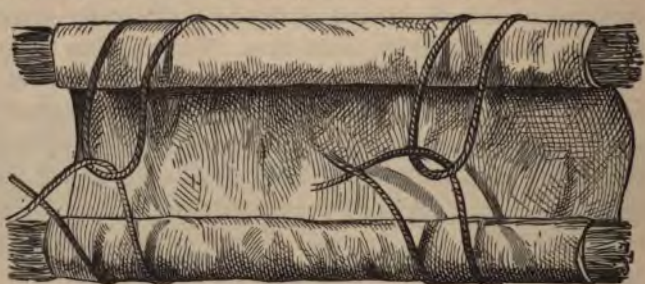

Fig. 28.—BUNDLES OF STRAW OR RUSHES USED WITH A CLOTH TO SUPPORT A BROKEN LIMB.

The injured man is laid on the straw mat; some rolled-up clothing, a sand-bag, a bundle of straw, or other suitable padding, is placed between the thighs, and the matting is wrapped around the patient's hips and thighs, and securely bound on by straps or cords.[1] When you have supported the injured limb and secured it as firmly and comfortably as possible in its natural position, then it is safe to move the patient from the scene of the accident to his home or the hospital; but he must be carried in a lying-down position on a stretcher, and the greatest care must be taken in lifting him on and off the stretcher. It must be the sole business of one man to attend to, and take charge of, the injured

[1] *Surgeon's Pocket-Book*—Surgeon-Major Porter.

limb; and certain precautions, which I shall explain to you in the last lecture, must be taken by the bearers of the stretcher.

Fractures of the leg, between the knee and ankle, are about the commonest accidents of importance at collieries and other large works. They occur frequently also among those who follow less laborious occupations, being caused by kicks from horses, carriage accidents, heavy falls, kicks at football, jumping or stumbling from great heights, and other kinds of violence. They are second in importance

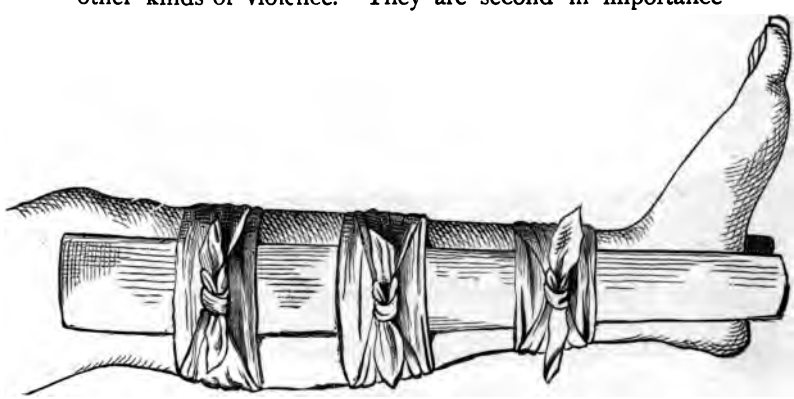

Fig. 29.—WOODEN SPLINTS FOR A BROKEN LEG.

only to fractures of the thigh; and as you might expect from the exposed and superficial position of the larger bone of the leg, or shin-bone, compound fractures of the leg are more common than similar injuries in any other part of the body. A simple fracture of the leg is, for the same reason, very easily converted by careless, rough, or unskilful handling into a compound one; and though such a mishap is not usually attended by the danger that attends a compound fracture of the thigh, still at the very best the suffering of the patient is much increased and his recovery greatly delayed. This, especially in the case of a working man, is a most

serious matter. If he has no club, no money at all is forthcoming; and if he has a club, about half—or it may be only a quarter—of the amount of his usual wages is all there is to support himself and his family. And this state of affairs lasts two or three months longer, looking at it in its most hopeful light, than if the case had been one of simple fracture. There is always the chance, too, of the surgeon being obliged to amputate the man's leg to save his life; and if the case progresses unfavourably there is further the risk of a fatal result. I am not at all exaggerating. This

Fig. 30.—SCABBARD AS SPLINT FOR A BROKEN LEG.

story of disaster has followed over and over again the careless or unskilful handling of a broken leg by well-meaning but badly-informed friends.

The usual signs of fracture are present when a leg is broken. There is swelling, and the shape of the limb is unnatural; there is crepitus; on passing your finger down the large bone of the leg you can feel the irregularity caused by the ends of the broken fragments at the seat of fracture; and the patient complains of pain and is unable to use the limb. When both bones of the leg are broken the nature of the injury is usually very plain; but if only one bone is

fractured, then the sound bone acts as a splint for it, keeping it in position, and there is more difficulty in telling what has occurred.

If you have the necessary materials at hand, you should support the injured limb by binding on two splints—one on the outer side, one on the inner side, of the leg (Fig. 29). These splints should be properly padded, if made of hard material such as wood; but, as I have already explained to you, very good temporary splints may be made of rolls of straw, or straw bottle-casings, wrapped up in cloths or

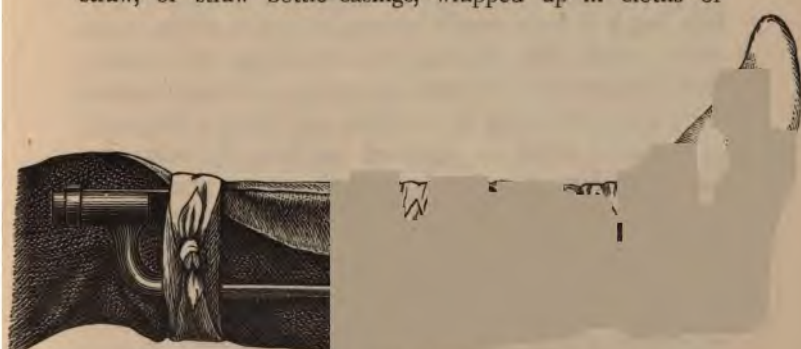

Fig. 31.—SPLINT MADE OF TWO BAYONETS FOR A BROKEN LEG.

handkerchiefs (Fig. 28), folded newspapers, cardboard, and similar articles. The diagrams (Figs. 30 and 31) show how fractured legs may be put up with bayonets and bayonet scabbards; and in these illustrations you will observe that the trousers are made use of as padding. When you have securely bound on your slpints you should tie the legs together at the knee and ankle, so that additional support may be given to the injured limb by the sound one. If you cannot get anything to make splints of, the sound leg must serve as your splint, and you should place some pieces of clothing, hay, or straw between the limbs, and bind them securely together. Should there be a board

handy, you could place it under the two limbs, and fasten them to it; or if on the battlefield, you could bind the two legs together and support them on a knapsack in the same way, but you should always remember to use something soft, as straw, fragments of clothing, etc., to place between and under the legs so as to make the patient as comfortable as possible. When you have secured the broken limb by one or other of these methods the patient is ready to be moved away on a stretcher.

The *knee-cap* is fractured sometimes by heavy blows or falls, but it is more usually broken by violent efforts to recover oneself after slipping, the bone being, so to speak, torn across by excessive muscular action. In these fractures there is no shortening of the limb, and the two fragments of the bone, which are separated one from the other, can be readily felt. The leg is perfectly useless, the patient being unable to stand upon it or to raise it; and the more the knee is bent, the farther the two pieces of bone are separated. In an accident of this kind you can either apply a splint to the back of the limb, and bind a handkerchief or scarf around the knee like a figure of eight, so as to keep the two fragments of bone as near together as possible; or if you cannot improvise a splint, you should tie the two limbs together at the ankle, knee, and thigh. Always keep the limb as straight as possible, and a little raised.

Fractures of the bones of the foot are the result of great violence, so that there is considerable pain and swelling of the injured part. The foot looks an unnatural shape, and you may be able to feel crepitus. All you can do is to keep the foot raised, and apply cold by means of sponges, folded handkerchiefs, or cloths steeped in cold water.

So far I have been speaking to you about fractures or broken bones, and explaining to you the best way of giving first aid in such cases. But there are other injuries to the

skeleton with which you may meet besides fractures. A bone may, without being broken, be displaced, put out of joint, or *dislocated.* Most of you have heard of, and perhaps known, some one who has had his "shoulder put out," his "elbow out," or his "jaw out." Such injuries are spoken of as *dislocations*—dislocation of the shoulder, elbow, jaw, etc., as the case may be. This displacement, or unjointing, of a bone is a very different thing from a fracture, and is just one of those accidents for which you can give no help, except by assisting the patient along, or carrying him to his home or to the nearest doctor. *Never interfere with a dislocation, but leave it to be taken in hand by a qualified medical man.* By meddling with an injury of this kind you may do great harm; but if you wish to display your zeal, send for the doctor, or help to convey the patient to where he will receive professional assistance.

In fractures it is in your power to give most valuable help before medical aid can be procured; in dislocations you must attempt nothing, but leave everything to the surgeon. You should therefore be able to distinguish fractures from dislocations. The bones of the limbs may be either broken or displaced as the result of violence: in either case the patient is unable to use his limb, and there is pain at the seat of injury, with distortion—or an unnatural shape—of the limb. In a fracture, however, the seat of injury is usually somewhere about the middle part of the bone—not at a joint; there is crepitus—or grating between the broken ends of the bone—felt and sometimes heard on movement of the injured part of the limb; the limb is unnaturally movable at the seat of the fracture; there is frequently shortening of the limb from one of the broken ends of the bone overriding the other; and often the rough ends, edges, or sharp points of the broken ends of the bone—or some irregularity—can be felt at the seat of fracture.

In a dislocation, on the other hand, the seat of injury is at a joint; there is no crepitus; the injured joint is more or less fixed and immovable; and there may be either shortening or lengthening of the limb. In dislocation of the jaw the mouth is open and the jaw fixed; there is no crepitus, or irregularity of the line of the teeth and the lower margin of the jaw (as there is in fracture), and in many instances it is caused by gaping. Women are the most frequent sufferers; and if the accident occurs once, the patient has to be very careful in future, or the jaw will slip out of place again. Indeed after any joint has once been dislocated the different tissues (such as the ligaments, etc.) of the affected part are so weakened that displacement of the bones will much more readily occur from some violence or incautious movement than at the time of the first accident.

Sprains and Strains.

Sometimes, from over-exertion, or from slipping on rough ground, a joint gets wrenched, twisted, or *sprained*. The joints most frequently injured in this way are the wrist and ankle. Colliers, labourers, and others who work hard with their arms often get their wrists sprained; and sprained ankles are pretty frequently caused by slipping over a loose stone, stepping in a rut or hole, or "turning your foot." In these accidents the ligaments, tendons, and other tissues about the joint are stretched, twisted, and torn to a greater or less extent; the small blood-vessels of the part are ruptured as well, so that blood escapes underneath the skin in and about the joint, causing swelling and a bluish-red discoloration. These injuries, as some of you know from bitter experience, are often extremely painful. If the pain is very severe, soak the injured part in hot water thoroughly —as hot as can be conveniently borne for about a quarter

of an hour, and then apply a good large hot bran poultice. This usually gives great relief; but if hot water cannot be obtained, or should hot applications fail—as in some cases they do—to give much ease, then apply cold in the form of cloths, handkerchiefs, clean soft rags, or sponges, steeped in cold water, spirit and water, or vinegar and water, taking care to keep your applications constantly cold and wet. But always remember, whatever else you do, to give the injured joint *absolute rest*, and to keep it continually *in a raised position.* Later on, when the pain is relieved and the swelling more or less subsided, friction and stimulating liniments, such as hartshorn and oil, are useful.

Sprains or *strains* of the muscles or flesh, of the back, loins, hips, and shoulders, are rather common amongst labourers, platelayers, and others who get their living by manual labour. The pain and stiffness caused by these muscular sprains or strains is best relieved by hot fomentations and bran poultices, followed by good hard rubbing with a strong liniment of hartshorn and oil.

CONTUSIONS OR BRUISES.

These are caused by violence, as falls, blows, squeezes, etc., and are everyday occurrences. They may be extremely trivial or very severe. In these injuries the skin is not broken, but the soft tissues underneath the skin are more or less torn and lacerated; the small blood-vessels are torn, and the blood escaping from them causes swelling and discoloration of the bruised part. The colour varies from a purplish-red at first to a greenish-brown or yellowish tint later on. You may study these changes of colour conveniently in the next black eye you see. In trivial contusions you can apply cold by means of wet sponges, cloths, or handkerchiefs; but for severe and extensive contusions,

such as I often find colliers suffering from, as the result of heavy falls of coal and dirt from the roof of the pit, there is nothing that gives so much relief as copious hot fomentations, followed by large thick bran poultices, over which vinegar has been sprinkled.

