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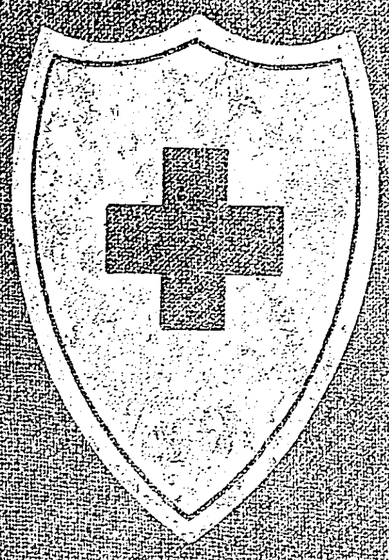

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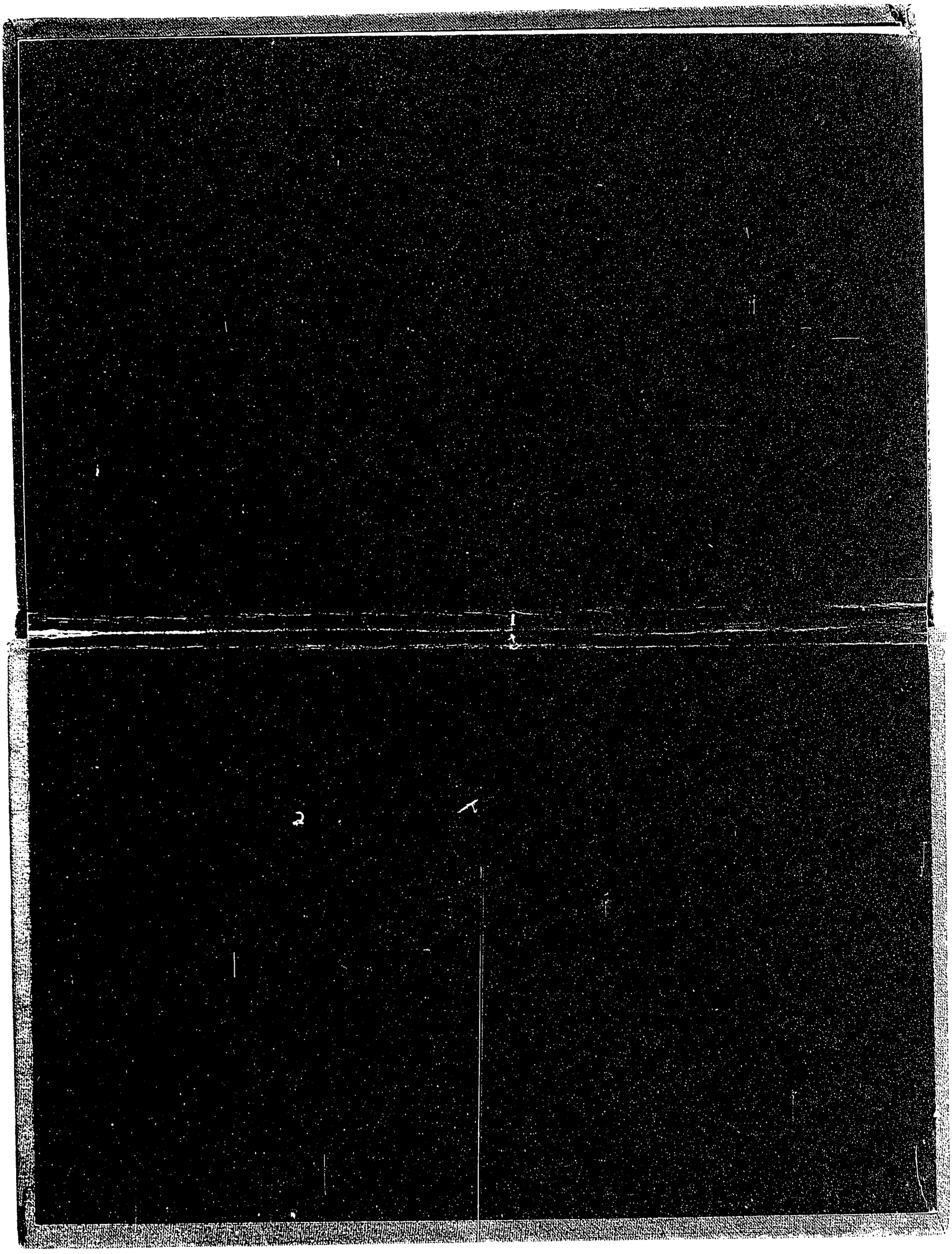

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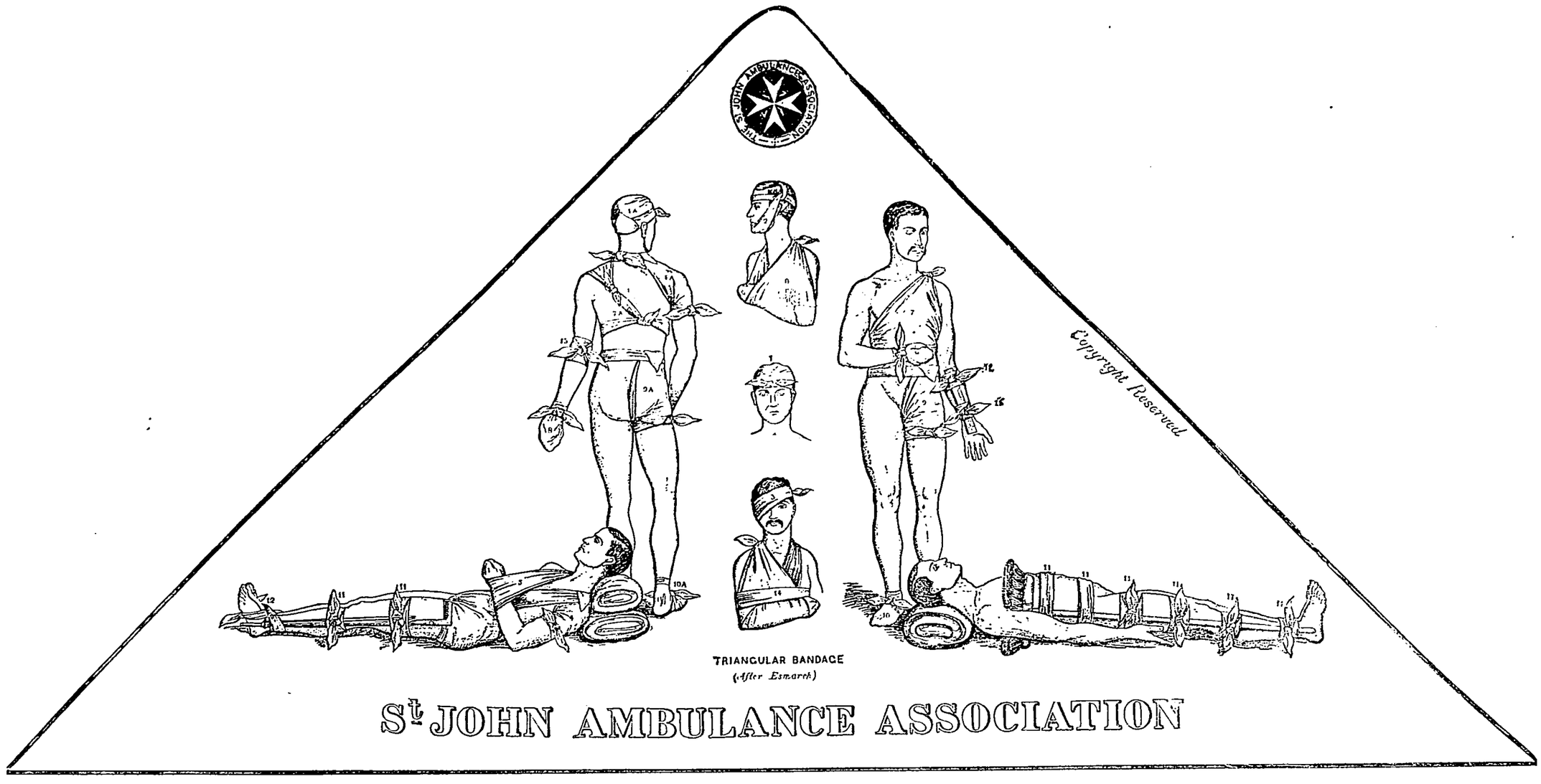

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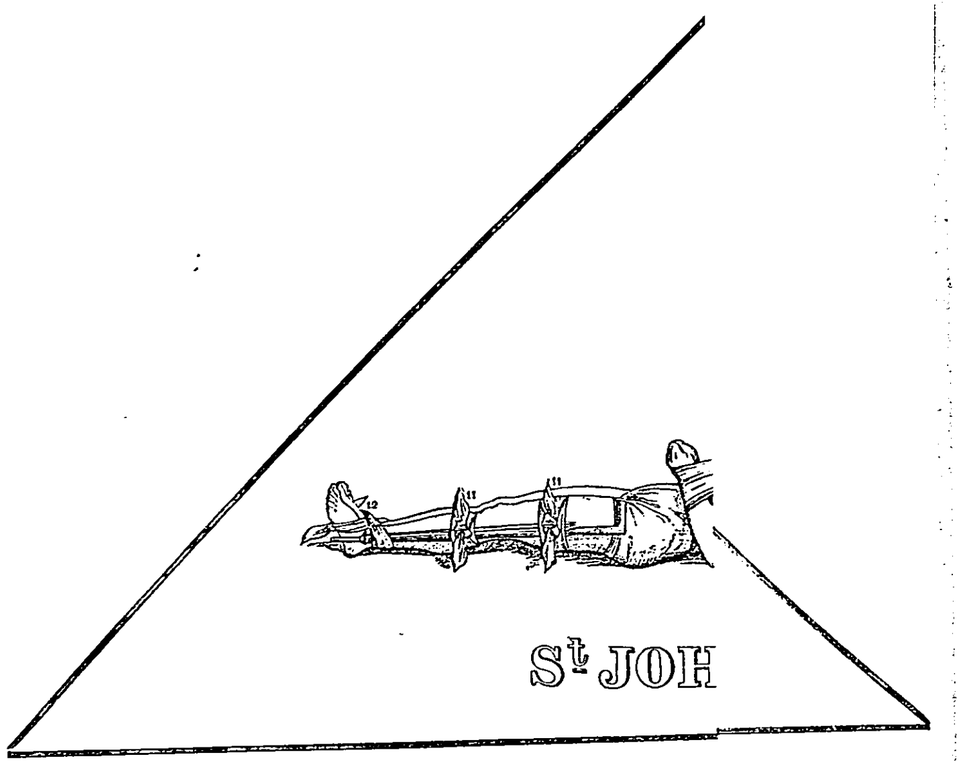

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ILLUSTRATED LECTURES

ON

AMBULANCE WORK

BY

R. LAWTON ROBERTS

M.D. (LOND.), D.P.H. (CAMB.)