In very severe contusions, such as those occurring from railway accidents, heavy falls of rock, and other forms of great violence, one or more of the important internal organs, such as the liver or intestines, are sometimes torn, and then the case is a most dangerous one. You can usually tell that something very serious has happened by the faint, pale, and prostrate condition of the patient. I shall speak of this prostrate state—or, as it is called, collapse—in the next lecture.

LECTURE IV.

SUDDEN ATTACKS OF ILLNESS, SUFFOCATION,[1] ETC.

First aid in cases of shock, stunning, compression of the brain, apoplexy, epilepsy, fainting, and intoxication—The immediate treatment of the apparently drowned, or otherwise suffocated—Burns, scalds, sunstroke, and frost-bite—Poisons—Bites from rabid and venomous animals—Foreign bodies in the nose, ear, and eye.

SHOCK OR COLLAPSE.

WHEN a man meets with a very severe accident, such as having one of his limbs shattered, he not only suffers pain at the seat of injury, but he is altogether shaken. His whole system receives a shock; his face is pale, pinched, and haggard, and bears a vacant yet anxious and alarmed expression; he is frightened, faint, depressed, and complains of cold; he has lost all his "pluck"; he trembles and staggers; his skin feels cool and clammy; his breathing is feeble and labouring; his pulse is extremely weak, and sometimes can scarcely be felt. His friends say that he "has the fright in him," or that he is "upset." When a man is in this condition as the result of an accident, he is said to be suffering from *shock* or *collapse*. A person may die from shock immediately, as in accidents from lightning; or he may sink in a few hours after some terrible injury, such

[1] Or, as it is called technically, *asphyxia*.

as an extensive burn, shattering of a limb, or wound of the cavity of the belly. In other instances the shock is very slight, and the patient soon rallies. People, as you know, differ very greatly in temperament, and an accident that would cause intense shock in one man would affect another to a very trivial extent. Weak, nervous, and timid people suffer more severely from shock generally than strong and robust ones. The signs of shock usually appear immediately after an accident; but in some instances they are delayed, and seem to be for a time controlled by the strong self-command of the injured man, or else kept under by the all-powerful instinct of self-preservation. Thus, a soldier who had his arm taken off close to the shoulder at the battle of Waterloo by a cannon-ball, rode upright for fifteen miles to Brussels, but became insensible from shock on his admittance into the hospital.[1] There is a peculiarity about shock that any of you who have had the misfortune of witnessing many accidents must be aware of. It is that the severity of the shock by no means always corresponds with the severity of the injury which causes it. When a man meets with a very severe and painful accident, you would naturally expect dangerous collapse as a result, and this is usually the case. But it is not always so, for people who are possessed of great determination and high spirit not unfrequently bear up with wonderful "pluck" and fortitude, even when very severely and dangerously hurt. On the other hand, it often happens that the signs of shock are severe, out of all proportion to the injury received, and a man who has been but slightly wounded is sometimes placed in extreme danger from the shock that follows. Death, indeed, occasionally occurs from shock when the injury itself is quite insufficient to account for it.

When a man is suffering from shock he is depressed, so you should speak kindly to him, try to cheer him up, and

[1] *Gunshot Injuries*—Surgeon-General Longmore.

give what encouragement you can. He is faint, so you should place him in a lying-down position—flat on his back. He is cold, so you should cover him with clothes, blankets, or your own coat if there is nothing else handy, and put hot-water bottles, or heated bricks wrapped in flannel, to his feet, apply friction to the hands and surface of the body, and give him, if he is not perfectly insensible, warm tea, a little hot spirit and water, or wine, to drink. If the patient is quite insensible, you can apply sal-volatile or smelling-salts to the nostrils. In all cases take care to remove anything tight about the neck, as the collar, necktie, etc.

Concussion of the Brain or Stunning.

When a man is *stunned* he is said to suffer from *concussion of the brain.* Stunning is caused by falls or blows on the head, and may be very severe, even fatal, or it may be extremely trivial. Most of us have had personal experience of slight concussion or stunning, and remember the giddiness and the stupid confused feeling which lasted a few minutes after a fall or blow on the head, and then passed away. When the injury to the head is severe, the patient lies motionless and insensible, the pupils of the eyes are contracted, the face is pale, the skin feels cold, the pulse is weak, and the breathing slow and quiet. If he is roused or addressed in a loud voice, he answers peevishly, and falls back again into insensibility. By and by he gets uneasy, tosses about, vomits, and then quickly comes to himself. In bad cases the patient is perfectly insensible and cannot be roused at all; the pulse is very weak and irregular, the skin is cold and clammy, and he either dies or recovers very slowly.

In a case of stunning, place the patient in a lying-down position with the head slightly raised; keep him perfectly quiet, remove any tight articles of clothing, see that he has

plenty of fresh air, wrap him up in blankets, and put hot-water bottles to his feet; and apply cloths, folded handkerchiefs, or sponges steeped in cold water, to his head.

Compression of the Brain.

Unfortunately much more serious mischief than stunning is often caused by accidents to the head. The skull may be broken, and a fragment of bone driven against the brain, or a blood-vessel may be ruptured inside the head with bleeding in the cavity of the skull—the blood pressing upon the brain.

In these cases of compression of the brain by pieces of bone or accumulated blood, the symptoms are very grave. The injured man lies in a state of complete insensibility; the pupils of the eyes are insensible to light, and one or both are dilated; the eyes themselves are quite insensible to touch—this of course shows how deeply insensible the patient is; the breathing is deep and snoring, and there is a puffing or blowing movement of the cheeks and lips—these being blown out during expiration, and drawn in during inspiration; the pulse is slow and full; there is more or less complete paralysis, and sometimes convulsive movements; and there may be drawing of the face to one side, or squinting. As you might expect, persons injured in so serious a manner often die at once; but in a case of this kind, however bad it looks, never refuse your help because you think it useless. While there is life there is hope. It is, moreover, well to remember the saying of one of our greatest surgeons—Liston—"That no injury of the head is too trivial to be despised, or too serious to be despaired of."

I have already explained to you, when speaking of fractures of the skull, how you may best give aid in cases of compression of the brain.[1]

[1] See Lecture III.

All the conditions I have so far been describing to you—shock or collapse, stunning or concussion, and compression—are the results of injury; but there are also certain kinds of disease—associated with a state of insensibility—which it is very necessary you should know something about. I allude to certain forms of sudden illness which are often met with, which frequently cause the greatest alarm, fright, and dismay among the bystanders and the relatives of the patient, and for which you can generally give valuable assistance before it is possible to obtain professional advice. I refer more particularly to those sudden and unexpected seizures which you know by such names as "strokes," "fits," and "faints"; and I also include certain forms of poisoning, viz. those in which there is insensibility or loss of consciousness.

Apoplexy—Apoplectic Fit—Stroke.

A man beyond middle age goes to bed apparently in good health, having taken a heavy supper; in the morning he is found helpless, his face flushed, and his mouth drawn a little to one side; he has a difficulty of speaking, so that you cannot well understand what he says; he moans, and tries to direct your attention to the arm and leg of *one* side of the body, and on examination you find they are perfectly helpless, and perhaps also devoid of feeling or sensation. If you lift either limb up a little, and let it go, it falls a dead weight and useless, and the patient has no power to move it. If you pinch either limb the patient in many instances does not feel you. The man has had a stroke: a diseased blood-vessel has given way in his brain, there has been internal bleeding, and the pressure of the escaped blood on the tissue of the brain is the cause of the symptoms I have described. In more severe cases the patient lies completely

insensible, snoring loudly, the cheeks and lips puffing out with expiration and being drawn in with inspiration, the pupils of the eyes fixed and unequal in size, with more or less complete paralysis—in fact, with symptoms such as I described as resulting from compression of the brain.

Apoplexy is rather common amongst those who are in advanced years, and the seizure often occurs in the early morning, so that the sufferer is found helpless in bed. In other cases the patient is taken suddenly ill when sitting at a meal or going about his daily occupation, and he either falls insensible or sinks to the ground from the sudden loss of power of one side of the body.

In an emergency of this kind you may do great harm by attempting too much. You should lay the patient quietly in a lying-down position with the head slightly raised; and if he is not already in bed, take advantage of the nearest sofa, or get a bed or mattress moved into the room where the man was taken ill. The less you move the patient about or disturb him the better, for any rough or unnecessary movements are likely to increase the bleeding from the ruptured blood-vessel, and so make bad worse—probably, indeed, lead to fatal results. Loosen anything tight in the way of clothing, as the collar, waistcoat, braces, necktie, or scarf. Place hot-water bottles against the feet, and apply cold wet folded handkerchiefs, cloths, or sponges to the head, or ice broken up in small bits and tied in a bladder. See that the patient has plenty of fresh air. If the room is close open the window, and do not let the sick-room be crowded with noisy, sympathetic inquirers. Keep the patient still and quiet, and prevent him from being annoyed, excited, and worried by attempts at conversation. Do not give him anything to drink—stimulants are especially to be avoided, but send at once for a medical man, and wait for further instructions from him.

Epilepsy—Epileptic Fits—Falling Sickness.

Attacks of epilepsy are spoken of usually as *fits*. Many of you know people who are liable to these attacks, and some among you have frequently witnessed the seizures themselves. There is no mistake about an epileptic fit—no shamming or imposture. The patient when attacked falls suddenly, often with a moan or cry of some sort. It does not matter where he is, or what he is doing—he may be at his work, having his dinner, standing at the edge of a precipice, or warming himself before a fire; but when the fit comes on he falls suddenly—as suddenly as though he were shot dead—and he is *quite insensible*. Thus it happens that people subject to these fits are often badly hurt. It is common for them to bruise themselves severely by falling against something hard. If a man has a fit and tumbles into a fire he will, if no one is present to give help, be severely burnt—perhaps burnt to death; in the same way, if he should be seized on the brink of a precipice, he will fall down and be killed. The attack is sudden, and the insensibility complete; but the patient is not quiet and still. On the contrary, he works hard in the fit—his face his livid, his pupils dilated, his eyes roll, and his features are twitched and drawn all ways; there is a chewing movement of the mouth, the tongue gets between the teeth and is bitten, and the patient foams and froths at the mouth. At the same time the breathing is laboured, and the arms, legs, and trunk are twisted, jerked about in all directions, and twitched—in fact, violently convulsed. There is usually more or less twisting around towards one side in the fit. This is particularly noticeable in the head, which looks as if the patient was straining around and trying to look over his shoulder at something behind him. Alto-

gether an epileptic fit is about the most horrible sight you can witness, and once seen is not readily forgotten.

You cannot stop a fit; it will have its own way, and take its own time; but you can prevent the patient from hurting himself. Remove him, if necessary, from a position of danger, and see that nothing interferes with the freedom of his breathing. He may fall across a line of rail, on to a fire-place, or in some other awkward and dangerous position. Your first business would then, of course, be to get him into a place of safety. Next you should see that there is nothing tight about his neck and chest hampering his breathing. Remove or loosen his collar and scarf, and undo his waist-coat. Let him lie on his back, and slightly raise the head. You may save his tongue from being bitten by pushing a cork, a rolled-up handkerchief, a piece of indiarubber,—anything, in fact, handy and suitable,—between the teeth. Do not attempt to forcibly hold or tie the patient, but simply try and control the violent jerking movements of the limbs to some extent with your hands, so as to hinder the sufferer from hurting and severely bruising himself. After the fit the patient is often stupid, heavy, and sleepy, and it is best to let him rest quietly for some hours.

Hysteria—Hysterical Epilepsy—Hysterical Fits.

There is one form of disease which somewhat resembles epilepsy. It is called hysteria, and is usually found in weak nervous girls or young women. You may form some idea of it by considering it to be sham epilepsy. The girl never bruises herself, never tumbles down a precipice or into a fire, never hurts herself at all, never even tears her dress; she does not entirely lose consciousness, and never bites her tongue, though there may be frothing at the mouth, spluttering of the lips, and jerking movements of the head

and body. She never has an attack unless there is some one present to witness it, and she is generally in an excited state—talking, laughing, or crying—when the seizure occurs. You need never be alarmed for the safety of the patient in a case of this sort. Show you are not alarmed by your manner, and ask unsympathetically and loudly (so that the patient may hear) for a jug of cold water. This will help to bring her round, and the cure will probably be completed when you dash the cold water smartly over her face and head.

SYNCOPE—FAINTING—FAINTING FITS.

When a person's heart from any cause works feebly and fails to pump up a sufficient amount of healthy red blood to the brain and head, the face becomes ghastly white, the lips even turn pale, there is a sensation of giddiness or "swimming" in the head, a feeling of sinking at the pit of the stomach, a singing noise in the ears, surrounding objects seem to float up and down, the pulse becomes very weak, and can scarcely be felt, and the man falls down insensible —in other words, he *faints*. Fainting may be brought about in many ways: it may be caused by bleeding, by heat, fright, sitting in a close room, going long without food, over-fatigue, general weakness, exhaustion, hearing bad news, etc. When giving first aid in cases of fainting your object is to restore the circulation of blood in the brain and head, so you should lay the patient down flat, with his head on or below the level of the body, and keep him in that position until he is better. Loosen the clothing about the neck and chest—the collar, necktie, shirt, and waistcoat. Let the patient have plenty of fresh air; if he is in a room open the window; if outside keep people from crowding around; dash cold water on the face, and, if they are at hand, apply sal-volatile or smelling-salts to the nose. Of course, if there is bleeding,

you must at once arrest it, and when the patient revives sufficiently to swallow give him a little stimulant, as wine or weak brandy and water to drink. It may happen that a man faints in a narrow confined space, so that he cannot be laid down flat on account of want of room. In such a case you should get his head as low as possible by pressing it well down between his knees.

But I must remind you that loss of consciousness or insensibility is not always the result of either injury or disease. It may be caused by certain poisons, as alcohol and laudanum. These substances, like arsenic, strychnine, and deadly nightshade, are very useful when given in proper doses at the right time in many cases, but if taken in too great a quantity hurtful effects are sure to follow.

Intoxication—Drunkenness—Poisoning by Alcohol.

There seems to be a mistaken idea amongst many people that "drink" never kills rapidly, but that persons who die from taking too much stimulant only sink after months—it may be years—of hard drinking. Never was there a greater mistake. Cases of acute poisoning from taking excess of stimulant are unfortunately too frequent. Men have been known to die on the spot, from shock to the nervous system, after swallowing large quantities of spirit, and death from the same cause after a few hours is, comparatively speaking, a common event.

When a man is in danger from drinking he is in the stage of drunkenness usually described as "dead drunk." He lies helpless and insensible, his face often flushed and bloated, the pupils of the eyes equal in size, dilated, and fixed, the eyes themselves reddened, the lips livid, the breathing slow, the pulse soft and quick, and the body is cooler than natural—the temperature being two or three

degrees lower than it should be; the breath smells strongly of spirits or other stimulant; there is no squinting or drawing of the face, no frothing at the mouth, nor biting of the tongue, but the patient lies motionless and speechless, all the limbs being equally helpless.

People in this helpless stage of drunkenness are in a position of great danger, particularly if they are lying out in the cold; for, as I have told you, the heat of the body is much lower than natural when a man is intoxicated, and if he fails to reach home on a sharp frosty night the probability is that his drinking bout will end in the sleep of death. It is too much the fashion for people to pass men lying insensible on the roadside without taking any notice of them. They are so eminently respectable and so morally perfect themselves that they cannot possibly even look at any poor creature lying helpless and unconscious if they have the slightest suspicion that he has been drinking. Let me tell you that if you pass a man lying insensible without giving what assistance you can—without even informing the police or others—so that help of some kind and the means of removal may be obtained, you are guilty of gross and culpable neglect, you fail in your duty as a Christian, and you may indirectly be the cause of the man's death.

In these cases of intoxication, always get the patient under cover as soon as possible. If he is deeply insensible, try and rouse him by dashing cold water on the head and face. The effect of this is sometimes wonderful, the patient commencing to breathe well and deeply almost immediately after the application of the cold douche. Endeavour to make him vomit by tickling his throat with a feather or—if he is capable of swallowing—by giving him an emetic of mustard and water. Apply friction to the surface of the body by rubbing the limbs and trunk well with warm dry cloths or flannel. Wrap the patient in blankets and put hot-

water bottles to his feet, for it is of the utmost importance that the warmth of the body should be maintained. Never forget that the heat of the body in intoxication is lowered, whereas in apoplexy it is raised.[1] For this reason it has been suggested that police-officers should be taught how to take the temperature of those found in an insensible condition, as such instruction would be of help in distinguishing between apoplexy and drunkenness, and would, moreover, suggest the immediate "abolition of the practice of thrusting the really intoxicated into a cold and damp cell, which to such a one is actually an ante-room to the grave."[2]

Poisoning by Opium, Laudanum, etc.

In poisoning by laudanum and other substances containing opium the patient becomes sleepy and passes into a state of insensibility. The pupils of the eyes are contracted to the size of a pin's point, the breathing becomes slower and slower, and the insensibility deeper and deeper. The great thing in a case of this kind is to make the patient vomit as soon as possible by the administration of emetics, and to keep him awake by walking him about, dashing cold water on his head and face, and giving him strong coffee to drink. If the breathing should cease, artificial respiration (which I shall describe later on) must be resorted to.[3]

Blood Poisoning from Kidney Disease.

When the kidneys from any cause become diseased they fail to perform their proper function of excreting or getting rid of certain hurtful materials which result from the decay,

[1] The usual temperature in health is 98° Fahr.
[2] *Cantor Lectures on Alcohol*—Dr. B. W. Richardson.
[3] The whole subject of poisons is discussed on p. 128.

waste, and wear and tear of the different structures of the body. These products of waste, therefore, accumulate in the blood and act as poisons, giving rise to insensibility and convulsions, which more or less resemble epileptic fits in their appearance. In these cases the patient has usually complained previously of illness, and there is moreover generally dropsical swelling of the lower limbs and face—it may be, indeed, of the whole body. If you met with a case of this description, and recognised its nature, you should apply cold to the head, a mustard poultice across the loins, and administer (if the patient is able to swallow) any household aperient medicine, such as castor oil, etc.

The different varieties of *insensibility* or *loss of consciousness* may be conveniently arranged in a table, which may enable you to get a clearer idea of their several causes:—

1. Injuries of any kind in any part of the body	Shock or Collapse.
2. Injuries to the Head	Stunning or Concussion. Compression of Brain.
3. Diseases of the Brain	Apoplexy. Epilepsy. Hysteria.
4. Fatigue, Fright, Bleeding, Debility, etc., causing failure of heart's action.	Fainting.
5. Poisoning.	Intoxication. Opium poisoning. Poisoning of the blood due to kidney disease.

I will finish my remarks on this subject by describing the precautions you should take, and the way you should set about trying to discover what is the matter, when you meet

with any one lying helpless and more or less completely insensible.

Always be particular to note the position of the body and its surroundings; the case may end in a law court, and you may have to give evidence as to marks of blood, torn clothing, bruises, knives, or other weapons, the state of the ground —whether much trampled on, etc.—the posture in which you found the body, and other similar matters. Try and find out the cause of the patient's condition. Due attention to the surroundings may help you in this; thus, if the patient is lying prostrate at the foot of a ladder or high scaffolding you would suspect concussion, compression, or other injury resulting from a fall; or if there is an empty bottle labelled laudanum, or a flask smelling of whisky, lying near, you would think the man had taken poison or had been drinking. But without loss of time you should place the patient flat on his back, with the arms to the sides and the legs extended straight close to one another, and the head slightly raised if the face is flushed, but perfectly flat if the face is pale. If there is the slightest inclination to vomit the head should be immediately turned to one side, or the patient may be choked by the matters rejected from the stomach. You should also loosen all tight clothing about the neck and chest—collar, scarf, shirt, braces, and waistcoat—so that nothing may interfere with the breathing or with the return of blood from the head; and you should carefully examine the head, trunk, and limbs for any signs of injury—wounds, bruises, or fractures. The position of some injury may be indicated by blood, torn clothing, or by the patient clutching the part that is hurt. If the head is injured you would suspect concussion, or, if there are fixed dilated pupils, stertorous or snoring breathing, squint, drawing of the face to one side, or other signs of serious brain mischief, compression. If the trunk is severely wounded, or one of the

limbs badly hurt or shattered, then you would think of shock; whereas if there is smart bleeding going on, and the face and lips of the patient are ghastly white, then you would judge that the case was one of fainting. If there is arterial or venous bleeding going on you should of course arrest it promptly; and if the patient is in a violent epileptic fit, which you could hardly fail to recognise, you should endeavour to prevent him biting his tongue or otherwise hurting himself. If the patient does not appear to have sustained any injury, but is flushed, deeply insensible, his skin feeling hot, his pupils fixed and dilated—one bigger than the other—his face drawn to one side, his breathing of a snoring character, etc., then you would consider you had apoplexy to deal with. If the breath smells strongly of brandy or other stimulant, and the face is bloated and flushed, the eyes red, the pupils dilated and equal in size, the skin cool and clammy, and the pulse full and quick, then the patient is probably dead drunk. In opium poisoning the pupils are contracted to a pin's point, and this, with the slow breathing, the deepening insensibility, with the absence of any smell of stimulant, should make you suspicious of the true state of the case. If you have to deal with an insensible person it is always best and safest to obtain medical aid as quickly as possible; and if a doctor does not happen to be near, it is better without loss of time to convey the patient on a stretcher or in a trap to the nearest hospital or surgery. In many cases it is extremely difficult to ascertain the cause of the insensibility. Indeed, there is not unfrequently a complication. Thus, a man may be dead drunk and apoplectic at the same time; or he may be so deeply and dangerously intoxicated that all your attention becomes concentrated on his drunken state to the neglect of some important injury from which he is suffering as well—such, for example, as broken ribs or a fractured thigh.

Drowning.

The following directions for restoring persons apparently drowned are recommended by the Royal Humane Society :—

Send for medical assistance, blankets, and dry clothing, but proceed to treat the patient *instantly*.[1]

The points to be aimed at are, *first* and *immediately*, the restoration of breathing; and *secondly*, after breathing is restored, the promotion of warmth and circulation.

The efforts to restore life must be persevered in until the arrival of medical assistance, or until the pulse and breathing have ceased for an hour.

The Sylvester Method of Restoring Natural Breathing.

Rule 1. *To adjust the patient's position.*[2]—Place the patient on his back, or on a flat surface, inclined a little from the feet upwards; raise and support the head and shoulders on a small firm cushion or folded article of dress placed under the shoulder blades. Remove all tight clothing from about the neck and chest.

Rule 2. *To maintain a free entrance of air into the windpipe.*—Cleanse the mouth and nostrils; open the mouth; draw forward the patient's tongue and keep it forward. An elastic band over the tongue and under the chin will answer this purpose.

Rule 3. *To imitate the movements of breathing.—First,*

[1] And, when possible, *in the open air*, exposing the neck, face, and chest to the wind, except in extremes of weather, as intense cold, heavy rain or snow, etc.

[2] First lay the patient flat on his face, supported by folded articles of clothing, with one of the arms under the forehead, and the head rather lower than the body, so that any water in the mouth and air passages may drain off.

induce inspiration.—Place yourself at the head of the patient, grasp his arms, raise them upwards by the sides of his head, stretch them steadily but gently upwards for two seconds. (By this means fresh air is drawn into the lungs by raising the ribs; see Fig. 32, Inspiration.)

Secondly, Induce expiration.—Immediately turn down the patient's arms, and press them firmly but gently downwards against the sides of his chest for two seconds. (By

Fig. 32.—DR. SYLVESTER'S METHOD OF PERFORMING ARTIFICIAL RESPIRATION—*Inspiration.*

this means foul air is expelled from the lungs by depressing the ribs; see Fig. 33, Expiration.)

Thirdly, Continue these movements.—Repeat these measures alternately, deliberately, and perseveringly fifteen times in a minute, until a spontaneous effort to respire be perceived. (By these means an exchange of air is produced in the lungs similar to that effected by natural respiration.)

Rule 4. *To excite respiration.*—During the employment of the above method excite the nostrils with snuff or smelling-

salts, or tickle the throat with a feather. Rub the chest and face briskly, and dash cold and hot water alternately on them. Friction of the limbs and body with dry flannel or cloths should be had recourse to. When there is proof of returning respiration the individual may be placed in a warm bath,[1] the movements of the arms above described being continued until respiration is fully restored. Raise the body in twenty seconds to a sitting position, dash cold water against the chest and face, and pass ammonia under

Fig. 33.—DR. SYLVESTER'S METHOD OF PERFORMING ARTIFICIAL RESPIRATION—*Expiration.*

the nose. Should a galvanic apparatus be at hand, apply the sponges to the region of the diaphragm and heart.

[1] There is much difference of opinion about this: several authorities consider that a warm bath should on no account be given *unless under medical direction.*

TREATMENT AFTER NATURAL BREATHING HAS BEEN RESTORED.

To induce circulation and warmth.—Wrap the patient in dry blankets, and rub the limbs upwards energetically.[1] Promote the warmth of the body by hot flannels, bottles or bladders of hot water, heated bricks, to the pit of the stomach, the armpits, and to the soles of the feet.

On the restoration of life, when the power of swallowing has returned, a teaspoonful of warm water, small quantities of wine, warm brandy and water, or coffee, should be given. The patient should be kept in bed, and a disposition to sleep encouraged. During reaction large mustard plasters to the chest and below the shoulders will greatly relieve the distressed breathing.