MEMBER OF THE ROYAL COLLEGE OF SURGEONS, ENG.; ASSOCIATE OF THE COLLEGE OF STATE MEDICINE; MEMBER OF THE SANITARY INSTITUTE, AND EPIDEMIOLOGICAL SOCIETY; HONORARY LIFE MEMBER OF, AND LECTURER AND EXAMINER TO, THE ST. JOHN AMBULANCE ASSOCIATION

FOURTH EDITION, WITH ILLUSTRATIONS

LONDON

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1891

LONDON
PRINTED BY H. K. LEWIS,
136, GOWER STREET, W.C.

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 TO FOURTH EDITION.

A NEW edition being called for, the book is re-issued with only such alterations as are found to be absolutely essential. The device or badge on the bandage in the frontispiece has been altered to the pattern authorized by the Charter of Incorporation which, on May 14, 1888, Her Majesty the Queen was graciously pleased to grant to "The Grand Priory of the Order of St. John of Jerusalem in England," the said Charter containing "the full recognition of the St. John Ambulance Association, the Ambulance Department of the Order." The section on Ambulance Corps in the Appendix has been brought up to date, and altered in accordance with the scheme of massing all Corps connected with the Association into "The St. John Ambulance Brigade."

The work carried on so vigorously and extensively, both at home and abroad, by the St. John Ambulance Association, and the similar action, though within a limited area, of the St. Andrew's Ambulance Association, has been followed by such happy results that the value of First Aid is now recognized and appreciated even by the majority of those who formerly were the most sceptical. Advantage is freely taken by the representatives of our important industries (worked unavoidably at some risk to life and limb) of the facilities afforded by the Ambulance Association to spread instruction in First Aid amongst their employés. The clause in the Coal Mines Regulations Act (1887)—"Where persons are employed underground, ambulances or stretchers, with splints and bandages, shall be kept at the

mine ready for immediate use in case of accident"—led to the formation of numerous ambulance classes in connection with collieries, the teaching of First Aid being further diffused among the mining population by means of the "Crusades" undertaken by Surgeon-Major Hutton, at the instance of the St. John Ambulance Association.

Similarly, classes for teaching Ambulance Work are constantly being held amongst all our different labouring and industrial communities, as well as in every walk of civil—and, we may almost add, of military—life. Such being the case, it is certainly a little singular to find that, until a comparatively recent date, our great Railway Companies and their many thousands of employés have been considerably behindhand, compared with other industries, as regards practical knowledge of First Aid. Isolated, independent, or "detached" St. John Ambulance classes of railway men no doubt have been formed here and there for years; but these unconnected and spasmodic efforts, though honourable to those immediately concerned, could be of little practical and general utility, especially when the vastness and intricacy of our railway system is considered. Isolated, and formed quite independently of any good scheme or system, such classes were unworthy of our great Railway Companies, and to all intents and purposes useless to the mass of employés working under them and to the public utilizing their lines.

It may be readily supposed that this state of affairs had not escaped notice at St. John's Gate, and that it led to the appointment of Surgeon-Major Hutton, in August, 1890, to the post of "Organizing Commissioner" to "promote Ambulance Work on the Railways of the Kingdom." Within a week of this step an inaugural public meeting was held at York, with Lord Wenlock as chairman, and shortly afterwards the directors of the North-Eastern Railway Company caused printed notices to be issued that "when any of the company's servants join the Ambulance Association, and obtain a certificate, the ordinary class fees may be

allowed them"; arrangements being also made for the supply of stretchers and other ambulance materials to stations as required. The matter has been taken up in a similar spirit, it is satisfactory to know, by other railway companies. "*Now*," I am informed on the highest authority, "the Directors of the Great Lines, such as the North-Eastern, the London and North-Western, the Great Northern, the Great Eastern, the Great Western, and other companies have sanctioned the holding of classes on an organized system, they paying the expenses, wholly or partly. The London and North-Western has gone so far as to *order* men to join *nolens volens*."

There are one or two points in connection with railway work on which Surgeon-Major Hutton rightly lays especial stress:—(*a.*) Classes should be established at the small outlying stations no less than at the larger and more important ones, for in case of accident in such localities great delay may ensue before professional help is obtainable, more especially as country medical men often have practices ranging over many miles, and, therefore, may not be available for hours. In such outlying localities, classes might usefully be made up of the railway employés with villagers and others in the neighbourhood. (*b.*) There should also be kept properly constructed ambulances or stretchers, with splints, bandages, and tourniquets at every station in the kingdom, ready for immediate use in case of accident. It would be a great thing to introduce a clause, rendering such a step compulsory, into the Railway Regulation Act, similar to Rule 34 in the Coal Mines Regulation Act. The "Furley" stretchers, with telescopic handles, are admirably adapted for such a purpose, for their peculiar construction allows them "to be placed in railway carriages and other vehicles not otherwise sufficiently long to receive them"; and also "to be passed into a carriage or through a doorway rather less than two feet in width," the bearers being able to "diminish the breadth without inconvenience to the patient." These stretchers, moreover, are adapted to the

Ashford two-wheeled litters, with which certainly railway stations (all the larger ones, *at least*) should be supplied. Speaking generally, an effort should be made, as I urged in 1886, to establish in connection with our great railway system *an organization for affording relief at railway accidents*, similar to that described by Baron Mundy.

Passing to another body, it is simply a truism that "both at the home and colonial centres the absolute necessity that *all police officers, of whatever force or grade*, should possess the knowledge of how to render First Aid, is fast becoming daily more and more recognized by the various corporate and other bodies charged with their administration"; and further, that "no special services performed by the police have brought them so much in pleasant touch with the public." Surgeon-Major Hutton, addressing a meeting on May 15th, at which sixty-one members of the Government Police Force received "certificates," remarked that "he had recently received a batch of thirty essays from members of the Lancashire Police on Ambulance, in competition for a £5 prize which a gentleman had offered . . . . Such work as that was a step in the right direction"; and alluding to the difficulty in instructing members of the *County* Police, "distributed as they are often in distant and isolated stations of the county," advised that all recruits should be instructed in First Aid during such time as they are kept up at Headquarters for the purpose of learning Police Drill, and that each man should hold an Ambulance Association Certificate.

There are other departments or communities in which Ambulance instruction is much needed. One of these is the Mercantile Marine Service. Numbers of vessels are unprovided with surgeons, not only those which are engaged in coasting work or in running comparatively short distances, but the great majority of merchant ships; and under such circumstances when accidents occur, the injured are completely cut off from professional aid, the only chance of relief for, it may be, several days or weeks, being that some on

board are conversant with the simple and easily-acquired principles of First Aid. An experienced Captain, of the Royal Naval Reserve, told me that he considered every ship master should possess a knowledge of Ambulance work and a book of reference on the subject by which he could refresh his memory as occasion required.

Another class to whom a sound knowledge of First Aid is simply indispensable consists of those who go abroad to live in one or other of our colonies, or with a view of being employed in some special field of labour or industry. I have myself received direct testimony from persons living in South Africa and also in New Zealand as to the real value of Ambulance instruction.

The above are only a few departments of the nation in which Ambulance knowledge is greatly needed; but, speaking generally, the same necessity for univeral instruction in First Aid exists as when I first urged it in 1886. In a recent speech, H.R.H. the Duke of Connaught remarked that seventeen years ago "he met a distinguished foreign Count in St. Petersburg . . . . and in the course of conversation, asked him, 'What has struck you most in England?' and his reply was, 'The utter ignorance of English women and men of the most ordinary and common-sense remedies in case of accident or illness' . . . . If the intelligent foreigner could come back again now he would not be able to say the same thing to-day." This is certainly true, in a *general* sense, since (according to a statement by Sir Kenneth Barrington) "over half a million of persons have received instruction, 200,000 have received certificates after examination, and 20,000 have been awarded medallions. Last year 19,500 certificates for First Aid and about 2,660 for nursing were awarded, and 13,000 were to men and 9,000 to women." Nevertheless, in spite of all these encouraging facts, and they *are* encouraging, when we come to view the matter, not in a general way, but as affecting the individuals, communities, and classes of which the nation is composed, we find "the uttter ignorance of English women and men,"

alluded to by the distinguished foreign Count, in every grade of life, every class of society, every industrial or public body. The population of England and Wales at the census of 1881 equalled 25,968,286. This figure has doubtless increased at the present time by some millions. Now it is authoritatively stated that over half a million of persons have received instruction in First Aid; this is very satisfactory, but what of the twenty-five odd millions who have *not* received such instruction? and who are in "utter ignorance . . . . of the most ordinary and commonsense remedies in case of accident or illness." Such figures require no comment; they at once show clearly what a vast amount of work remains to be done by the Ambulance Association, before the full value of First Aid can be obtained. For, as I have persistently urged, the effect of Ambulance instruction as shown by the diminution of the death-rate from accidents, lessened duration of illness after injuries, the reduction of cases of permanent maiming, not to speak of the more effective alleviation of suffering, can only be properly judged when such instruction becomes *universal*. The very essence of First Aid is its *immediate* application, pending the arrival of professional assistance; and this prompt succour, often of vital importance, can only be assured by *all* being instructed in Ambulance work. Let the universal teaching of First Aid be once effectually established, then any who chance to be at the scene of an accident will know how best to temporarily assist the injured, and, what is equally important, have confidence to apply their knowledge promptly.

Besides the general teaching of individuals throughout the length and breadth of the land, there should be formed disciplined bodies of men, trained to work together, for the purpose of enabling the public at large and the different sections and communities of which the nation is composed to reap the full benefit of First Aid. In this direction the *Invalid Transport Corps*, and the different local corps of the *St. John Ambulance Brigade*, both of which are described in the Appendix, are already doing excellent work. Yet here

also there remains a large field for study. Putting aside the military aspect of the question as concerning the auxiliary forces (since this is dealt with elsewhere), carefully organized Ambulance services are urgently needed in connection with our large towns, our extensive railway system, and our numerous fields and centres of iudustry. It is only in such a manner that First Aid can be applied for the public weal usefully and practically.

While preparing the re-issue of this work, I received the cordial assistance of Lieutenant-Colonel Sir Herbert C. Perrott, and Surgeon-Major Hutton. My thanks are also due to Dr. A. H. Jones, Drs. Cassidi and Lawrie Gentles, and Mr. J. H. Buckley, for kindly revising the accounts of the corps established respectively at Northampton, Derby, and Leicester.