Note.—In all cases of prolonged immersion in cold water, when the breathing continues, a warm bath should be employed to restore the temperature.

These directions are so simple and so easily understood that I have given you them exactly as they are stated by the Royal Humane Society. I wish you to study them very carefully; and when you meet for practice you should try to imitate the movements of breathing, or, in other words, perform *artificial respiration*, one on the other. The method of performing artificial respiration recommended by the Humane Society is that introduced by Dr. Sylvester; there are, however, several other methods, notably those of Dr. Marshall Hall, and Dr. Howard of New York. All these various plans are only different ways of doing the same thing—viz., imitating as closely as possible the movements of

[1] Thus pressing the blood along the veins towards the heart. The friction should be continued under the blankets or over the dry clothing. If necessary, dry clothing can usually be borrowed from the bystanders.

natural breathing. It is better that you should confine your attention only to *one* method of performing artificial respiration in order to avoid confusion; and that introduced by Dr. Sylvester is, I think, the best one for you to adopt, because, first, it is found to be very successful; secondly, it can be performed by *one* person alone; and thirdly, it is very simple, and does not require any great amount of skill to practise it.

HANGING.

Suicides not unfrequently choose this way of destroying themselves. Should you meet with a case, cut the body down immediately. You may be surprised that I should direct your attention specially to what your own common sense would, or ought to, tell you; but I do so purposely, as it too often happens that very precious time is wasted by persons, when they see a body hanging, running off to tell some one else what has occurred. Your only chance of doing any good, if you meet with a case of this kind, is to cut the body down *at once*, and loosen the noose around the neck, taking care, however, while you do it that you so support the body with one arm as to prevent further injury by a heavy fall. Loosen anything tight in the way of clothing about the neck and chest, such as the collar, necktie, waistcoat, shirt, and braces. Let the patient have as much fresh air as possible—if in a room open the window. Dash cold and hot water alternately on the face and chest, and use vigorous friction to the limbs and body by means of dry flannels or cloths. Apply snuff or smelling-salts to the nostrils; and endeavour to restore natural breathing by artificial respiration.

Suffocation by Gases.

Persons may be suffocated by breathing "choke-damp" in mines, charcoal vapour, sewer gas, the vapours from burning lime-kilns, brick-kilns, and cement-kilns, the smoke in a burning house, coal gas, the vapours from blast-furnaces, the foul air in wells, cellars, deep cuttings and excavations, and the close confined air of overcrowded rooms. In these cases the great thing is to drag the patient as quickly as possible into fresh air. Unfasten the clothing about the neck and chest. Dash cold water on the head, face, and upper part of the chest; and if the breathing has stopped resort to artificial respiration.

Choking.

People are occasionally in danger of suffocation, and sometimes actually die, from pieces of food, coins, or other substances sticking in the throat in such a way as to stop, more or less completely, the passage of air into the windpipe. If the entrance to the air passages is completely blocked of course insensibility and death rapidly follow, unless the obstruction is speedily removed. In most cases, however, it fortunately happens that the block is not complete, so that there is more time for help to be given to the patient by those about him. Most of you know very well from personal experience the signs of choking—the distressing difficulty of breathing, the cough and retching, the violent efforts to get rid of the offending substance, the dusky bluish colour of the face, the prôminence of the eyes, the tossing about (by the sufferer) of his arms or the clutching of his throat—followed, if relief is not speedily obtained, by unconsciousness. In bad choking, where the patient suddenly turns

dark in the face, throws his arms out wildly or snatches at his throat, and falls insensible, no time is to be lost. You must open the mouth, and push your forefinger over the tongue right back, and try to hook away or push aside the obstructing substance. If you do not succeed in this you may—by pressing the hinder portion of the tongue—bring on vomiting and so get rid of the obstruction. A good plan is the one which you see so often practised with children, viz. that of pressing the chest and stomach against something hard, as a table or a chair, and then slapping or thumping the back between the shoulder blades; in this way air is driven from the lungs along the windpipe so forcibly as often to dislodge the obstruction. Another good plan with a child is to take the little patient up by the heels and give it a shake or slap its back at the same time. This method has at times acted very successfully, particularly where the obstruction consisted of a coin, as a shilling or a halfpenny. It often happens in cases of choking that the patient can manage to swallow liquids even when the breathing is distressing and difficult; in such instances emetics—hot water, salt and water, mustard and water, ipecacuanha wine, etc.—can be given with great effect, as the vomiting they cause clears away the offending substance.

Burns and Scalds.

Injuries caused by excessive heat in one form or another are of common occurrence, particularly in parts of the country where large ironworks, mines, and manufactories of different kinds exist. Injuries produced by flame or hot solid substances are usually called *burns*, whereas injuries caused by hot liquids are generally spoken of as *scalds*.

Burns result from such accidents as explosions of gas and gunpowder, falls into fireplaces and furnaces, contact with

hot metal, burning clothes, etc. For the sake of convenience we may also include under burns the injuries caused by strong chemical agents, such, for example, as oil of vitriol, carbolic acid, caustic potassa, etc. Scalds occur from such accidents as boiler explosions, contact with boiling water, steam, hot oil, or other heated liquids. When a person is severely scalded or burnt, send at once for medical aid, but proceed to give what assistance you can. In the first place, be very careful how you remove the clothes. Do not attempt to pull them off, but cut them off with a sharp scissors or knife, so that you can remove them without adding to the sufferings of the patient, and, what is more, without pulling off the skin from the injured part with them. If in a severe burn there is a portion of the clothing that sticks tightly to the skin, do not drag it off, but cut it around with your scissors and leave it where it is. It is the custom in this neighbourhood to apply equal parts of linseed oil and lime-water to these injuries; and it is indeed about the best application you can use. This mixture of linseed oil and lime-water goes by the name of *carron oil*, because it was first used at the Carron ironworks. You should soak pieces of linen, lint, or any soft clean rags, into the carron oil, and then cover the burnt or scalded part with them, placing over all a layer of cotton-wool, wadding, or flannel. A quick and ready way is to get a number of sheets of wadding, cover one side with carron oil, and put them on the burnt portions as speedily as possible, securing them by bandages, handkerchiefs, lint, or anything convenient; a number of patients can be dressed very rapidly by this method. If lime-water is not at hand you should use linseed oil by itself, or olive oil, castor oil, almond oil, or *fresh* lard would do. If no oil of any kind is available, you can dust or dredge flour, whiting, or prepared chalk thickly over the injured part, and then cover the whole with wadding in the

usual way. Whatever application you make use of, remember that your object is to keep the air from the injured part. If the pain is extremely severe a strong solution of carbonate of soda, lime, or magnesia applied by means of pieces of lint, linen, etc., steeped in it—the whole being encased in wadding in the ordinary way—will sometimes afford great relief.

Burns from strong chemicals, as oil of vitriol, carbolic acid, aquafortis, spirit of salt, lime, caustic potassa or soda, and other similar substances, are caused by such casualties as falls into lime-kilns, explosions in chemical laboratories, and accidents in the various chemical manufactories; they are sometimes also caused wilfully and maliciously, as when a man throws oil of vitriol into the face of another, or pours it into his ear or mouth as he lies asleep. In these cases you should at once get rid of the obnoxious chemical by bathing the patient with cold water, or if necessary by throwing buckets or basins of water over him, or by putting him in a bath or the nearest pool. If the chemical is an acid, then its action is best counteracted by mixing soda or lime, if you can get either of them at once, with the water; but if the injury is caused by some alkali, as caustic potassa or lime, then the part should be washed with water to which some acid, as vinegar, has been added. After the injured part has been thoroughly cleansed, then it should be dressed with oil in the same manner as other burns.

Sunstroke and Heatstroke.

When people are exposed for a considerable time either to an intensely hot atmosphere or to the direct powerful rays of the sun (particularly if their clothing is too heavy and worn too tightly, and if they have undergone much fatigue), they are liable to suffer from giddiness, a feeling of sickness,

great heat and thirst, and in a short time drop insensible—the skin being hot and dry, the eyes reddened and the pupils contracted, the pulse quick, and the breathing noisy and hurried. Such cases are described as *sunstroke* and *heatstroke;* they occur most frequently in hot climates, and often terminate fatally. If you ever happen to meet with such a case, you should get the patient at once into the nearest shady place, put him into the lying-down position with the head slightly raised, remove all the clothing from the upper part of the body, and dash cold water freely over the face, neck, and chest. On no account give stimulants.

FROSTBITE.

When people are exposed to intense cold (more especially if they are exhausted, or the heat of the body is lowered by drinking) they become stiffened, pale, sleepy, and very cold; the extremes of the body, as the fingers, toes, nose, and ears, get quite numbed, shrunken, and of a pale bluish colour; and this state is followed, if no help arrives, by complete insensibility and death. A patient in this condition should on no account be taken either near a fire or into a warm room. He should first of all be placed in a *cold* room, and well rubbed with snow, washed with cold water, or placed in a cold bath; afterwards he should by very slow degrees be brought into a warmer atmosphere, and rubbed with dry and warm cloths; and, finally, a little very weak and cold stimulant may be given. But in this country it is generally the local effects of extreme cold, such as numbed and frost-bitten fingers and toes, that we have to deal with. For instance, men who have to handle cold metal, as iron rails, etc., in frosty weather, often get their fingers stiffened, cold, numb, and blue-looking; and should they unthinkingly try to warm their hands at a fire the reaction is so violent that the

circulation gets blocked, and mortification of the fingers is the result. Your main object in these cases is to restore the numbed parts to their natural state as gradually as possible; you should keep the patient quite away from any fire or warm room, and rub the affected parts with snow, bathe them with cold water, hold them between your own hands, and after a time wrap them in flannel.

Poisons.

Poisons may be described as substances which, when swallowed, are capable of destroying life. They produce their effects in different ways, and have been arranged in groups or classes by several authorities according to the manner in which they act. It will be quite sufficient for my purpose, however, if you consider all poisons to belong to one or other of two groups, viz. *irritants* or *narcotics*.[1]

By *irritants* I refer to those poisons which irritate and destroy the tissues of the body with which they come into contact. Such are oil of vitriol (sulphuric acid), aquafortis (nitric acid), spirit of salt (hydrochloric acid), carbolic acid, lime, caustic potassa, and soda. These powerful chemical agents burn and destroy the different parts as they touch them; the lips are stained, and the inside of the mouth, throat, gullet, and stomach is more or less corroded and destroyed. As you might expect, these poisons cause intense suffering, a burning sensation in the mouth and throat, and fearful agony in the stomach and belly, with retching and vomiting—blood and shreds of the lining membrane of the stomach often being among the rejected matters.

The other poisons, which you may conveniently group

[1] Poisons are often grouped into three classes—irritants, narcotics, and narcotico-irritants, which combine the properties of irritants and narcotics. For the sake of simplicity I divide all poisons into only *two* classes, one of which you treat *with*, the other *without*, emetics.

under the title of *narcotics*, since they usually produce more or less stupor, insensibility, or delirium, vary a good deal in their action; thus morphia, laudanum, and opium cause heavy sleep; strychnine brings on convulsions or fits; deadly nightshade (belladonna) and henbane induce violent mental excitement and delirium; and alcohol causes intoxication.

In all cases of poisoning send at once for the nearest medical man, and be sure to acquaint him with all the particulars, so that he may bring his stomach pump and anything else that he may think necessary. Do not lose any time yourself, however, but (*unless the poison is an irritant*, as oil of vitriol, etc.), try your best to get the poison out of the patient's stomach by means of emetics, or, in other words, by giving him something to make him sick. You may bring on vomiting by giving a tablespoonful of mustard in a tumbler of warm water, or the same amount of common salt with warm water. If there is any ipecacuanha wine at hand (it is kept by many people as a household remedy) one or two tablespoonfuls mixed with warm water will make a powerful emetic. If the patient is already retching, you may afford much relief and greatly assist vomiting by giving him copious draughts of water as warm as he can drink it. Should a chemist live close at hand you could send for twenty grains of sulphate of zinc, and give it to the patient in warm water. This is an emetic that rarely fails. Tickling the back of the throat with your finger or a feather is another ready mode of causing vomiting, and may prove of great service if you should chance to be far away from any houses, and unable to lay your hand on mustard, salt, or other materials of which to make an emetic.

If the patient is very drowsy, you must use every effort to keep him awake by dashing cold water on his head and face, giving him strong coffee to drink, and walking him about.

If he becomes insensible, try and rouse him by throwing cold water smartly on the face and chest, flicking him with a cold wet towel, and, if the breathing threatens to stop, perform artificial respiration.