Of the fifty-nine illustrations in the book, twenty-six (Figs. 8 to 33 inclusive) are obtained, with the permission of Messrs. Sampson Low and Co., from Esmarch's *Treatment of Wounded in War;* four others (Figs. 7, 41–3) are taken, with the sanction of Messrs. W. Clowes and Son, from Evatt's *Ambulance Organization, Equipment, and Transport;* the authorities at St. John's Gate have kindly allowed me to represent their "Illustrated Triangular Bandage," in the frontispiece; and I am indebted to the central committee of the St. Andrew's Ambulance Association for permission to publish diagrams of their "Illustrated Triangular Bandage," Stretcher, Wheeled Litter, Ambulance Waggon, and Knapsack of First Aid appliances.

R. LAWTON ROBERTS, M.D.

RUABON, NORTH WALES,
July, 1891.

PREFACE TO SECOND EDITION.

* * * * *

I CANNOT omit to urge the necessity that exists for *universal instruction in Ambulance work*. In connection with active *military* service, the Public are aware that some kind of Ambulance arrangements are necessary; but they, as a whole, fail altogether to appreciate the degree of method, the vastness, and comprehensiveness essential to any Ambulance Organization which is designed to meet the requirements and stand the strain of a great war. "Nobody," as an eminent Military Surgeon said to me a little time ago, "knows anything of it." Yet the work of collecting the wounded and attending to their first wants, after an engagement, is described by an experienced authority on such subjects as a "vast and serious concern:" and on the way in which this duty is performed depends, in numerous instances, whether the sufferers rally from their hurts or rapidly succumb; and, in very many other cases, whether the wounded eventually recover to spend useful lives or, on the other hand, linger out a crippled and miserable existence. And this is by no means all, for there is the subsequent treatment and nursing of the wounded, day by day, and month by month, in localities where ordinary conveniences are absent, and clean water

and other necessaries of life, it may be, difficult to obtain. Further, there is the work of conveying the patients, as circumstances permit, stage by stage, back by the route along which the army advanced; and here numerous obstacles are often encountered, such as the impracticable character of the country; the absence of anything like good roads; the scarcity of transport animals, horses, mules, camels, etc., suitable to the climate and ground; and the difficulty in procuring or improvising vehicles, or other means for conveying the wounded, which are alike suitable for the easy carriage of patients and adapted to the nature of the ground to be traversed. Moreover, it must be borne in mind that, over and above the wounded, there are always a considerable number of sick to be attended to. On an average, under favourable circumstances, during a ten days' march, as many as 1,440 to 1,800 of an Army Corps, 36,000 strong, require "hospital treatment;" and this number is greatly increased by bad weather, improper food, epidemic diseases, and other unhealthy conditions.

As a matter of fact, no military ambulance service has, so far, been able unassisted to grapple satisfactorily with the huge masses of sick and wounded incidental to a great campaign. Solferino, with its five leagues of battle-ground thickly strewn with wounded troops in every stage of agony and lingering despair, incited the different nations to establish Red Cross Societies. Yet in the Franco-German War, when these "societies put forth all their strength and struggled with unexampled energy," the wounded remained at Sulz "for three days absolutely deserted on the battle-field, and exposed to cold and hunger," and at Gravelotte, where the ambulances "could not arrive in time, their absence was severely felt."* At the beginning of the Russo-Turkish War, the Russian official medical service "compelled the admiration of connoisseurs, who said, that nothing was left for others to do"; yet during the progress of the campaign, the efforts of the official medical service, the exertions of the Red Cross Societies, and the benevolence of private individuals were all taxed and strained to the utmost in the endeavour to succour the prodigious masses of sick and wounded troops.

As to our own Army Medical Service, we are told by one of the Medical Staff that both in officers and men, it is "quite too small to deal with a large foreign war;" that, "we are to-day passing through the constructive stage of the organization of medical aid to armies in the field," and that "it will take a generation to carry out organization to its true stand-point of efficiency." Further, it is pointed out that the "Army Estimates" are "heavy," and "cannot very largely exceed their present amount:" and that the "paucity of men" and "costliness in maintaining them," consequent on our system of enlistment (as distinguished from conscription), render it quite impossible to support an Army Medical Service of sufficient numerical strength to relieve the wants of the sick and wounded during a great war. Moreover, the Volunteer Force, from which a great deal might reasonably be ex-

* *The Red Cross*, Gustave Moynier, translated by John Furley.

pected, is powerless, in case of war abroad, to assist the Army Medical Service with trained and drilled ambulance men; for, strangely enough, though about 200,000 strong, it is itself lamentably deficient in anything like medical and ambulance organization. Hence the need of instructing the people generally in ambulance work; so that all may comprehend fully what ambulance aid means, and, in war-time, involves. Hence the necessity of impressing upon the public what is required in the way of organization and equipment, of *matériel* and *personnel*, of discipline, drill and training, high courage (both moral and physical), devotion to duty, and boundless energy and determination, in order to lessen the horrors of war, and effectually minister to the wants of those who fall sick and wounded while upholding the honour of the British flag in a foreign campaign. Hence the necessity, too, of establishing a Volunteer Medical Service, 10,000 strong, and officered by skilled Surgeons (entirely exclusive of, and not interfering with the duties and rights of the Regimental Surgeons): which may work with the Volunteer Force, should the occasion occur, in the field; and also act as a reserve, from which, in case of need, a numerous and trained *personnel* may be drawn, for the Medical Service of the Regular Army: and, in furtherance of this scheme, "the Volunteer Forces need one Bearer Company and one Field Hospital for each Regimental District" these bodies "to be made up of Volunteer Medical Staff Corps Officers and Men, in addition to all existing regimental aid."

Passing from military to *civil* life, we find, though the conditions are very different, the same need for general ambulance instruction. The horrors and losses incidental to a war of any dimensions are of such appalling magnitude as to rivet the attention of civilized nations, and to evoke gigantic efforts for their alleviation. But fighting, however severe, has a limit. Military campaigns, though terrible enough, in all truth, from a humanitarian aspect, are nevertheless but temporary evils. It is far otherwise with, what I may call, the dark side—the untoward incidents—of *civil* occupations. Occasionally, it is true, the whole country is startled by some unexpected catastrophe, as the collapse of a railway bridge, an explosion in the recesses of a mine, or the wreck of an ocean steamer, by which scores, it may be hundreds, of people are swept into eternity, crippled for life, or seriously wounded: but sad and grievous as such great calamities always are, they are luckily exceptional occurrences, and are far overshadowed in reality by the perpetual dribbling away of the life and strength of the nation, bit by bit, little by little, by day and night, in the depths of the mine, amid the whirl of machinery, in the streets of crowded cities, on the hunting field, in country lanes, on rivers and water-courses—here, there, everywhere—by individual accidents, which, though scarcely noticed in the excitement and bustle of every-day work, mount up into terribly large items of the annual bill of suffering and death—such as 1,230 killed and 8,123 injured on railways; 1,000 killed and 100,000 wounded in collieries and

mines; 3,000 drowned in rivers, lakes, and other inland waters; 8,501 injured in factories, and so on. Surgeon-General Longmore's remarks concerning the wounded in war apply with equal force to those who are injured in the peaceable avocations of civil life: for the manner in which immediate assistance, or "first aid," is given, the promptitude with which it is rendered, and the fashion in which removal of the sufferers is carried out, in cases of accident, is truly a "serious concern," . . . "not merely important in respect to preventing aggravation of existing suffering," but on which "the question of life itself, in numerous instances," and, "in many others, the whole future state of the wounded, whether it shall be one of continued pain and of comparative uselessness, or the reverse of these conditions," depends. So, too, in sudden seizures of illness, as fainting, apoplexy, fits, and poisoning, the chances of a patient's recovery are increased or diminished according as the efforts of the bystanders for his relief are well-directed or injudicious: and in any case, whether of sickness or injury, in which the removal of the sufferer is necessary or desirable; on the manner in which such removal is conducted depends, in many instances, the life; in several others, the future welfare; and in all, the comfort, of the patient.

R. LAWTON ROBERTS, M.D.

RUABON, NORTH WALES,
August, 1886.

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—o—

AMBULANCE LECTURES.

LECTURE I.*

The St. John Ambulance Association—Its origin, objects, and progress—Necessity of general instruction in Ambulance work—A general description of the structure and functions of the human body—The Triangular Bandage—First aid to the injured, general precautions—First dressing of wounds—First Field Dressings.

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 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

* 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, 4, 5 and 6, given, *simply for the sake of reference*, the technical names of some of the more important structures of the body.

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 90,000 people have received its certificates of successful instruction; and the movement has extended to Gibraltar, Malta, Australia, New Zealand, Canada, China, South Africa, 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. Petersburgh, delivers courses of five ambulance lectures to classes of from twenty to twenty-five men, and has had the *Aide-Mémoire* and the *Handbook* (written by Surgeon-Major Shepherd) of our Association translated into the Russian language for purposes of instruction.* 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† 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

* "The Red Cross Society and Ambulance Work in Russia," Captain Dalton, *Brit. Med. Jour.*, Dec. 2nd, 1882.

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

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,* "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 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 acci-

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

dental 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 the year 1883 no less than 1230 persons were killed and 8123 injured by accidents on the different railways of the United Kingdom; that "during ten years the fatal accidents in London streets from vehicles amounted to 2195, while the injuries were 28,071"; that "in collieries and mines the annual loss of life is at least 1000"; that "no less than 100,000 accidents, large and small, occur in the mines in this country in one year"; that about 3000 people are drowned annually in our rivers, lakes, canals, and other inland waters alone—not counting similar losses at the seaside and the mouths of rivers;* and "that in the twelve months ending October, 1884, in factories alone 8,501 various bodily injuries, not fatal, were caused by machinery."†

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;

* Reference No. 50, St. John Ambulance Association, July, 1885.
† *Annual Report, St. John Ambulance Association*, 1885.

another falls suffocated by some poisonous gas; and another gets badly hurt, a large blood-vessel being opened, perhaps, or a bone fractured. 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, 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.

The course of instruction required to enable you to help a suffering comrade in the moment of his distress and peril, is not in the least difficult to understand, neither will it take me long to impart it to you. Only five lectures, of which this is the first, delivered at intervals of a week, are needed to convey to you all the necessary information. But these lectures (though each should last an hour or an hour and a half, and be followed by half an hour's actual work in bandaging, putting on of splints, and similar exercises) will prove of little use unless you all meet frequently together for the purposes of practice. "Practice makes perfect" is an old motto which you will find holds good in respect of your voluntary task of acquiring knowledge of the methods by which you may render "first aid." When the lectures are completed, your progress and competency will be tested by an Examiner sent down by the Ambulance Association; and those of you who succeed in the examination will receive "certificates of proficiency." Successful candidates, however, should on no account cease their "practices" in the application of bandaging, tourniquets, splints, and in the different stretcher exercises; but should at least meet monthly for the purpose. Unsuccessful candidates, moreover, should not be crestfallen or disheartened; for they must have gained, during their course of instruction and their meetings for practical work, some amount of knowledge which may bear good fruit at a future period. After an interval of not less than a year, those who hold "certificates" will, according to the rules of the Association, be re-

examined; and after yet another twelve months have elapsed they will be examined for the third and last time, when each successful candidate will be entitled to receive a Bronze Medallion with his name and registered number engraved on the back. I trust, however, that you will not look upon Certificates and Medallions—honourable distinctions though they be—as the chief objects of your work; but rather that you will pursue your Ambulance studies in the hope that, when an emergency arises, you may be able—instead of standing aghast and palsied—to relieve the sufferings, perhaps save the lives, of your stricken comrades; that you may act a worthy part, together with your neighbours, in assuaging "that ever-constant, never-ending pain endured by the mass of civilians daily injured in railway accidents, in the streets, in the mines, and in all our varied industrial developments;"* and that you may be competent (should opportunity occur; and you never know under what circumstances you may be placed) to succour the wounded during a military campaign and assist in their conveyance from the battle-field to positions of quietude and safety.

Another point which I desire earnestly to impress upon you is this,—that with whatever zeal you may pursue your self-imposed task; with whatever promptitude, devotion, and success you may act on the occasion of accidents—however terrible; still in point of numbers you will continue hopelessly and fatally deficient, until it is fully recognised and understood by the owners, managers, and men of all collieries, mines, manufactories, railways, and other fields of industry, in fact until it is acknowledged by the public—by the nation at large—that ambulance instruction should be *universal*. For example, here *you* are—thirty ambulance men—thirty men only out of a thousand or more employed by the same company, and distributed throughout an area—both above and below ground—which is measured by miles. Everything is going on briskly, all appears safe, when there comes quite unexpectedly a fall, a crash, a cry for help, and a shout for the "ambulance men"—and not one of you within a mile of the place! There is a poor fellow down with a large bloodvessel laid open and bleeding profusely. You hurry, one of you, to the scene of the accident, but it takes you, being a mile or more distant, several minutes to

* *Ambulance Organization*, Surgeon-Major Evatt.

reach the spot. When you *do* get there, there is a pool of blood and a corpse. There is a man in the prime of life, the bread-winner of a large family; or, may be, a young man, the only son—the only support—of his mother, and she a widow, *lost*—lost for want of help—lost because the man nearest to him did not know how to use his fingers—lost because his "butty" was not an "ambulance man." I might give many similar illustrations, but fortunately not always attended by such terrible results. And "these cases" writes Surgeon-Major Hutton, "are often occurring in this country."

If we turn from railways, factories, and all other centres of labour and industry, to the various public bodies, as the police, the fire brigades, the navy and the merchant service, the army, etc., the necessity of *universal* instruction in the methods of giving "first aid," and in the proper means of conveying the sick and injured from place to place, at once forces itself to the front. Are not the police continually brought face to face with accidents and injuries of all kinds? Have they not constantly, in their ordinary routine of duty, to deal with persons found insensible; to judge whether such unfortunates are "drunk or dying," in a fit, faint, senseless from poisoning or injury; and to remove them carefully on stretchers to a place of safety, where skilled assistance may be obtained? And so with the members of other public bodies—firemen, soldiers, sailors, and others—of whom, as of the men of the police force, we are all so proud, and whose lives and health are of such vital importance to the nation. These men, as you know full well, are all exposed, in their respective callings, to great and peculiar risks, and too frequently meet with wounds, maiming, and violent deaths of varied and terrible kinds. Let us consider more especially the military force of this country, which—on account of its great reputation as a fighting machine—you would naturally expect, above everything else, to be complete as regards its ambulance staff of bearers and helpers, material, equipment, and organization. "To-day," writes Surgeon-Major Evatt, "it would be absurd to say that our own, or indeed any foreign army, is yet completely organised in an ambulance sense." And again "the ambulance service of the military force of this country must be looked upon as completely in a stage of development." You may readily believe that it is impossible in times of peace to keep up the

extensive ambulance arrangements which are essential during a great war; and it is therefore very necessary that there should always be a large reserve of trained men and ambulance materials which may be drawn upon when the hour of trial arrives. You might reasonably expect such a reserve would be afforded, at all events in part, by the auxiliary forces: yet it was stated, as recently as May, 1884, that "our large militia force" is "completely defective in ambulance and medical arrangements," and that "our large volunteer army, 200,000 strong, is completely unprovided with bearer companies or field hospitals, and has nothing but some regimental help. There are probably not half a dozen ambulance waggons with the whole volunteer force."*

Thus, to whatever class of people you turn—whether civil or military—you find the same pressing need of *universal ambulance instruction*—instruction as to the simple methods of rendering *first aid* in cases of sudden illness or injury; whether occurring on the battle-field or amidst the varied peaceable employments of civilian life—instruction as to the best means of *transporting* or *carrying* the sick and injured (it may be for a few yards or for many hundreds of miles); whether soldiers, from the front of an army to the "dressing stations" and "field hospitals" in the rear and thence home to old England; or civilians, from the scenes of their misfortune to their own homes, the nearest surgery, or to a neighbouring hospital. An excellent beginning has certainly been made: H.R.H. the Duke of Cambridge alluded especially, in an address at the Royal Military College, Sandhurst, "to the necessity for and the value of ambulance training to all branches of the naval and military services," and the remarks of the Field-Marshal Commanding-in-Chief on this subject "have since been further emphasized by the recent War Office order, authorizing the formation of Ambulance classes for both the regular and auxiliary forces in all garrison towns:"† and, as a matter of fact, innumerable ambulance classes, such as I am addressing this evening, have been formed throughout the length and breath of the land, in connection with collieries, manufactories, fire brigades, volunteer corps, the police, military colleges, public schools, and other portions of the community. A good be-

* *Ambulance Organization, Equipment, and Transport*, Surgeon-Major Evatt.

† *Annual Report, St. John Ambulance Association*, 1885.

ginning indeed has been made, but *only* a beginning. *You* have made a good beginning, for you have formed the first class in connection with these extensive works; but still *you* are only beginning, for however zealous, prompt, and proficient you may become, the good you can do is necessarily limited. You are too few. As I have shown, ambulance instruction should be universal; and all in these large works, above ground or below, should be ambulance men. To that end, I would earnestly impress upon you all—not only the gentlemen who have the control and the management of the works, but also the overlookers and the workmen themselves—the necessity of holding *regular annual ambulance classes*, so that every one connected with these extensive works may be by degrees properly instructed in "first aid," and be fitted to act with promptitude and effect in an emergency. For similar reasons, it is highly desirable that *annual* classes of this kind should be held regularly in connection with all mines, factories, iron-works, warehouses, fire brigades, the police, the different volunteer corps, regular battalions, regiments, and batteries, colleges, public schools, in fact, all the different bodies of which the nation is composed. It may be long—perhaps many years—before these quietly-conducted, unostentatious, interesting, *annual* classes bear their natural and certain fruit; but when once the desired results are obtained, when once ambulance instruction becomes universally diffused throughout the nation, the People will take care that, even in the most stupendous wars, our soldiers shall, as far as trained helpers and costly equipment can effect it, be promptly aided in their moments of suffering and danger, and be rapidly withdrawn out of the battle to suitably placed "dressing stations" and comfortable though temporary hospitals in rear of the army, and thence—if unable to return to their duties—transferred in "hospital ships" back to their families and homes: the People will see that in all our great cities and towns, in all our country districts and villages, in connection with all our railways, mines, factories, and other industrial centres, attached to all our large hospitals and kindred institutions, there is permanently established a complete system of ambulance transport (of stretchers, wheeled stretchers or litters, horse ambulance carriages or waggons, ambulance railway carriages, ambulance steam-boats and launches), by which any person, hurt or taken suddenly ill, after being temporarily "aided" by

the first passer by or by his working comrade, may be rapidly borne off with ease, comfort, and in the recumbent position, to his home, the nearest hospital, or a neighbouring surgery; and the People individually—learning how to lessen the pains of others, how to help each other in case of accidents and unexpected illness, how to lift and carry their stricken comrades without disturbing the broken limb or jarring the bruised body—will go forth to their daily occupations, however toilsome or dangerous, with greater confidence, will show themselves more manly, braver, more humane, more charitable and neighbourly, and altogether prove themselves better and more useful citizens. Truly, as Surgeon-Major Evatt says, "*Let us as the years go on teach the people, and all will be well.*"

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 patient, 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 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 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

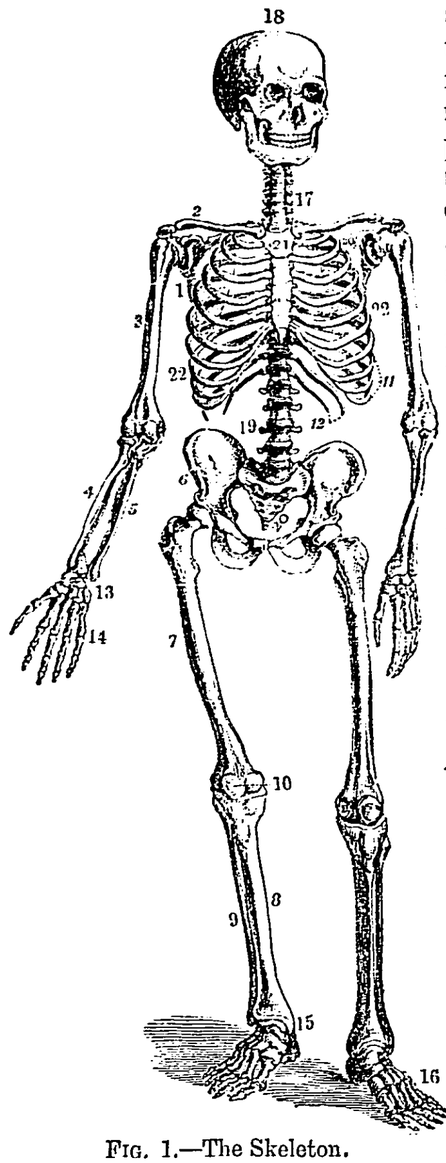


FIG. 1.—The Skeleton.

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.