In poisoning by irritants, such as oil of vitriol, caustic potassa, etc., the manner in which you can best give first aid differs from that most suitable for cases of narcotic poisoning. You should *not* give emetics, but should endeavour to save the gullet and stomach as much as possible from the destructive action of the poison by giving soothing drinks, as barley water, milk, flour and water, white of egg, almond oil, linseed oil, castor oil, olive oil, etc. You should also endeavour to counteract the effects of the poison—*if it is an acid*—by giving magnesia, soda, potash, chalk, whiting, plaster from ceilings or walls of rooms, soap suds, or lime, mixed with plenty of water; and *if it is an alkali*, vinegar, acetic acid, or lemon juice, also much diluted with water. The back of the throat and the entrance to the windpipe is often more or less injured in these cases of poisoning by irritants, giving rise to choking, hoarseness, cough, difficulty of breathing, and risk of suffocation.[1] For these distressing symptoms you should apply sponges or flannels, wrung out of hot water, around the throat.

In cases of poisoning you should always, if possible, preserve the vomited matter, also any bottles or vessels of any kind that have contained the poison or suspected liquid, as the medical man will probably wish to examine them, and it may be that evidence in connection with them may have to be given in a court of law. You should, moreover, always endeavour to find out what the particular poison is that the patient has taken. You will generally have no difficulty in

[1] Similar injuries are sometimes the result of *scalding*, as when a child sucks at the spout of a kettle full of boiling water. In such cases hot moist applications should be put around the throat, and oil—olive, linseed, etc.—be given the child to drink.

recognising a case of irritant poisoning, even if the patient is unable to tell you, by the stains on the clothes, chin, and lips, the burning sensation in the mouth and gullet, the frightful agony in the stomach and belly, the retching and vomiting of blood, shreds of tissue, etc.

Bites from Rabid and Venomous Animals; and the Stings of Insects.

In this country there are fortunately not many accidents of this kind, but occasionally people are bitten by mad dogs and also by the common viper.[1] Rarely, too, we hear of the keepers in menageries being bitten, through carelessness or misfortune, by some foreign serpent which is kept for public exhibition. If you wish to do any good in these emergencies you must act quickly: tie an elastic band, a piece of cord, a handkerchief, or other ligature tightly around the limb *above* the wound—that is, on the side nearest the heart, so as to arrest the circulation and thereby prevent the poison or venom from being carried into the system. After you have made the ligature quite secure, try to get rid of the poison by bathing the wound well with water (*hot* if you can get it), and sucking it. If you have no cracks or abrasions on the lips and in the mouth, you can suck the poison out of the wound with safety to yourself, but it is always better to rinse the mouth well out first with brandy or other strong spirit, if such be available. Of course, in a serious case of this kind (in which the dog is known to be mad, or the snake to be very venomous), medical aid should be sought for *at once*, but you should lose no time in arresting the circulation by applying a ligature above the wound, and

[1] It is very different, however, in some of our foreign possessions. For example, in India, in the year 1883, no less than 20,067 deaths occurred from snake bites.

then, if the doctor does not arrive immediately, trying to destroy the poison by thoroughly burning the wound with a red-hot wire, knitting-needle, or cinder, a lighted fusee, strong-fuming nitric acid, or, as has been done in India, by placing gunpowder on the wound and firing it. Snake bites are productive of very great depression and faintness, so that ammonia, brandy, or some other powerful stimulant must be administered in these cases. Ammonia is also recommended as an external application. The stings of insects are sometimes exceedingly painful, and in some instances are followed by considerable depression and faintness. The first thing is to remove the sting. This, in the case of bees and wasps, can be done by pressing a watch-key firmly down over the sting, which is thereby forced up into the hollow of the key. Ammonia, as sal-volatile, or in any other convenient form, should then be applied to the painful part, and any faintness and constitutional depression should be relieved by the administration of ammonia, brandy and water, wine, or other stimulant.

Foreign Bodies in the Eye, Ear, and Nose.

Eye.—You only increase the pain and irritation by rubbing the eye when bits of sand, grit, etc., find their way into it, and the same remark applies to random and careless attempts to remove the foreign body by means of pins, pieces of wire, and similar articles. It is better to close the eye for a time, when the tears will accumulate, and perhaps wash out the offending substance on to the cheek or the edge of the eyelid. An improvement on this way of proceeding is to hold the face over some sliced onions which cause the eyes to "water" so freely that if the irritating particle is not actually imbedded the patient will, as a rule, readily get rid of it. Another plan is to pull the upper eye-

lid well down over the lower one, two, or three times successively. In this way the lower eyelashes sweep or brush the inner side of the upper eyelid, and in some instances clear away the offending particle. I find it stated that in an iron factory, where accidents of this kind were common, the usual plan was to pull the upper eyelid well down over the lower one, and at the same time to close the nostril *of the opposite side* with the thumb or finger, and to *forcibly blow the nose;* and further, that this method, if the bit of grit was not imbedded and fast, was never known to fail.[1] If, however, you do not succeed by these means in getting the foreign body out of the eye, stand behind the patient (who should be sitting down), place a narrow pencil, a probe, piece of wire, a knitting-needle, or a large pin, on the top of the upper eyelid, and, seizing hold of the eyelashes with the finger and thumb of your disengaged hand, turn the lid upwards over the pencil, or whatever it is you have got. The eyelid is thus turned inside out, and the offending piece of dirt, grit, or metal may be readily swept away by a feather, small brush, or a moistened corner of your pocket-handkerchief. If, as occasionally happens, the foreign body is under the lower lid, you can very easily draw the lid down and sweep the offending particle away. Should the foreign body —a bit of steel, iron, flint, or other hard material—be firmly imbedded and fixed in the clear portion of the eye, or, as some say, "in front of (or near) the candle," drop into the eye a small quantity of sweet oil or castor oil, protect the part by covering it with a folded handkerchief, and seek medical advice. Should mortar or lime get into the eye you ought to wash the eye *at once*, when practicable, thoroughly with a tepid weak mixture of vinegar and water, about two teaspoonfuls of vinegar to three or four tablespoonfuls of water, and carefully get rid of any small fragments from under both

[1] *Ambulance Handbook*—J. Ardavon Raye.

upper and lower lids. A little oil should then be dropped into the eye.

Ear.—Foreign bodies in the ear may sometimes be got rid of by gentle syringing with tepid water—that is, substances that will not swell, as peas, by such application. Insects can be easily removed by pouring warm oil into the ear—the patient hanging his head towards the opposite side: the insect floats on the oil, and so can be got away. Small particles may be shaken out of the ear by causing the patient to lean his head over on the side in which the foreign body is lodged, and sharply tapping the *opposite* side. Under no circumstances whatever must any attempt be made to remove anything from the ear by means of hair-pins, knife-blades, pins, knitting-needles, or pieces of wire, etc., as *deafness* will likely enough be the result—and perhaps even *death.* If you are unable to achieve your object by the simple means indicated, it is your duty to at once consult your medical attendant.

Nose.—Foreign bodies in the nose may be got rid of by causing the patient to sneeze by means of snuff, or by getting him to blow his nose hard at the same time that pressure is applied to the side of the nose in which the passage is clear.

LECTURE V.

Methods of Lifting and Carrying the Sick or Injured.

Giving aid by means of one helper; and the best ways of lifting and carrying by oneself, unaided, an insensible man—Giving aid by means of two helpers; and the methods of making two-handed, three-handed, and four-handed seats—The conveyance of patients on stretchers— Furley's Lowmoor Jacket—The Tibshelf Ambulance Tram—Wheeled stretchers or litters—Improvised stretchers—The conveyance of patients in country carts and by rail.

When you have given all the assistance you can on the spot in a case of accident or sudden illness, you have by no means completed your duty. You have to see that the patient is conveyed safely either to his home, the nearest hospital, the residence of his medical attendant, or it may be to a neighbouring shed or cottage—there to await the arrival of the surgeon. In cases of severe injury—as when a leg or thigh is fractured, or the head, chest, or belly badly wounded—the patient should *always* be carried off in the lying-down position, and for this purpose a stretcher or some other means of conveyance is required. The same remark applies to cases of sudden and serious illness, as apoplectic attacks, and severe continued fainting fits; and also to all cases of accident attended by marked shock, faintness, or troublesome bleeding. In less serious cases, when the injuries are —comparatively speaking—slight, and when more especially

they affect the arms, head, or upper part of the trunk, the lying-down position is not absolutely requisite, and such patients may frequently be helped or carried along by their comrades or attendants without the aid of a stretcher or any other sort of conveyance—that is, providing they have only to go a moderate distance.

Giving Aid by means of One Helper.

If there is only one person to give assistance, there are several ways in which he may act, according to the state of the patient (whether conscious, unconscious, faint, or helpless), the position and severity of the wound, and other circumstances. Thus (*a*) he may put one arm around the patient's loins at the same time that the patient puts an arm around his helper's neck—the patient's hand resting on the helper's opposite shoulder, and grasped firmly by the helper's disengaged hand. If the injury is in the head, neck, upper part of the body, or lower limb, the patient may also assist himself by means of a stick in the hand farthest from the helper; but if the arm is the part that is wounded, it must of course be properly slung. In this way one helper can give considerable assistance: placing his hip behind the near hip of the injured man, he can not only support him to a certain extent, but can even bear him along. In going down hill, the helper must be particular to hold the patient firmly, as there is risk of him falling or slipping forwards from weakness.

(*b*) If the helper is sufficiently strong, he may carry the patient in his arms like a child; or (*c*) he may carry him on his back—if the thighs are uninjured—holding and supporting the patient's thighs with his arms. These two last methods are useful when the patient cannot stand or walk: in both of them the patient must put his arms around the

neck of his bearer. In former times, before stretchers were regularly used, wounded soldiers were generally carried off the battlefield on the backs of their helpers; and Surgeon-General Longmore states it was in this way that the great French surgeon, Baron Percy, carried an officer, dangerously wounded, over a bridge which was being destroyed by the fire of twelve Austrian guns.

Carrying by oneself, unaided, an Insensible Man.

(*d*) If the patient is unconscious, then the task of his helper is much more arduous. A correspondence on this subject has recently appeared in the columns of the *Lancet* in reply to inquiries made by officers in the Soudan, and also in South Africa, as to the *best way of carrying by oneself, unaided, an insensible man.*[1] One very good plan is that advocated by the chief officer of the Metropolitan Fire Brigade; it is described as follows:—First turn the person face downwards,[2] and take hold close up under each armpit; then raise the body as high as it can be lifted in that position, and allow it to rest on one of the knees; then shift the arms round the waist, and, after interlocking the hands, lift the person in an upright position. After this, take hold of one of the wrists with one hand, and drop into a stooping position; at the same time pass the arm that is free between or around the legs, and the person will then fall across the shoulders; then rise in an upright position, and balance the body well on both shoulders.[3] A somewhat similar method, in which, however, the helper has perfect freedom of one of his arms, is thus described by a correspondent of the *Lancet*.—(*e*) Turn the individual upon his face, with the arms extended in a line with the body.

[1] *Lancet*, March 14, 21, and 28, 1885.
[2] Standing in a line with the patient and facing his head.
[3] *Fire Protection*—Captain Eyre M. Shaw.

Raise the trunk until he be in a kneeling position. Place yourself under him, so that his stomach rests on your right shoulder. Pass your right arm between the thighs and behind his right thigh. With your left arm draw his left hand forwards under your left, and grasp the wrist with your right hand; then raise yourself to an erect position. If you can obtain assistance in this operation, so much the better; or if there be a bed or table upon which the subject may be placed, he will be the more easily raised, or, rather, you will more easily raise yourself and burden. By this method the weight falls directly on your shoulders. The person carried cannot slip forwards, as you have his hand grasped from behind; nor can he slip backwards or off the shoulder, as your arm is over the thigh. The left arm is disengaged. Or, by reversing the operation, he may be carried on the left shoulder, in which case the left arm is passed behind his left thigh and his right hand grasped from behind. Your right arm is then free. This is very advantageous; as, for example, going down a ladder from an upper storey of a burning building where the rescued one is overcome by smoke, or where the operator wishes to carry weapons, etc., off the field of battle.[1]

If straps, bands, scarfs, or other materials suitable for slinging or tying, are available, other methods may be adopted. Thus the correspondent, alluded to above, writes —(*f*) Seat the subject with the legs flexed[2] on the thighs, and these flexed on the trunk; the head will then rest on the knees. Pass a broad continuous strap (a soldier's belt, for example) behind the thighs at the popliteal spaces[3] and under his arms. Crouch down behind him, *dos à dos*,[4] pass the strap over your forehead, and raise yourself. The strap

[1] "How to carry, unaided, an insensible man"—Beaver.—*Lancet*, March 28, 1885.

[2] Bent.