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.* 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

* 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 sup-

porting 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 forearm 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

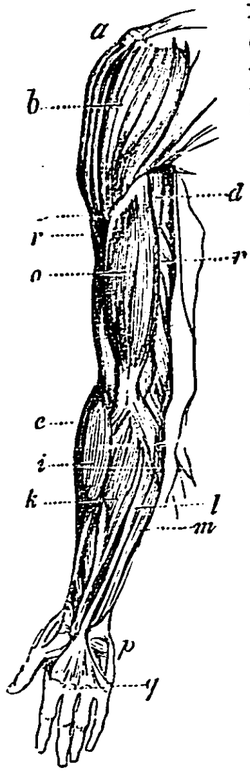
as pillars of support to the entire weight of the body; the bones, though arranged much on the same plan as those of the arms, are much stronger, more massive, and are connected together by joints of much greater strength in such a way as to render the lower limbs exceedingly powerful, but less capable 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* (Fig. 2), 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 (Fig. 2). 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* and *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



G. 2.—Muscles of Arm. This figure represents the different masses or *muscles*, *a*, *b*, *c*, *d*, etc., into which the flesh of the arm is divided; and it also shows well the leaders or *tendons*, alluded to in the accompanying letterpress.

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. 3), 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—

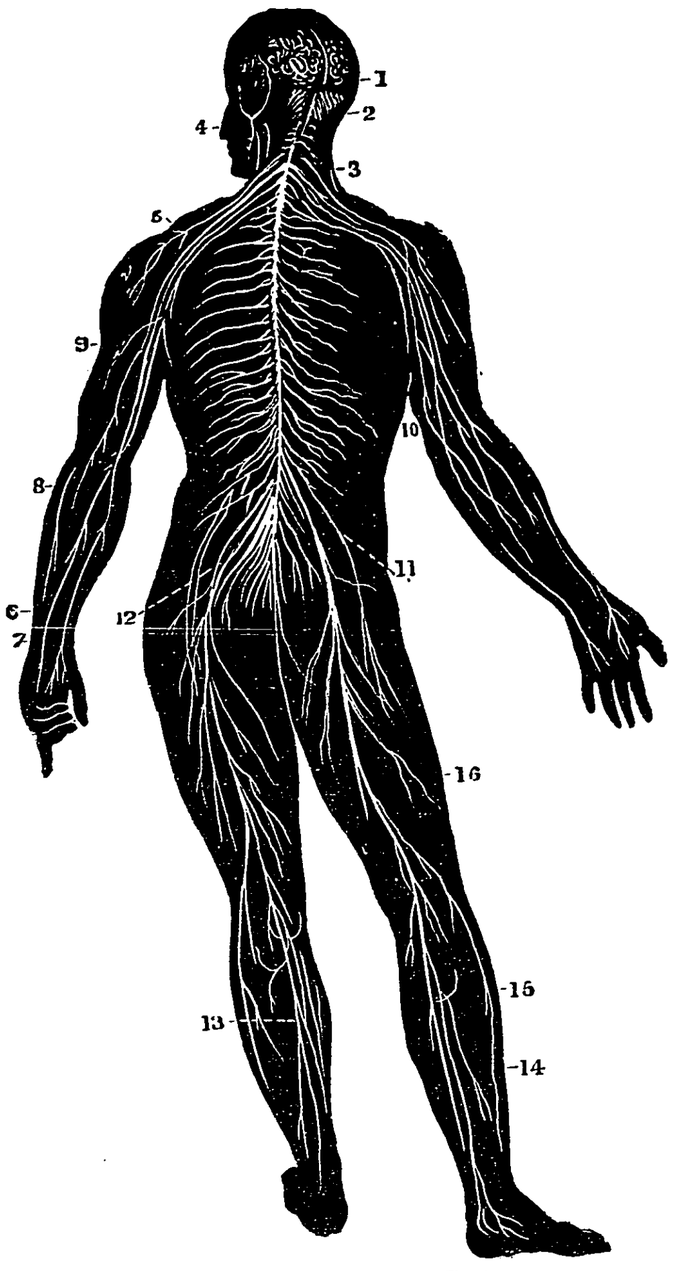


FIG. 3.—The Nervous System.

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 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.

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. 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*.

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 in which it terminates; when a sensory nerve is injured or diseased, there is loss of sensation in the part in which *it* ends; 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. 4, 5 and 6).

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

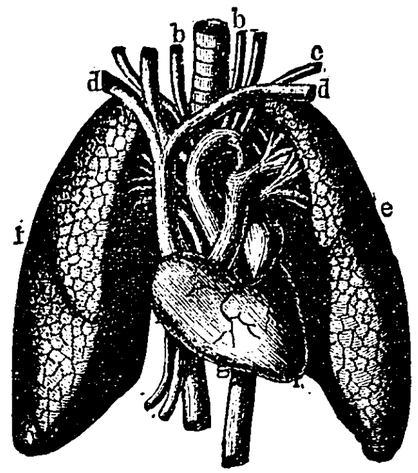


Fig. 4.—Heart, Lungs, and Large Blood-vessels.

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.

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 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. 4). 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 nutriment 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. 4 and 5); 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. 5, *a*, and Fig. 6); 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, Brachial, Femoral, &c., for the sake of more

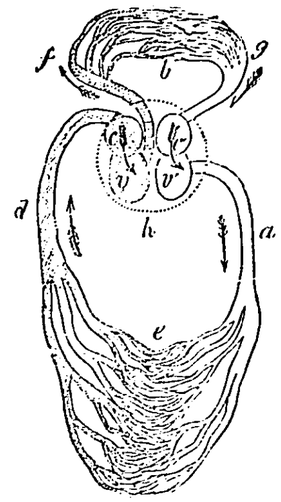


FIG. 5.—Plan of the Circulation.

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.

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. 5, *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

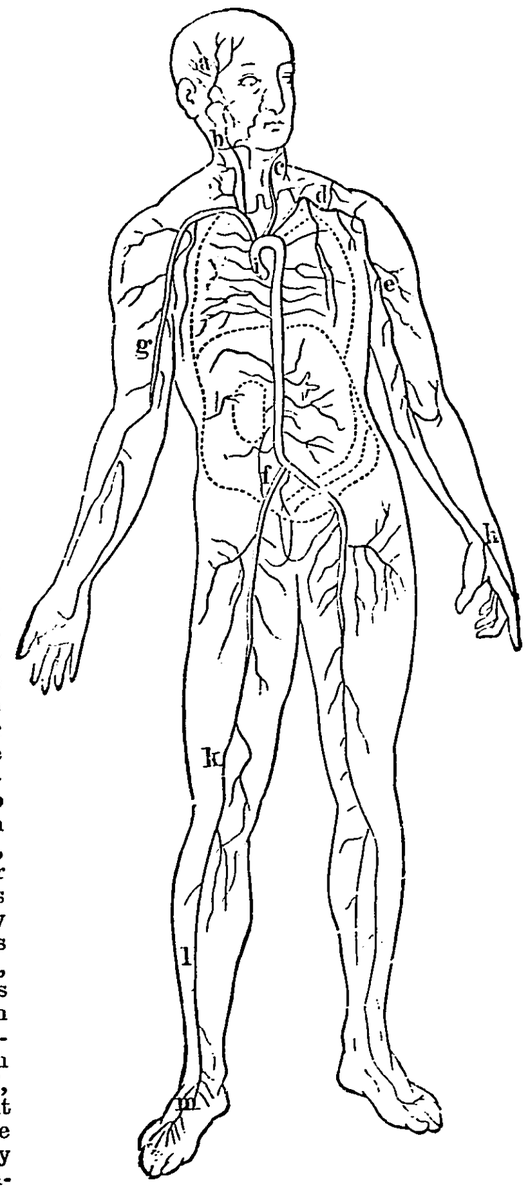


FIG. 6.—The Arteries.

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 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.

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. 5) the capillaries join again together into larger tubes, and these unite again and again until at last they terminate in *veins* (Fig. 5, *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 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 on 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. 5, *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 net-work of those delicate little tubes called capillaries (Fig. 5, *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. 5, *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. 5, *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. 5, *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. 4).

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 breath 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 organ

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 other 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 (Fig. 7).*

Bandages—of which there are two principal kinds, the *roller bandage* and *Esmarch's triangular bandage*—are used for the purpose of covering wounds, and so protecting them from dirt and dust, the hot rays of the sun, flies and other insects, &c.; 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.

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 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 con-

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

striction by the tightening of some of 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.

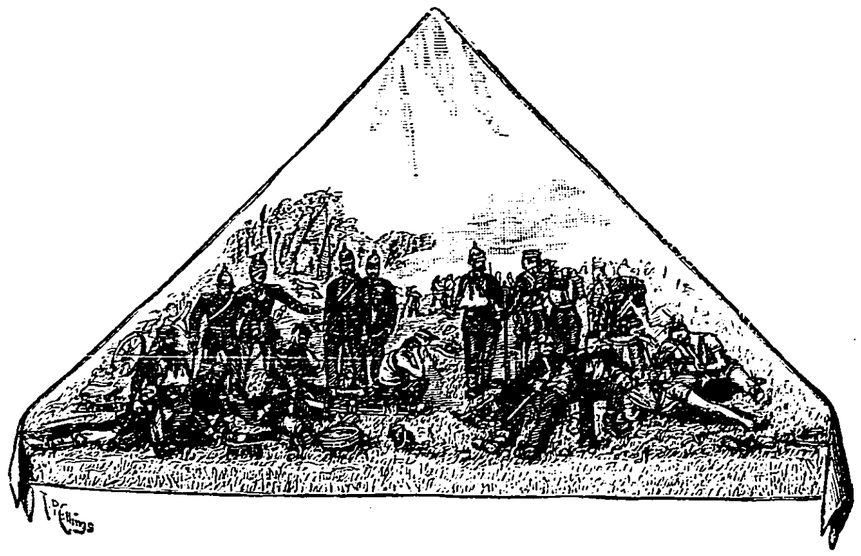


FIG. 7.—Esmarch's Illustrated Triangular Bandage. Of the three corners of the bandage, the two which are represented as hanging down are called the *ends*: the other uppermost corner being termed the *point*. Of the three borders, the long lower one is called the *lower border*; the other two being spoken of as the *side borders*.

For ambulance work, *Esmarch's triangular bandages* (Fig. 7), or *handkerchief bandages* are much more suitable; they answer all requirements; there is not the same risk or difficulty in

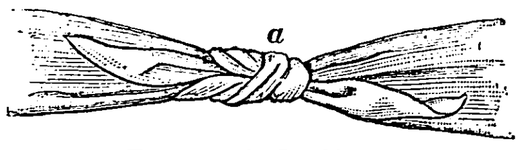


FIG. 8.—The Reef-knot.

using them as I mentioned in connection with roller bandages; and, above all, the manner of applying them can be learnt with the greatest facility.

These bandages are nothing more than triangular pieces of calico or linen, measuring about 4 feet at the lower border and 2 feet 10 inches at the sides; and any number of them

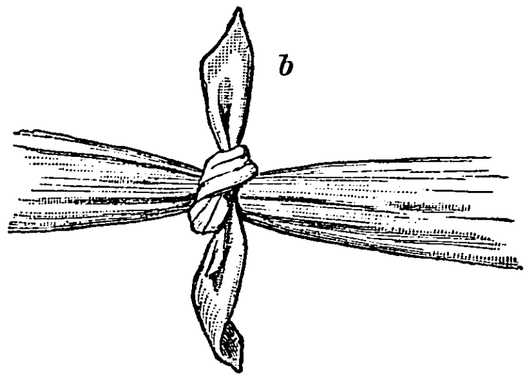


FIG. 9.—The "Granny."

may be readily cut out of ordinary unbleached calico. Moreover, they can be readily improvised on emergency by simply folding good-sized pocket handkerchiefs or neck handkerchiefs across into triangular shape, and so forming true *handkerchief bandages*.

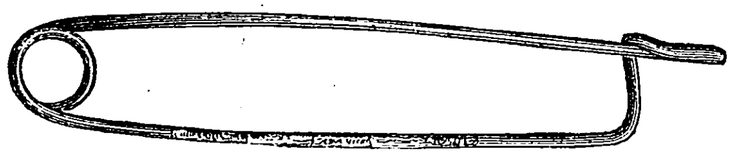


FIG. 10.—The Safety-pin.

The triangular bandage—whether ready-made or improvised—is used either *folded* or *unfolded*, according to the purpose for which it is required; and the ends of the bandage may be fastened by either tying or pinning—if tied, the reef-knot (Fig. 8) should be used (because more secure) in preference to the "granny" (Fig. 9); if pinned, safety-pins (Fig. 10), if handy, should be chosen before ordinary pins, as they are more likely to hold fast without slipping during the movements of the patient. 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. 13), serves to bind on splints,

temporary or otherwise, for the support of broken limbs (Figs. 28, 29, 31, 32, 33), is useful for fastening compresses securely and tightly in their places in order to stop bleeding, is suitable for making an improvised "tourniquet" (Fig. 26), and is well adapted for bandaging wounds of the forehead, back and sides of the head, eyes, ears, nose, cheek, chin, jaws, and upper and lower limbs (Figs. 13 and 19).

The method of making a small arm-sling is given in the description of Fig. 13; the fixing on of compresses and of temporary "tourniquets" is explained in the Lecture on Bleeding; and the means of affording aid with bandages and splints in cases of broken bones are fully discussed in the

FIG. 11.—Bandage for Head (from before).

FIG. 12.—Bandage for Head (from behind).

Directions.—Take an *unfolded* bandage; double the lower border over so as to form a rim or hem about 1 in. or 1½ in. deep: then lay the bandage on the head, the point hanging down the back of the neck, the rim resting across the forehead close to the eyebrows; carry the ends backwards just above the ears, cross them at the back of the head, bring them around again to the lower part of the forehead and tie in a reef-knot; lastly, pull the point downwards so as to tighten the bandage, then turn it up towards the top of the head and secure it with a pin.

third lecture. In dressing wounds of the front of the face, of the eyes, nose, lips, or chin, the centre of the bandage—folded rather narrow—should be placed on the wound, the ends being carried around to the back of the head and tied. For wounds under the jaw and on the sides of the face, the middle of the bandage should be placed beneath the chin, the ends being carried upwards over the cheeks and secured at the top of the head. In dressing injuries of the fore-head, back or sides of the head, the centre of the bandage should be laid on the wound, and the ends carried around to the opposite side of the head and tied there, or crossed, brought

back, and tied over the wound. Similarly, when the upper or lower limbs are wounded, the centre of the bandage should be laid on the injured spot, and the ends carried around the limb, crossed, brought back, and fastened over the wound (Figs. 13 and 19). An *unfolded* bandage makes an admirable *large* arm-sling (Fig. 14), and is especially adapted for bandaging the head for scalp wounds (Figs. 11 and 12), the chest (Figs. 15 and 16), back, hand (Fig. 13), foot (Fig. 18), the stump of a limb—a portion of which has been torn or blown away by an accident, or on the battle-field (Fig. 16), and (if used with a second bandage), also the shoulder (Figs. 13 and 16), and hip (Fig. 17).

The different ways of applying an unfolded bandage are explained in the descriptions of the various woodcuts (Figs. 11 to 18).

FIRST AID TO THE INJURED.

General precautions.—You should always remember that when giving aid to the injured, you are affording but *temporary* help, with the hope of relieving the sufferer's pain, preserving his life, and preventing any aggravation or increase of his injuries, *until the arrival of medical assistance.* To begin with, there are certain *general precautions* which you should always bear in mind when helping an injured person, irrespective of the nature of the hurt, whether a wound, a broken limb, or other result of violence.

(a) People are liable to turn sick, giddy, and faint, when injured: so do not keep a patient standing, but on the contrary, put him to lie down, or at all events to sit, while you are attending to his needs, and if he should faint right away, lay him flat on his back, with his head on a level with, or rather lower than, his body.

(b) Persons who are injured suffer more or less from "shock": that is to say, they are to a greater or less extent, anxious, depressed, tremulous, pale, faint, chilly, the skin often feeling quite cool and clammy, and the sufferer complaining of cold and shivering: so you should therefore always avoid, as far as possible, undressing the patient. It is of course necessary to completely expose a wound before dressing it; and to lay an injury bare, so as to see it at its worst at once, and so that you can understand what to do for the best: but this may be accomplished with-

FIG. 13.—Bandages for Shoulder, Hand, Elbow; and a Small Arm-sling.

Directions.—For wounds of the shoulder, lay an *unfolded* bandage over the shoulder so that the point rests on the side of the neck and the lower border across the middle of the upper arm; carry the ends around to the inner side of the arm, cross them, bring them back and tie them on the outer side of the arm. Take a second bandage, *folded* broad, and place one end over the shoulder of the injured side; raise the arm gently, bringing it across the middle of the bandage hanging down in front of the chest; then carry the other end of the bandage upwards in front of the wrist, over the shoulder of the sound side, and tie the ends together behind the neck (thus making a *small* arm-sling). Finally, pass the point of the first bandage under the sling, double it back, and pin it at the top of the shoulder (thus completing the bandage for the shoulder). For wounds of the hand, lay the hand on an *unfolded* bandage, so that the fingers are directed towards the point, and the wrist rests on the centre of the lower border; turn the point backwards over the fingers to the lower part of the fore-arm; and lastly, wind the ends around the wrist, cross them over the point, carry them around again, and tie on the opposite side.

out stripping the patient. Thus, if the lower limb is injured, you should cut or rip up the seam of the trousers, and if needful, 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. It may be necessary also to loosen portions of the clothing which appear to be fastened too tightly, and to interfere with the breathing or the circulation of any part of the body; such as the collar, necktie, waistcoat, braces, or, in soldiers, the tunic, waistbelt, or the other accoutrements.

It is possible that, after assisting an injured man to his home or to a neighbouring cottage hospital, you may be called upon to help in undressing him for bed; and in doing this you should be careful to take the clothes off the sound side first, and then to remove them gently (cutting or ripping them if there is the slightest difficulty) from the injured side. Should you, on the other hand, have to assist in dressing a patient, pull the clothes first very carefully over the injured arm or leg, and then proceed to dress the sound side.

(c) It is commonly thought that, because people who are injured frequently suffer from thirst and often become faint, depressed, and chilly, it is necessary to give them a quantity of brandy, whiskey, or other stimulant. This is altogether a wrong and mischievous idea, and the sooner you disabuse yourselves of it the better. Should an injured person turn very faint, or be much lowered and depressed by "shock," then *(if there is no risk of bleeding)* a *small quantity* of wine, brandy, or other spirit, mixed with water, may be given with advantage; but otherwise stimulants are hurtful, and should be avoided. Indeed, if there is any danger of bleeding, stimulants aggravate the danger by increasing the force of the heart and the circulation.

The following remarks by Surgeon-General T. Longmore,* in connection with this subject, are just as applicable to those injured during times of peace, as to soldiers wounded on the battlefield. "The patient who has fallen from shock, or from faintness, will recover from gradual restoration of circulatory action where he lies, or may be carried away on a stretcher without material harm resulting from his condition; in some

* *Gunshot Injuries.*

particular instances even with more advantage than if he had been roused from it by the administration of some of the usual remedies.....Water is the natural beverage for relieving thirst, and under ordinary circumstances is the only one that should be used among wounded in the field. In warm weather the coldest water from a spring will be the most grateful and the most appropriate; in winter, cold drinks are in a great degree hurtful. The depression of nervous energy, and of the temperature of the surface of the body, by exposure to cold; the aggravation of these depressed conditions when there has been loss of blood, naturally indicate that whatever beverages are given should be in a state to add warmth to the frame, and within due bounds, vigour to the circulation.

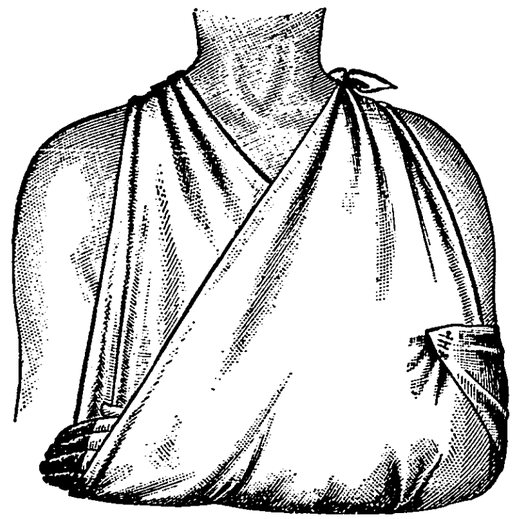


FIG. 14.—Large Arm-sling.

Directions.—Take an *unfolded* bandage, place one end over the shoulder of the sound side, allowing the other end to hang down in front of the patient, and drawing the point well behind the elbow of the injured arm, carefully bend the latter and place the fore-arm across the middle of the bandage, then raise the lower end of the bandage, carrying it over the shoulder of the injured side, and tie both ends behind the neck, finally bring the point well around the elbow and pin it in front. The sling should be so arranged that the hand lies at a higher level than the elbow.

Warm weak tea or coffee, warm broth, are really the only suitable beverages under such circumstances.....if circumstances ever admit of their being given, the opportunity should not be neglected. They are restoratives of vital importance. They become all the more essential when a

wounded soldier has remained long without any attention, when he has been lying on wet ground, or exposed to rain or snow. Spirituous stimulants may often be given with benefit under these special circumstances, when other liquid restoratives are not at hand; but they should be administered cautiously, only in small quantity, and then diluted with water. If it be possible to combine them with heated water, their effect will be all the more advantageous."