[3] That is, behind the back of the knees.

[4] Back to back.

should be short enough to allow the weight to fall upon the shoulders and upper part of your back while you are bent slightly forwards. The head may drop backwards; but, if so, it falls on the top of yours. The strap, being under his arms, prevents him from falling through. Both your arms are comparatively free.

GIVING AID BY MEANS OF TWO HELPERS: AND THE METHODS OF MAKING TWO-HANDED, THREE-HANDED, AND FOUR-HANDED SEATS.

(*a*) Two helpers may carry a patient by joining two of

Fig. 34.—TWO BEARERS CARRYING A PATIENT, IN A SITTING-UP POSITION, ON A TWO-HANDED SEAT.

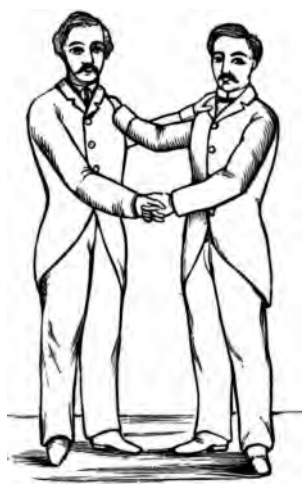

Fig. 35.—PLAN BY WHICH TWO BEARERS MAY CARRY A PATIENT, IN A LYING-BACK POSITION, ON A TWO-HANDED SEAT.

their hands under his thighs, and clasping him around the loins with their disengaged arms. The patient is thus carried in a sitting position (Fig. 34), and may further support himself by putting one or both of his arms around the necks of

his helpers—that is, supposing from the nature of his injuries he is able to do so. This method acts well for a short distance; but the helpers cannot long bear the severe strain thrown on the arms and joined hands which support the thighs and sustain the entire weight of the patient.

(*b*) A patient may be carried in a lying-back position by the helpers joining two of their hands tightly under his thighs, and placing their other hands on—and grasping firmly—each other's shoulders (Fig. 35). This is an excellent method for carrying patients who are very weak, absolutely helpless, or injured in both arms; and in this way, as the weight of the body does not fall entirely on one pair of arms (as in the former method), but is pretty equally distributed on all the arms and to some extent on the chests and shoulders of the helpers, a wounded man can be conveyed for a considerable distance without extra fatigue to his bearers.

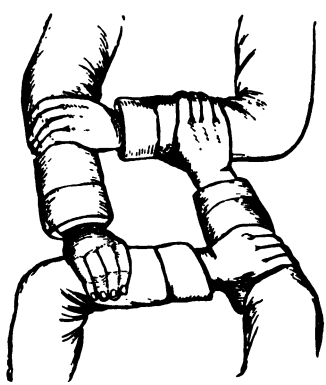

Fig. 36.—FOUR-HANDED SEAT, MADE WITH THE ARMS UNCROSSED; SOMETIMES CALLED THE SEDAN-CHAIR OR DANDY-CHAIR.

(*c*) The helpers, by crossing their arms and then taking hold of each other's hands, can form a four-handed seat on which to carry a patient—that is, if he is in a fit state to be conveyed in the sitting-up position, and also able to support himself by putting his arms around the necks of his bearers. A good seat can certainly be made in this way; but a great disadvantage is, that the weight of the patient quickly tells upon the bearers' arms at the points where they cross each other, and so rapidly causes severe pain.

(*d*) When it is decided to use a four-handed seat for any

particular case, it is better, therefore, to make one with *uncrossed* arms. This form of seat is that known as the "sedan-chair" or the "dandy-chair," and, though it looks a little complicated (Fig. 36), can easily be made as follows: —Let the two bearers stand face to face, each grasping the middle of his right fore-arm with his left hand, the backs of the hands upward; then let each bearer grasp the middle of the other's left fore-arm with his right hand, the *backs* of

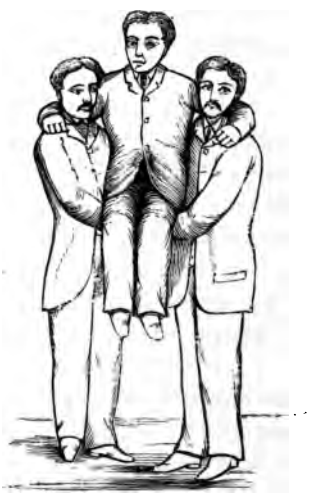

Fig. 37.—TWO BEARERS CARRYING A PATIENT ON A FOUR-HANDED SEAT.

Fig. 38.—THREE-HANDED SEAT AND BACK SUPPORT.

the hands—I repeat—*upwards*, and the chair is complete. A four-handed seat made in this way is comfortable and also secure, providing that the patient can further support and steady himself by putting his arms around the necks of his helpers (Fig. 37). The weight of the patient too, by this arrangement of the bearers' arms, can easily be borne.

(*e*) Perhaps the most useful method of all—because it is the easiest for the bearers as well as the most suitable for

the greater number of injured men, who are generally weak but not utterly helpless—is that known as the *three-handed seat and back support* (Fig. 38). This method, like the former one, looks rather complicated, but can easily be managed as follows:—Let one bearer grasp his left fore-arm with his right hand, and the other bearer's left fore-arm with his left hand at the same time that the other bearer grasps his right fore-arm with his (the other bearer's) left hand, and places his (the other bearer's) right hand on his left shoulder. By this method the patient is provided with a comfortable firm triangular seat, as well as with a cross support behind, which prevents him falling backwards; and the bearers can sustain the weight of the patient with greater ease to themselves, as well as much more comfortably and for a longer distance, because their bodies face rather more to the front.

(*f*) An *insensible* patient may be conveyed by two bearers —one walking in front carrying a leg under each arm, the other walking behind supporting the upper part of the body. This plan, however, should only be adopted when no stretcher can be procured or improvised.

Instead of employing any of these methods the bearers may sometimes *improvise a seat* by carrying horizontally between themselves a pole, rifle, a piece of light planking, a bar of a gate, or anything else suitable and handy, around which something soft has been rolled, as a blanket, rug, overcoat, or tunic. The patient sits on the seat thus formed, and further secures himself, if he is able, by placing his arms on the shoulders of his bearers. If any straps, belts, as accoutrements are available, the bearers can use them as shoulder straps with which to sling the seat, and then their hands are free to lend additional support to the patient.

Patients whose injuries are comparatively slight (more particularly if it is the upper part of the body that is wounded —the arms, head, face, or upper portion of the trunk; or

the foot) may be conveniently carried by one or other of the methods described. But when the joints are injured, or the bones fractured, of the lower limbs; or when there are severe wounds of the head, chest, or belly; or serious injury of the shoulder joint; or when there is much shock, faintness, or tendency to bleed; and indeed whenever the injuries are *severe*, or whenever the case is one of grave and sudden illness, such as apoplexy—then the patients should be carried in the *lying-down position* by means of *stretchers* or other suitable conveyances.

Methods of Lifting and Carrying the Sick or Injured on Stretchers.

A stretcher may be described as a light and strong frame of an oblong shape (provided with handles), on which a canvas is stretched tightly so as to afford a comfortable and elastic support to any one lying upon it. You have received an admirable stretcher from the Ambulance Association, and you observe that it is provided with four foot pieces, which prevent the patient being exposed to wet, or to pressure from stones or rough ground, when the stretcher is laid down. Cushions on which to rest the head are provided with some stretchers. In the one sent to you from the Association you can—if you wish it—raise the canvas up at the end of the frame in such a way as to give head support. Should it be required—for some stretchers are altogether unprovided with any kind of support for the head—a coat or other article of clothing rolled up, or a bundle of hay or straw, will serve very well for a cushion.

You will observe that your stretcher is provided with telescopic handles in order to render it more serviceable for accidents in mines where the space is more or less limited. It has also shoulder straps attached by which

it can be borne without the strain on the hands, and—what is more important—without the danger of dropping down from the careless conduct of the bearers. When not in use it can be folded and packed up so as to occupy comparatively little space.

The Regulation Stretcher of the British army is made of a piece of canvas, 6 feet 6 inches long and 1 foot 11 inches wide, nailed to two side poles, 7 feet 9½ inches long, with two hinged steel cross-pieces; it is also provided with four foot-pieces, to which small rollers are attached, so that when laid down it is raised by means of its foot-pieces about 6 inches from the surface on which it rests; and, moreover, when required, it can be readily pushed along on its rollers into any waggon, cart, or other conveyance having a level floor.

Now, you are possessed of a capital stretcher; but that is not all that is required for the proper and safe removal of a sick or injured man. Everything depends upon your own behaviour and steadiness. You must use the utmost care and gentleness when lifting the patient from the spot where he lies on to the stretcher. When raising and marching with the stretcher, you must not relax any of your caution, but must move strictly according to the rules which I shall presently explain to you; and lastly, when you reach your destination you must continue to exert the greatest patience, care, and gentleness in removing the patient from the stretcher to his bed. Any carelessness, rough handling, or want of attention to the proper rules on your part, will cause increase of the patient's sufferings, aggravation of his injuries, and perhaps even danger to his life.

Before beginning your work always see that you have "plenty of help." If possible, never have less than three men to remove a patient, for a third man is absolutely necessary if the patient is perfectly helpless, in cases of

fractured thigh or leg, if one of the other bearers gets wearied or "done," or (as may happen in military work) one of the men should be wounded.

The three men chosen should be distinguished from each other by being numbered—No. 1, No. 2, and No. 3. The strongest man of the three should be selected for No. 1, as he will have to bear the greatest weight. In order that the little party may act regularly, steadily, and move easily together, one of them should superintend the work and give the necessary directions by simple words of command. This duty is best performed by No. 3, as, from his position, he can see the other two bearers as well as the patient.

At the word *Place the stretcher*,[1] then, from No. 3, No. 1 takes the head of the stretcher and No. 2 the foot, and they place it in a line with the patient's body, the foot of the stretcher being next the head of the patient. The stretcher is placed close to the patient so that he need not be moved by hand farther than is absolutely necessary; and it is put in a line with the patient's body, as if placed crosswise the bearers would have to turn round, and would be liable to stumble when moving him. Again, if the stretcher is placed by the side of the patient, it interferes with the movements of the bearers, and is liable to make them stumble when placing the patient on it.

No. 3 (after satisfying himself that the patient has received all the *immediate* assistance which it is possible to render him on the spot, and after arranging cushions or folded articles of clothing, etc., on the stretcher, so as to give any support to the injured part that may be necessary) gives the word *Fall in.* At this order No. 1 places himself on the right and No. 2 on the left side of the patient—the two bearers facing each other—and No. 3 places himself on the injured side in a line with the patient's knees, his busi-

[1] *Stretcher Exercise*, No. 1, St. John Ambulance Association.

ness being to look after the injured part, to see the dressings, etc., do not get displaced, and also that No. 2 does not interfere with or touch the patient's feet when lifting or carrying the stretcher.

At the word *Ready* Nos. 1 and 2 go down on one knee, grasping each other's hands under the shoulders and upper part of the thighs of the patient, while No. 3 places his hands underneath the lower limbs, always taking care, in case of a fracture, to have one hand on each side of the seat of injury.

At the word *Lift* the bearers rise together, slowly and carefully, keeping the patient in a horizontal position.

At *March* all the bearers take short side paces until the patient's head is over the pillow of the stretcher.

At *Halt* the bearers stand still.

At *Lower* the patient is placed gently on the stretcher, and the bearers then stand up.

At the word *Fall in* No. 1 places himself at the head of the stretcher with his face towards the patient, No. 2 at the foot with his back to the patient, and No. 3 at the side of the patient.

At *Ready* Nos. 1 and 2 stoop down and grasp the handles of the stretcher, having previously adjusted their shoulder straps in case they are used.

At *Lift* the stretcher is gently raised to position ready for moving off.