(d) The injured man should have the benefit of as much fresh air as possible, so do not allow idle and ignorant people to crowd around him: he should on no account be teazed, pulled about, moved, or even touched unnecessarily and aimlessly, therefore consider calmly, but quickly withal, what is best to be done, and then act promptly and without any fuss: he should, unless the case is a trivial one, be placed under medical treatment as soon as practicable, therefore it is your duty to see that a messenger is at once despatched for a doctor, or that steps are taken to carry the patient in a proper manner to his home, the hospital, or other spot where he may receive professional assistance.

THE FIRST DRESSING OF WOUNDS.

Wounds (that is to say, injuries in which the skin, flesh, or other soft tissues are laid open) differ 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, and swords; 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 and bayonet thrusts, blows from picks, &c., and are spoken of as *punctured* wounds; and, lastly, there are *gunshot* wounds, which, as the name implies, are caused by explosive weapons, such as rifles, cannons, sporting guns, and pistols.

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 battle-field. But in any case your attention should be directed to the cleansing of the wound from all dirt and impurities; the arrest of bleeding; the replacing of the edges of the wound as nearly as possible in their natural position; and, lastly, the application of a simple *clean* dressing by means of a handkerchief-bandage, in order

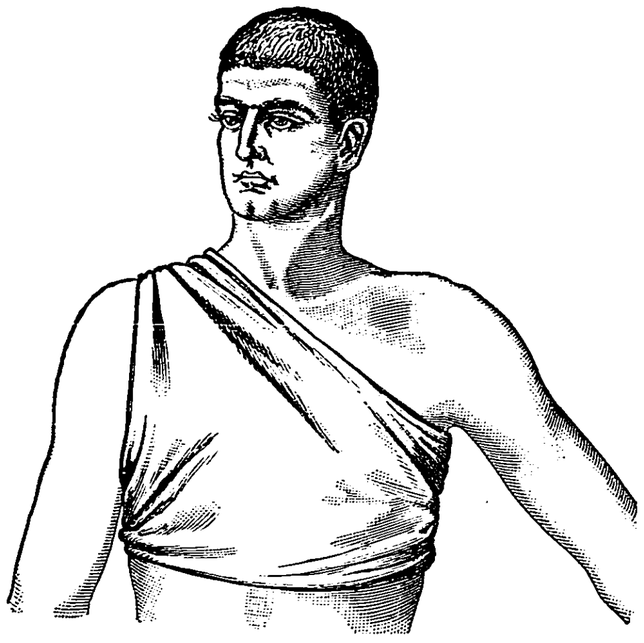


FIG. 15.—Bandage for Chest—from before.

Directions.—Take an *unfolded* bandage; lay it on the chest, placing the point well over the shoulder and the lower border across the front of the body; carry the ends around and tie them over the back-bone; draw the point down behind the shoulder and tie it to one of the ends of the knot (as shown in Fig. 16), or pass it under the knotted part of the bandage, double it back and pin. An unfolded bandage may be applied to the back in a similar manner.

to *protect* the wound from cold winds, hot rays of the sun, insects, dust, and other impurities; to *support* the injured part; and to make the patient as comfortable as you can until he has the benefit of skilled aid.

Cleaning the wound.—It is necessary to pick out any pieces of glass, bits of coal or stone, splinters of wood, fragments of clothing, etc., which may be sticking in the wound; and to

remove dirt, soil, mud, sand, and similar impurities (if you are in a position to obtain *clean* water) by thoroughly washing the wound and the surrounding parts. Spring water, the water of rivers and brooks, or even sea-water, may be used for this purpose; but rather than use dirty water it is better not to wash the wound at all, as by so doing, you may poison it; and, for the same reason, when dressing wounds you should always be careful to work with clean fingers. If

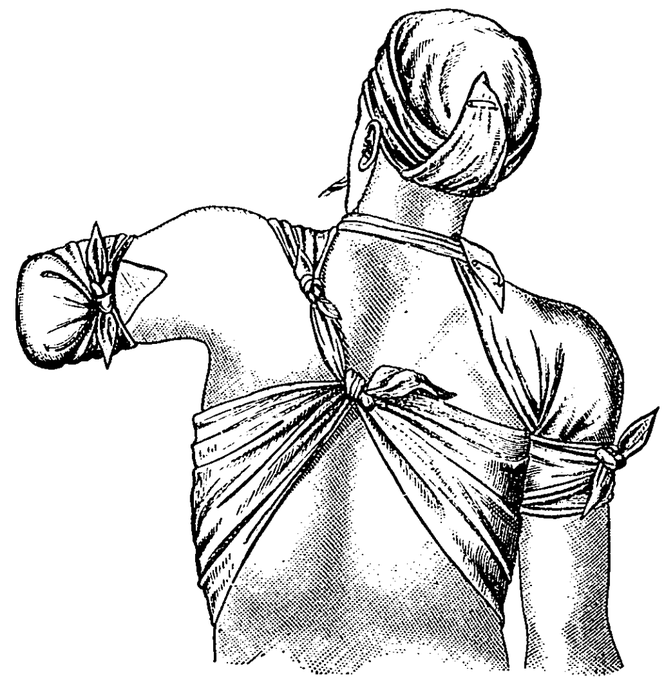


FIG. 16.—Bandages for Chest, Shoulder, Head, and Stump of Arm—from behind.

Directions.—To bandage the stump of a mutilated limb, cover the end of the stump with an *unfolded* bandage, drawing the point up on one side of the limb and the lower border on the other; then carry the ends around the limb and tie them over the point so as to secure it, or cross them over the point and tie on the opposite side. (See also Figs. 11, 12, 13, 15).

you are at home, or otherwise conveniently situated, it is best to add a little carbolic acid to the water (about 1 to 40). The articles used in washing the wound, as sponges, towels, handkerchiefs, or pieces of linen, should be scrupulously clean; indeed, to ensure cleanliness when large numbers of wounded have to be attended to, as in military campaigns,

it is safest to avoid the use of sponges altogether, and to cleanse the wounds with fresh clean bits of tow, linen, or lint, throwing the latter away immediately after use. The water should be *cold*, for the purpose of checking the bleeding.

In the case of wounds which are perfectly clean and free from all impurities, washing is not needful; and *when a clot of blood has formed in a wound, you should on no account disturb it* either by washing or meddlesome fingers, as you may thereby start fresh bleeding. If the wounded part is hairy—as, for example, is the case in scalp-wounds*—it is better, should you have time, and happen to have a pair of scissors about you, to clip off all the hair immediately around the injury.

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; and the 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 is sometimes 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 the injured parts—freed from all grit, dirt, splinters, &c.,—should be put back in their proper position as quickly as possible, and kept in place, as far as practicable, by a simple dressing and a bandage. This specially applies to wounds of the face, so as to lessen the risk of disfigurement; indeed in all the clean-cut wounds—even in slight ones—where 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

* The skin covering the upper portion of the head is termed the *scalp*.

may be stitched; thereby rapid healing of the wound will probably follow, and disfigurement will be lessened or altogether avoided.

In wounds of the belly, accompanied by the protrusion of a portion of its contents, as, for instance, a part of the intestine, the protruded parts should, if practicable, 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 and bandaging of the wound.—Fold up a piece of

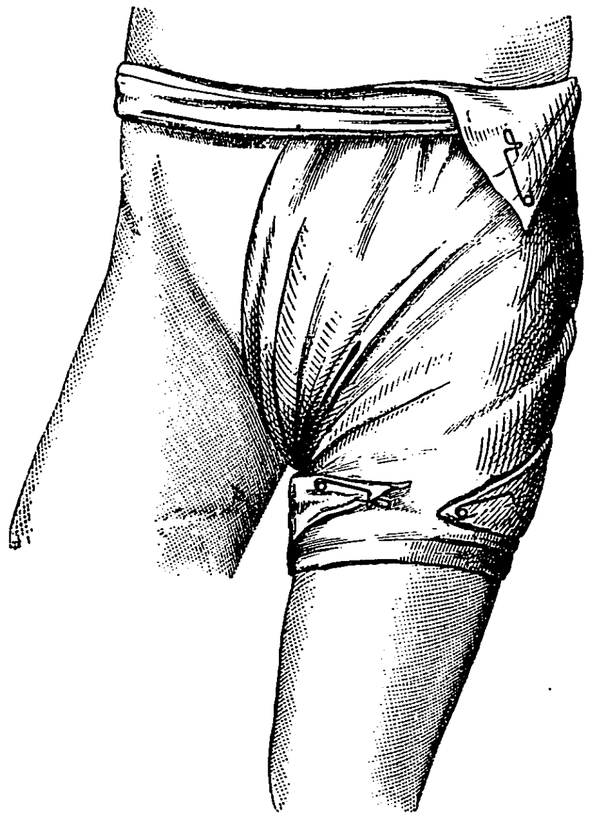


FIG. 17.—Bandage for Hip.

Directions.—For wounds of the thigh, tie a bandage, *folded* narrow, around the waist like a belt (this is not required if the patient has an ordinary waist belt). Take a second bandage, *unfolded*, and apply it with the point directed upwards, the centre on the wound, and the lower border across the front of the thigh; carry the ends around the thigh, cross them, bring them back and fasten them by pinning or by a reef-knot; pass the point underneath the waist-band, double it back, and pin it.

lint, linen, muslin, shirting, gauze, or any fragment of rag or handkerchief that is *clean* and soft into a pad; wet it, if you have the opportunity, in cold *clean* water; then apply it smoothly to the wound, and bind it on with your triangular bandage, handkerchief, or scarf. That is called a *cold water dressing*, and it is the best application in cases of *contused* and *lacerated* wounds; though very simple, it is amply sufficient, in the majority of skin and flesh wounds, to keep the edges of the wound in place, to stop the bleeding, and to protect the wound from insects, dust, and other impurities. Should carbolic acid be available, it is better to add a few drops (about 1 to 40) to the water before wetting your pad. If clean water is not to be got easily, as may happen, for instance, on the battle-field, or in the depths of a mine, you may use the same materials—lint, linen, &c.,—without wetting them—that is *dry dressing;* this kind of dressing is usually applied in cases of *incised* wounds; but it has, however, the double disadvantage of being somewhat irritating to the wound and of sticking firmly to the raw surface and edges, so that its removal, when surgical help is obtained, is only effected with a good deal of trouble and with considerable distress to the patient. The disadvantage of dry dressing is not so noticeable in civil life, for the services of a doctor can usually be procured within reasonable time; but it is very different in military campaigns, when it may be long, perhaps several hours, before an injured soldier reaches a position where he can have the first simple dressing—stuck fast and close to the wound, by that time—removed. It is urged, therefore, by military surgeons, that, in the absence of clean water, other means should be adopted to moisten the first dressings of wounds. Deputy Surg.-Gen. R. Wolseley suggests that the lint or bandage first applied to wounds received on the battlefield should be wet with Rangoon oil, which is used for cleaning rifles, and forms part of a soldier's equipment. In the battles around Paris, in 1870-71, charpie—a soft downy material, made by scraping and unravelling linen—moistened with glycerine and water "was found to be the best application for immediate use to wounds";* and in the Ashanti war, a little simple ointment was smeared over the lint used as a first dressing to prevent the sticking of the wounds.