Remember that the bearers must always carry the stretcher with their hands or by means of their shoulder straps. On no account must they ever carry it on their shoulders, for under such circumstances the patient might faint, bleed, and even die without being noticed, or he might fall off and have his injuries greatly aggravated thereby. It is stated that the American general, Stonewall Jackson, was being carried on a stretcher supported on the shoulders of four

bearers, when one of the bearers was shot and fell, and the sudden fall of the general from such a height so aggravated his injuries that he died in consequence.[1] In military work the plan of carrying stretchers on the shoulders of the bearers is attended by other and peculiar risks. Thus I find it recorded that in the Crimean War a wounded officer on one occasion was being carried on a stretcher which was supported on the shoulders of the bearers—who had their rifles slung across their shoulders, muzzles uppermost—when one of the rifles accidentally "went off," and the officer was shot dead.[2] Moreover, when a stretcher is carried on the shoulders, the patient is rendered nervous and uneasy because of the height at which he is placed, and as the bearers are scarcely ever the same size, it is impossible in this way to carry the stretcher in a perfectly horizontal position. It is better, however, if it can be managed, always to have the bearers as nearly alike in size and strength as possible, as they can more easily keep the stretcher level, and can work more evenly and regularly together; and if shoulder straps are used, their length must be carefully regulated before starting, so that the parts supporting the stretcher may all be at equal distances from the surface of the ground. When the bearers are ready to make a start, No. 3 gives the word *March.*

At this order the bearers move off with the patient, but they must not step off with the same foot; thus, if No. 1 steps off with the left foot, No. 2 leads off with the right, and *vice versâ.* The object of walking out of step is to keep the stretcher from rolling first on one side and then on the other. If the bearers moved in step each time they both advanced their right feet their bodies would also dip together with the stretcher somewhat in the same direction, and when their

[1] *Gunshot Injuries*—Surgeon-General Longmore.
[2] *Ambulance Handbook*—J. Ardavon Raye.

left feet advanced the dip would be on the left side. By marching out of step—or, as it is sometimes termed, with a "broken step"—the stretcher is kept level, and there is no tendency to roll. Moreover, the bearers must not step out as in ordinary walking or marching, but on the contrary they should take short steps of about twenty inches, and should move steadily and without any spring. The feet, as they are advanced, should not be raised farther off the ground than is necessary to clear stones, inequalities of the surface, or other obstacles, and should be planted firmly down without any jerking motion. The hips should be moved as little as possible, and the knees should be rather bent. In fact, the bearers when marching should imitate as closely as possible the walk of those persons who, in pursuit of their business, have to carry fragile articles and liquids—as eggs, crockery, plaster of Paris images, milk, water, etc.—on their heads. Their object is, of course, to cause as little movement of the body as possible, and so lessen the up and down motion of the stretcher during its carriage. Another advantage of taking short steps is that the bearers thereby avoid knocking one or other of their thighs against the transverses or crossbars of the stretcher. They are apt to constantly do this if they take long paces, hurting themselves, and, what is worse, jolting the stretcher. The bearers should also endeavour to take their steps equal in length one with the other, as, if one bearer is continually overstepping the other, jolting of the stretcher is the inevitable result. However irregular the ground is, the bearers should endeavour to keep the stretcher as level as possible. When the ground is moderately level the patient should be carried so that he faces the direction in which he is being moved. If the patient is being carried uphill his head should be in front, if downhill his head should be behind—except in cases of fracture of the thigh and leg, when, in going uphill, the head

should be behind, and in going downhill before, so that the weight of the body may not tend to displace the fracture. Never attempt to carry a stretcher over fences, hedges, or walls, but either forcibly break down the hedge or wall so as to make an opening for the stretcher, or carry the patient to where there is a gate or gap through which the stretcher may be got. If a broad ditch or hollow has to be crossed the stretcher should be laid down near the edge; the foremost bearer should then get into the ditch and support the front of the stretcher (pushed forward by the other bearer), the hinder end of the stretcher resting on the edge; the second bearer should next get into the ditch, and the stretcher after being carried across should have its fore part put to rest on the farther edge, while its hinder end is supported by the second bearer. The first bearer then gets out of the ditch, and the stretcher being pushed or lifted on to the level ground, remains there until the second bearer gets up. The bearers then raise the stretcher and move on. When the patient has been conveyed to his destination No. 3 gives the *Halt*, and the bearers thereupon stop —but not too abruptly, so as to avoid jerking the patient— and stand still.

At *Lower* the bearers gently place the stretcher on the ground and then stand up.

At *Unload Stretcher—Ready*, Nos. 1 and 2 sink down on one knee and grasp each other's hands under the shoulders and upper part of the thighs of the patient, and No. 3 places his hands underneath the lower limbs, taking care, in case of a fracture, to have one hand on each side of the seat of injury.

At *Lift* the bearers carefully raise the patient up.

At *Lower* they lay him gently on the bed, couch, or wherever it has been arranged to place him.

Such is the way in which you would usually transport a

sick or injured patient on a stretcher. It may happen, however, that a man is hurt or taken suddenly ill in a spot where there is very little room, and where there is not space sufficient to allow of the stretcher being placed in a line with the patient's body. In such an emergency you would have to place the stretcher at the side of the patient, and you would proceed somewhat as follows,—*supposing there were four bearers available.* The bearers should number off, 1, 2, 3, 4; and No. 4 gives the word of command.

At the order *Fall in*[1] No. 1 places himself by the patient's shoulders, No. 2 by the middle of his body, and No. 3 by his feet, all three standing on one side of the patient—*on the injured side.* At the same time No. 4 places the stretcher on the ground by the other side of the patient, and remains standing near its centre facing the other bearers.

At *Ready* Nos, 1, 2, and 3 stoop down and kneel on the left knee if they are on the left side of the patient, on the right knee if they are on the right side of the patient. They then proceed to take hold of the patient; No. 1 passing one of his arms beneath the patient's neck and the other under his shoulder-blades; No. 2 passing both arms round the middle of his body, one above, the other below the buttocks; and No. 3 passing both arms under the lower extremities, excepting in case of fracture, when he must place one hand on each side of the broken bone, so as to steady it. At the same time No. 4 grasps the nearest pole of the stretcher with his left hand, and the pole farthest from him with his right hand, near the centre.

At *Lift* Nos. 1, 2, and 3 gently raise the patient up, each at the same time placing on the knee which is not touching the ground his elbow of the same side. While the patient is thus being raised No. 4 moves the stretcher into proper position under him, and kneels down on one knee by its side.

[1] *Stretcher Exercise*, No. 2, St. John Ambulance Association.

At *Lower* Nos. 1, 2, and 3 carefully lower the patient down to the stretcher, while No. 4 at the same time assists in supporting and placing him on it.

At *Stand to stretcher* No. 1 goes to the head of the stretcher with his face towards the patient, No. 2 to the foot with his back to the patient, and Nos. 3 and 4 remain in position on each side of the stretcher. The bearers proceed then, in the same way as described previously, to lift the stretcher and move off, acting by similar words of command—*Ready*, *Lift*, *March*, etc.

It may happen that the space is insufficient for the stretcher to be placed in a line with the patient, and also that *only three bearers are available.* In such a case the bearers are numbered No. 1, No. 2, No. 3; and No. 3 takes charge of the party.

At the word *Place stretcher*[1] No. 1 places the stretcher on the ground close to the sound side of the patient.

At *Fall in* the three bearers place themselves on the injured side of the patient in the same positions as described in the last exercise.

At the words *Ready* and *Lift* the bearers act as in the previous exercise.

At *Lower* the bearers lean forward so as to carry the patient over the stretcher, and then carefully lower him down upon it.

At *Stand to stretcher* No. 1 goes to the head of the stretcher, No. 2 to the foot, and No. 3 remains at the side of the stretcher.

Then follow the orders *Ready*, *Lift*, *March*, etc., as previously described. In mines, underground workings of different kinds, narrow passages and cuttings, there may be only space sufficient for two men to be engaged in giving first aid and managing the removal of a patient on a stretcher.

[1] *Stretcher Exercise*, No. 3, St. John Ambulance Association.

In such a dilemma the stretcher should be placed by the two men,[1] No. 1 and No. 2, in a line with the patient's body, the foot of the stretcher being, if possible, close to his head. It is not advisable, however, to be too particular as to the head or foot of a stretcher in a mine, as it would probably be quite impossible to reverse it, and the bearers can always lower the pillow.

No. 1 gives the word *Ready*, when both the bearers get into position as follows:—No. 1 places his feet one on each side of the patient between his body and arms, the toe of each foot as near the armpits as possible, standing over the man. He then stoops down and passes his hands between the sides of the chest and arms underneath the shoulders, and locks the fingers. If the patient's arms be uninjured he may put them round the neck of No. 1, and by this means greatly assist him in lifting. No. 2 at the same time places his right foot between the calves of the injured man's legs, as close to the knees as possible, and his left foot at the injured man's right side, close to the crest of the hip (when the patient's legs are in splints and tied together, the feet of No. 2 must necessarily be placed outside); he then kneels down and passes his arms round the outside of the patient's thighs at the lowest part, and locks his fingers behind just at the bend of the knees.

When both bearers are ready No. 1 gives the word, *Lift and move forward.* The patient is then slowly lifted, just sufficient to allow his body to clear the stretcher, both bearers slowly and gradually moving forward, No. 1 by very short steps, and No. 2 by bending his body forward over his left thigh, by which means he exercises a pushing movement which very greatly assists No. 1. No. 2, when he has bent his body forward as much as he can without moving his feet, advances his right foot to his left, then again advances his left foot

[1] *Stretcher Exercise*, No. 4, St. John Ambulance Association.

and bends his body forward, this movement being repeated until the patient is laid on the stretcher.

The bearers will then act in the ordinary manner as far as the nature of the locality will permit.

The four different methods that I have given you of conveying sick and injured patients on stretchers are those framed and recommended by the Ambulance Association, and they are drawn up and arranged so that one or other of them may be usefully adopted in almost any circumstances under which an accident or sudden attack of illness may occur. Thus, when you have plenty of space at your disposal, the first exercise is practicable. When there is not space enough for the stretcher to be placed in a line with the patient, as in a small room or a crowded work-shed of some description, the second or third exercises, according to the number of bearers available, will be found suitable; and in the case of narrow cuttings, tunnellings, and narrow ways in crowded manufactories, the fourth exercise will be found the most serviceable.

The stretchers supplied by the Ambulance Association, when required for use in mines, are provided with telescopic handles, so that a patient can be placed on the stretcher down in the workings, and brought up the pit shaft in a horizontal position without being further disturbed. I understand that this can be done in well-constructed and roomy mines. There are, however, some mine shafts, borings, sewers, and other narrow places, up which it is impossible to bring a patient in the horizontal position, owing to the deficiency of lateral space. Now, to meet such emergencies an apparatus has been designed by Mr. John Furley, by which a patient can be drawn safely up, *in the vertical position*, through a narrow shaft, even with a fractured thigh. It is known as *Furley's Lowmoor Jacket*, as it was originally designed for use in the small pits at Lowmoor, near Brad-

ford. It can be used with any ordinary stretcher, having fixed handles, and is described by Surgeon-Major Evatt[1] as follows:—"A jacket which encircles the injured person's chest and abdomen, and which has strong back pieces which run up behind the patient's back, and cross over an iron bar, which is slipped by iron rings over the handles of the stretcher. There is also a strong support passing between the legs and fastening to the jacket. The legs are kept in their place by a strap, and additional support is given by a web-stirrup into which the sound foot can be slipped if desired. The patient can thus be drawn vertically out of the mine or sewer, or lowered into a boat, without injury to the wounded part."

In reply to my inquiries on the subject, the Manager of the Lowmoor Iron Works very kindly wrote to me,[2] and said that fortunately no occasion had arisen for the use of the ambulance jacket that had been designed for his small pits, but that he had every confidence in it, and believed it to be admirably adapted to the purpose for which it was intended, as he had proved it by experiments.

I now pass on to refer to a method of *conveying the sick or injured along underground workings* which has not as yet attracted the attention it deserves. I allude to the *Tibshelf Ambulance Tram*, which was arranged by the chairman and members of the Tibshelf Centre of the Ambulance Association, and which I believe only requires to be generally understood throughout the various large mining districts for it to be greatly appreciated and extensively adopted.

Mr. S. C. Wardell, of the Babbington Coal Company, Nottingham, chairman of the Tibshelf Centre, has, with the greatest courtesy, favoured me with very complete information concerning the ambulance tram—indeed, his description is so complete and lucid that I cannot do better than give

[1] *Ambulance Organisation, Equipment, and Transport*—Surgeon Major G. Y. H. Evatt, M.D.

[2] 17th November 1884.

it in his own words. It is as follows:—"The tram we have designed is like our ordinary pit-trams in size and shape, except that it has no end boards, both ends being open. In the case of an accident, when a stretcher is not used, we made arrangements for a head-rest to be fixed up at one end of the tram at an angle of 60 or 70 degrees, so that the patient may sit in the tram, with a comfortable support for his back and head. In this way he may be wheeled along the underground road to the shaft bottom, and be drawn up the shaft in the tram. To be prepared for a more serious accident underground, I caused to be fixed to a Furley stretcher with telescopic handles four legs, 7 or 8 inches long, each leg having a spiral spring around it. These legs fit into four holes bored in the bottom of the tram, but the spiral springs catch in the bottom of the tram, and, of course, give way at any jolt of the truck. At our Tibshelf Colliery this stretcher may be laid in the bottom of the tram and drawn up the shaft, the position of the patient thus not being altered between the place of the accident in the pit and his home.