* *Gunshot Injuries*, Surg.-Gen. Longmore.

In the case of clean cut (or *incised*) wounds, should you be at home, near a chemist's shop, or in any place where sticking plaster is close at hand, it is better to draw the edges of the wound well together, and strap them across with strips of plaster, before putting on your pad; taking care to leave spaces between the strips, so as to allow room for any discharge to escape.

Having applied your pad, and fixed it securely by put-

Fig. 18.—Bandage for Foot.

Directions.—For wounds of the foot, spread out an *unfolded* bandage; place the foot on the centre of it, with the toes directed towards the point; turn the point over the toes to the back of the foot or the instep; raise the lower border behind the heel, draw the ends forward, crossing them on the top of the foot and tying on the sole, or crossing them again on the sole and tying on the top of the foot or around the ankle.

ting on a triangular bandage or handkerchief in one or other of the ways, according to the position of the wound, which I have already described (p. 38, etc.), and illustrated by diagrams (Figs. 11 to 19), you should next see that the *injured part is placed in an easy position and properly supported*, so that the patient may walk away—or be carried off, or assisted along—from the scene of the accident with as little pain and discomfort as possible, and without any aggravation of his injuries. Thus, if the upper limb is wounded, it should be placed in a sling (Figs. 13 and 14); and if it is necessary to place the patient in a lying down position (on a stretcher for instance), he should be laid either on his back, or on the uninjured side; if the lower limb is injured, it should be

propped up by folded clothes, uniform, straw, hay, or a knapsack, and, if necessary, further supported and steadied by being bound to the sound leg, the patient being laid on his back with a slight inclination towards the injured side; if the chest is injured, more especially if the breathing is difficult, the patient should be placed in a half lying down position, with his head and shoulders well raised and his body inclined towards the injured side; if the belly is wounded, the patient should be placed in the lying down position with his knees well drawn up (and supported, if needful, by folded clothing, &c.)—on his back, if the wound is in front, but on the injured side, if the wound is at the side; if the head is wounded, and it is necessary to place the

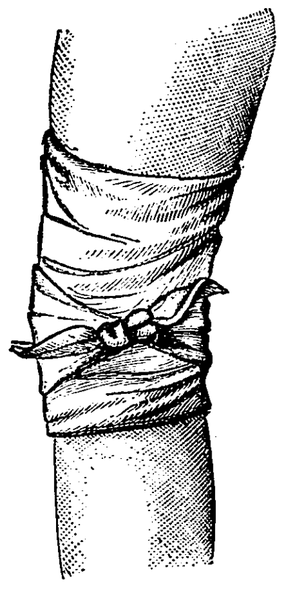


FIG. 19.—Bandage for Knee.

patient in a lying down position, care must be taken that the injured part does not press against the stretcher or conveyance; and lastly, when carrying a patient in the lying down position, his head should in all cases be kept low and not pressed forward on the chest.

It may possibly happen, on some rare occasion, that, meeting with a wounded man, you are unable to lay your hand on any clean material suitable for a dressing; but should you have a fairly-sized handkerchief, you can always

improvise a triangular bandage, which, properly applied, will serve as a protective covering to the wound, and, if you are luckily able to wet it with clean cold water, it will keep the injured part cool and comfortable until medical assistance is procured.

Before leaving this subject, I wish to warn you of the risk of totally neglecting *slight* wounds, such as small cuts, lacerations, abrasions, pricks, and scratches, which—though annoying, and often very painful—are not serious enough to interfere with your work. Splinters, bits of grit, &c., unheeded at first and left imbedded in the flesh, often lead to inflammation and the formation of a "gathering" or abscess; small cuts and trivial scratches, altogether neglected, frequently become poisoned by the entry of dirt and other impurities with a similar result, viz., inflammation and abscess; and so through want of the simplest precautions, many a finger has been lost, many a hand crippled, many a large abscess formed, and many a workman unfitted for labour and forced to depend, during several weeks, for subsistence on his club or the parish. Therefore, in *slight* injuries, which are everyday occurrences with most of you, be careful to pick out any splinters or pieces of grit, and wash away, if necessary, any dirt that may be present; and then bind a strip of clean rag, or a folded handkerchief over the wound to prevent the entrance of dust or other impurity. Perhaps you may have some difficulty in doing all this in the midst of your work; but on your return home, after your day's employment, you should take the opportunity—when having your usual wash—to carefully cleanse even the most trivial scratches and abrasions with warm clean water (to which a little carbolic acid, if you chance to have any, may be advantageously added), afterwards strapping the injured part with sticking plaster, and binding it over with a strip of clean linen or a folded handkerchief; and this should be done every evening at the end of your day's labour. I have recently seen two workmen who suffered from abscesses in the arm-pit, and another who lost a portion of a finger, from neglecting these simple precautions.

First Field Dressings.

Such great numbers of injured men need assistance on the battle-field; so destitute are troops on active service of anything soft, clean, and suitable for application to wounds; and so difficult is it often to obtain, in the midst of military manœuvres, even the simplest appliances just when most urgently required, that it is very necessary all soldiers, engaged in military campaigns, should be provided with such materials as are best adapted for the first simple dressing of wounds. Accordingly, in the present day, the troops of many nations—but more particularly, I think, the military forces of Germany—are supplied with small and conveniently shaped packets of a few useful articles (such as a triangular bandage, lint, pins, &c.) which are carried or sewn in some special part of the uniform. Our own soldiers, in the Ashanti War, were provided with a first field dressing, which consisted of a triangular bandage, a packet of lint smeared with simple ointment and enclosed in waxed paper, two safety pins, and some ordinary pins, all these articles being made up into a small flat parcel (measuring 4 in. by 3½ in. by 1 in.) covered with waxed paper, and carried in a breast pocket on the left side of the tunic. The first field dressing packet now adopted for use in the British service is one that was devised by Surg.-Gen. Longmore, and is composed of two pads of carbolised tow (that is, tow impregnated with wood tar to which 10 per cent. of carbolic acid has been added), measuring, dry, 4 in. by 3 in. by ⅛ in.; a carbolised gauze bandage, 2 yards long and 4 in. broad, with one safety pin; a triangular bandage of unbleached calico, of the usual size, folded and fastened together by four ordinary pins; a piece of tin-foil, measuring 7½ in. by 10 in.; and a cover of parchment paper, secured by flour paste impregnated with ½ per cent. of perchloride of mercury; the whole of these articles being arranged in a little parcel weighing only 4 oz., and measuring only 4½ in. by 3¼ in. by ⅞ in.

The first field dressing packets are free from disagreeable smell, as the two coverings—the inner one of tin-foil, the outer one of parchment paper—effectually prevent the escape of any tarry odour from the carbolised pads; the packets also can be kept or stored up for several years without being

any the worse, for the tin-foil covering stops evaporation of the carbolic acid, &c., with which the pads of tow and gauze bandage are impregnated, and also protects the dressings themselves from the effects of external damp or moisture; moreover, the outer casing of parchment paper, besides retaining the various articles of the packet together in a neat and handy little parcel, serves to keep out dust, sand, dirt, &c.; to save the inner envelope of tin-foil (which is readily torn) from being ripped by contact with sharp, rough, or pointed hard substances; and lastly, it is itself a suitable material on which to print the list of the contents of the packet and the directions for opening it. The flour-paste used for fastening the parchment-paper covering is prevented from going bad and secured from the attacks of insects by the perchloride of mercury with which it is impregnated.

As to the use of the different articles in the packet—the carbolised pads of tow may be applied either separately to the two wounds caused by the entrance into, and exit from, the body of a rifle bullet; or they may be used, placed together, as a first application to a sword cut as long as 7 in., or to a shell wound as large as 3 in. broad by 5 in. long; the tin-foil—if it is thought desirable—may next be carefully laid over the tow, as it serves to keep the pads moist, if these have been steeped in water before their application, and in any case prevents the evaporation of the carbolic acid from the dressing—both of which points seem of considerable importance, as it may be several hours or even a day or two before the patient has a chance of having his hurts again attended to; the gauze bandage is used with the safety pin to secure the dressing in its proper position and to afford support to the injured part; and the triangular bandage is used, according to circumstances, either to cover and fix the dressing with greater security, to make a sling for the arm, or to bind on splints.

Now, if every soldier of an Army Corps, in time of war, is provided with one of these first field dressing packets, placed in a particular part of his uniform which is known to all and easy to get at, materials for a simple temporary dressing will always be at hand—no matter under what circumstances injured soldiers may be situated—by which wounds may be covered, protected from cold, insects, dirt, and other impurities, and the injured parts supported, until the patients can have their hurts attended to; and the tar and carbolic acid

with which the dressings are impregnated will prevent those putrefactive changes which are so apt to be induced in wounds by the dirt, impurities, and unhealthy influences to which soldiers, during active service, are unavoidably exposed. A supply of these little packets was forwarded for the use of our troops during the military operations in Egypt and Bechuanaland; and Surg.-Gen. Longmore tells me that on examining some of the packets which were taken out to the Soudan and brought back after the Soudan expedition returned, he found the parchment paper and tin-foil covers, in spite of the heat, had prevented all escape of tarry material and carbolic acid from the dressings they enclosed.

It would doubtless be an improvement if the triangular bandages in these packets were "illustrated"—that is, marked by diagrams shewing the methods of applying them—such as Esmarch's bandage (Fig. 7), the bandage supplied by the St. John Ambulance Association, and the bandage issued by the St. Andrew's Ambulance Association. It is very important, too, that the packets should be carried securely in some particular part—settled by the authorities—of the uniform; and *not* in the knapsack or valise, or it will inevitably be missing when most urgently needed. During the Ashanti war, the packets were carried within an inside pocket in the left breast of the soldier's tunic; but Surg.-Gen. Longmore now suggests that a suitable pocket may be made, with a flap for buttoning over it, outside the left breast of the tunic. Surg.-Major Evatt, on the other hand, thinks that there is room for a small leather pouch on the waist-belt, on the left side, in which the packets could be carried. But whichever position may seem the most suitable, eventually, to those in authority, "it is," as Surg.-Gen. Longmore remarks, "very important that a field dressing packet should be so placed that every one, whether surgeon, orderly, or soldier, should know where to find it, and should be able to get at it without difficulty, in case of need."*

* Remarks on "First Field Dressing Packets," by Surg.-Gen. Longmore. *Army Med. Dep. Reports*, vol. xxv.

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 forwarded 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