"The tram without the stretcher could be used at any colliery. The use of the stretcher as well would depend on the width of the shaft or length of the 'cage' or 'chair.'

"The tram is 4 feet long and 3 feet wide, and will only hold one person.

"It can only be used underground or where tramways are laid on the surface.

"It was designed for the conveyance of injured men underground."

In towns and districts where the roads are good and suitable for wheeled conveyances, the quickest, least fatiguing, and altogether the best mode of transporting sick and injured patients is by means of *wheeled stretchers or litters.*

A wheeled stretcher or litter consists of two distinct parts

—a *stretcher*, such as has already been described, and a *wheeled support*. When it is desired to move a patient he is placed in the usual way on the stretcher, which is *detached* from the wheeled support, and laid either *on the ground or on a table;* the stretcher with its burden is then fixed on its wheeled support, and the whole contrivance can, always providing the roads are moderately good, be rapidly drawn or pushed along by a single bearer. On arriving at the patient's home, the hospital, or other destination, the bearers remove the stretcher and patient from the under-carriage, *passing between the wheels* of the support. The stretcher is finally placed on the ground, floor, or a table, and the patient is lifted off in the usual way and laid on his bed.

There are many different appliances of this kind in use. Our army is provided with a military wheeled stretcher, and there are two varieties, the "Ashford" Litter and the Order of St. John Litter, that are supplied by the Ambulance Association. In all these the stretcher provided is a good one, and capable of being placed quickly and firmly on its wheeled support, and as rapidly removed from it when necessary. The whole can be easily pushed or drawn by one man, and, should the bearer be called temporarily away, it rests quite safely and securely on its own supports.

Wheeled stretchers were practically tried in the Schleswig-Holstein War of 1864, the German War of 1866, and in the great Franco-German War of 1870-71, and they were found to be of great service in parts where the roads were good, and more adapted therefore for work in connection with stationary hospitals and garrisons. On the battlefield itself, however, and in its immediate neighbourhood, they were found not so suitable on account of the rough and broken character of the ground over which the troops manœuvred. Such conveyances have been found to answer admirably in the streets of our towns and cities, and also in rural districts,

in connection with collieries and large manufactories where the roads are moderately good and suitable for wheeled transport.

The great advantages of these hand-wheel litters are the *rapidity* with which the patient can be conveyed from place to place, the *ease* with which the conveyance can be moved, and the fact that *one man only* is required to push or drag the litter along. It is stated by Surgeon-General Longmore that one man with a wheeled stretcher can do as much work in a given time as four men with ordinary hand stretchers. You may understand, therefore, what a saving of valuable time, fatigue, and labour may be effected by the use of hand-wheel litters in preference to the ordinary stretchers. Coming to the question of expense, the Ambulance Association supplies the "Ashford" Litter for £10 : 10s., and the St. John ambulance wheeled litter for £16. Once procured a wheeled litter only requires a little cleaning and occasional repainting, and, if looked after with ordinary attention and kept in a suitable shed, it will last for an indefinite period, and be always ready for immediate use.

Now that you have some idea of the different methods of helping along or carrying the sick or injured, you should on no account rest satisfied with mere theoretical knowledge, but should frequently go through the various methods of transporting patients amongst yourselves. When you meet together for practice you should ask a comrade to represent an injured man, and then see how well you can give him aid by means of one helper and two helpers, and by supporting him on two-handed, three-handed, and four-handed seats. Above all, you should constantly practise lifting him on to the stretcher, carrying the stretcher, and lifting him off the stretcher, carefully going through each of the four stretcher exercises framed and recommended by the Ambulance Association. When you have an opportunity, you should

also practise carrying the stretcher—with a friend lying on it—uphill and downhill, over rough and broken ground, across ditches, and other obstacles. It is only by regular and careful practice that you can attain proficiency in transporting patients, and go through the stretcher and other exercises with the care, skill, and gentleness which are so necessary in removing any one really ill or badly hurt.

For the purposes of practice you have the stretcher sent to you by the Association; and if such stretchers (or, where the roads are suitable, wheeled stretchers) were kept in a convenient spot at all the various collieries and other works in the district, they would prove of the greatest possible service in case of accidents. It may happen, however, that no properly-made stretcher—just at the time when it is most sorely needed—is at hand; or there may be only one stretcher available, and several men badly hurt and urgently requiring removal. During military campaigns the want of stretchers has often been terribly felt in the presence of enormous numbers of severely-wounded troops. In such emergencies you should always be prepared to *improvise stretchers*—that is, to make temporary stretchers out of any materials that chance to be near at hand and suitable for the purpose. Shutters, doors, boards, short ladders, window-frames, bedframes, or benches, will serve as stretchers at a push; but they should be covered with something soft, as hay, straw, rushes, cushions, blankets, or clothes. Blankets, overcoats, rugs, counterpanes, curtains, or pieces of cloth or canvas—if nothing else is available—may be used, the four corners being held and carried by four bearers. Soldiers wounded in the trenches before Sebastopol were sometimes thus removed on the blankets with which they were supplied. The silk sashes of the officers—as formerly made—were also utilised in the same way. This plan should, however, only be adopted when no other means of extemporising stretchers

are at hand, and it is necessary to remove the patient immediately; it is very fatiguing to the bearers, and the patient falls into a kind of doubled-up position which—especially in cases of fracture—is likely to greatly aggravate his injuries. Sailors' hammocks and cots may be used as stretchers by being suspended from poles: temporary stretchers of this description were used in the Crimea after the battle of Alma, and also in the Ashantee War. When two poles can be procured, or rifles, oars, boat-hooks, broom-sticks, rake-handles, bamboo-poles, or similar articles, temporary stretchers may be made in a variety of ways as follows:—

(*a*) By fastening loops to the four corners of a blanket, then folding the blanket, and passing one pole through the four loops, and the other within the doubling of the blanket. This arrangement is known as the *looped blanket.* If there is no time to fasten on loops, holes may be made at the four corners of the blanket instead. Counterpanes, rugs, table-cloths, and carpeting may be used in the same way.

(*b*) By fastening the sides of corn-sacks, flour-sacks, pieces of canvas, fragments of tents, hearthrugs, overcoats, skins of animals, etc., to the two poles. General Jackson had his wounded carried on the skins of oxen slung between two muskets.

(*c*) By pushing the poles through the sleeves (turned inside out) of two coats, which are buttoned across; or by pushing the poles through the sleeves of one coat; or by pushing one pole through the two sleeves of a coat which is buttoned across, and rolling the tail of the coat around the other pole. The two last arrangements would only be of sufficient size to support a patient in the sitting-up position, his back resting against the foremost bearer, and his legs hanging in front of the hindermost bearer. The tunics and overcoats of soldiers, and the jerseys and "jumpers" of sailors, may be made use of in the same manner.

(*d*) By stretching and looping across the two poles ropes of hay or straw, telegraph wire, ordinary rope, accoutrements of all kinds, girths, bridles, or stirrup straps. Netting fastened between the two poles would answer very well.

(*e*) By nailing or tying cross pieces to the poles; and then making the body of the stretcher either with boards or with some soft material, as blankets, articles of clothing, canvas, etc.

You should practise making temporary stretchers just as you accustom yourself to making improvised splints, bandages, pads, and tourniquets. It is astonishing how ready some people are in making the most of all their surroundings in case of emergency—improvising tourniquets, manufacturing splints, and contriving the means of transport out of almost anything within reach; while others, again, quite as willing but not so quick-witted, run about making a great fuss, and after all do next to nothing. The ability to display coolness, promptitude of action, and readiness of resource in the presence of some serious catastrophe, is to a certain extent quite a gift, and is not given equally to every one of us; but it is in the power of all, by frequent, careful, and steady practice, so to train themselves into the accurate and rapid performance of their various ambulance duties that, when opportunity occurs, they may render prompt and efficient "first aid" with the happy result of alleviating suffering, and it may be of saving life.

Conveyance of Patients in Country Carts.

In cases where you have to convey a patient for a considerable distance, and you have not the advantage of possessing a wheeled stretcher, and are also unable to collect a sufficient number of men to form relays of bearers for a

hand stretcher, you may be obliged to resort to an ordinary country cart as a means of transport. If no stretcher at all is available, neither any materials from which you can quickly improvise one, the bottom of the cart should be covered with some soft substance, as hay, straw, leaves, ferns, rushes, mats, cushions, or clothes, and the patient should be carefully laid on the soft bed thus formed, being lifted in the way described for placing the sick and injured on stretchers, and one man being in the cart to assist. If, on the other hand, the patient is on an ordinary hand stretcher, then the stretcher with the patient should be slung in, and from the sides of the cart, care being taken that the lashings are not too slack, or the stretcher will knock against the sides of the cart, and not too tight, or the patient will be jerked with every slight movement of the cart. Should you be unable to manage the lashing of the stretcher to the sides of the cart, it is better to lay it gently on the bottom; and if the stretcher is provided with foot-pieces, these will suffice to keep the canvas—on which the patient is resting—clear of the hard wooden floor of the cart. Should the stretcher, however, not have foot-pieces, then straw, hay, rushes, or other soft material must first be spread over the bottom of the cart. Considerable care is always required in getting a stretcher, with a patient on it, safely into a cart. When the foremost bearer of the stretcher reaches the cart, No. 3 must take fast hold of the right-hand pole at the same time that the bearer turns around the left-hand pole which he continues to support. Of course the bearer must be very careful not to let the right-hand pole go until No. 3 has firm hold of it. The foremost bearer and No. 3 then raise the poles of the stretcher to the required height—the bearer at the other end taking care to keep the stretcher level, and then (with the aid of the others) pushing it gently into the cart. The English Army

Regulation stretcher, being provided with four small rollers, is easily pushed along the floor of a cart or ambulance waggon.

Conveyance of Patients by Rail.

It may be necessary sometimes to transport patients by rail. Those who are injured in the arms, or slightly in the head, neck, or upper part of the body, can—after being dressed, and duly provided with splints, slings, etc.—easily travel in the sitting-up position. Persons who are hurt in the lower limbs may also travel in the sitting-up position, providing proper support, if necessary, can in one way or another be arranged for their legs. This may often be done by the simple method of cutting one or more planks to a suitable length, and fixing them across the front and back seats of the carriage, thus enabling the patient to travel sitting up with the legs raised. If patients have to be carried in a lying-down position, a difficulty exists in the fact that the doors of the railway carriages are barely large enough to admit of a stretcher being introduced. A large second-class compartment is found to answer best; and it is recommended to place two strong wooden cross supports on the opposite seats of the carriage, each about a foot from the door. Room is thus afforded for two stretchers to be placed on the supports, one over each seat. Great care must be taken to move the stretcher gently and evenly into the compartment. No. 3 gets into the carriage first, and grasps one pole of the stretcher, while the foremost bearer turns around the other pole—holding it firmly until No. 3 also seizes *that;* the stretcher is then gradually moved into the carriage until No. 3 lays his end on the farthest cross support, when it is easily placed in its proper position by the three bearers acting together. During the journey an

attendant should sit between the stretchers on one of the cross supports. In a first-class carriage, on account of the partitions separating the seats, only one stretcher can be introduced, and that placed over the interval between the seats. On the patient arriving at his destination, Nos. 1 and 2 place the stretcher along the middle of the compartment on the cross supports; Nos. 1 and 3, descending on the platform, bear one end of the stretcher out of the carriage, the other end being carried by No. 2. On No. 2 reaching the door No. 3 goes to his assistance, and the stretcher is got clear of the carriage. Luggage vans, cattle trucks, and goods waggons are much more roomy, and may be prepared in the same way as country carts for the reception of patients by placing a quantity of straw or hay, mattresses, cushions, etc., so as to make a soft layer for the injured men to rest upon. The greatest importance in the present day is attached to the rapid and safe transport by rail of sick and wounded troops during military campaigns; and as a consequence, much attention is directed—especially by the larger continental States—to the formation of regular *ambulance trains;* and, where that is inconvenient, to the fitting up of ordinary goods waggons, etc., with some kind of arrangement by which stretchers can be securely suspended or supported. The sick and wounded may be safely and comfortably transported—as they were on some occasions in the American Civil War, and also in the German War of 1866—by placing the stretchers, beds, or straw palliasses (on which the patients rest) on the floors of railway cars and waggons, over which hay or straw has been thick and evenly laid. In the present day, however, special ambulance trains are constructed for the purpose of conveying the sick and wounded in time of war. The Austrians, more particularly, have reached great perfection in this matter; and have ready for use trains consisting of—besides the engine and

guard's van—ten carriages, each arranged to carry ten stretchers; a dining waggon; store waggon, containing the eatables, etc.; a magazine waggon, containing instruments and other requisites; a kitchen or cooking waggon; and a sleeping carriage for the medical men.

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