DEPARTMENT OF THE INTERIOR
FRANKLIN K. LANE, SECRETARY
BUREAU OF MINES
VAN. H. MANNING, DIRECTOR

ADVANCED FIRST-AID INSTRUCTIONS FOR MINERS

A REPORT ON STANDARDIZATION

BY

A COMMITTEE OF SURGEONS:
G. H. HALBERSTADT, A. F. KNOEFEL, W. A. LYNOTT
W. S. ROUNTREE, AND M. J. SHIELDS

WASHINGTON
GOVERNMENT PRINTING OFFICE
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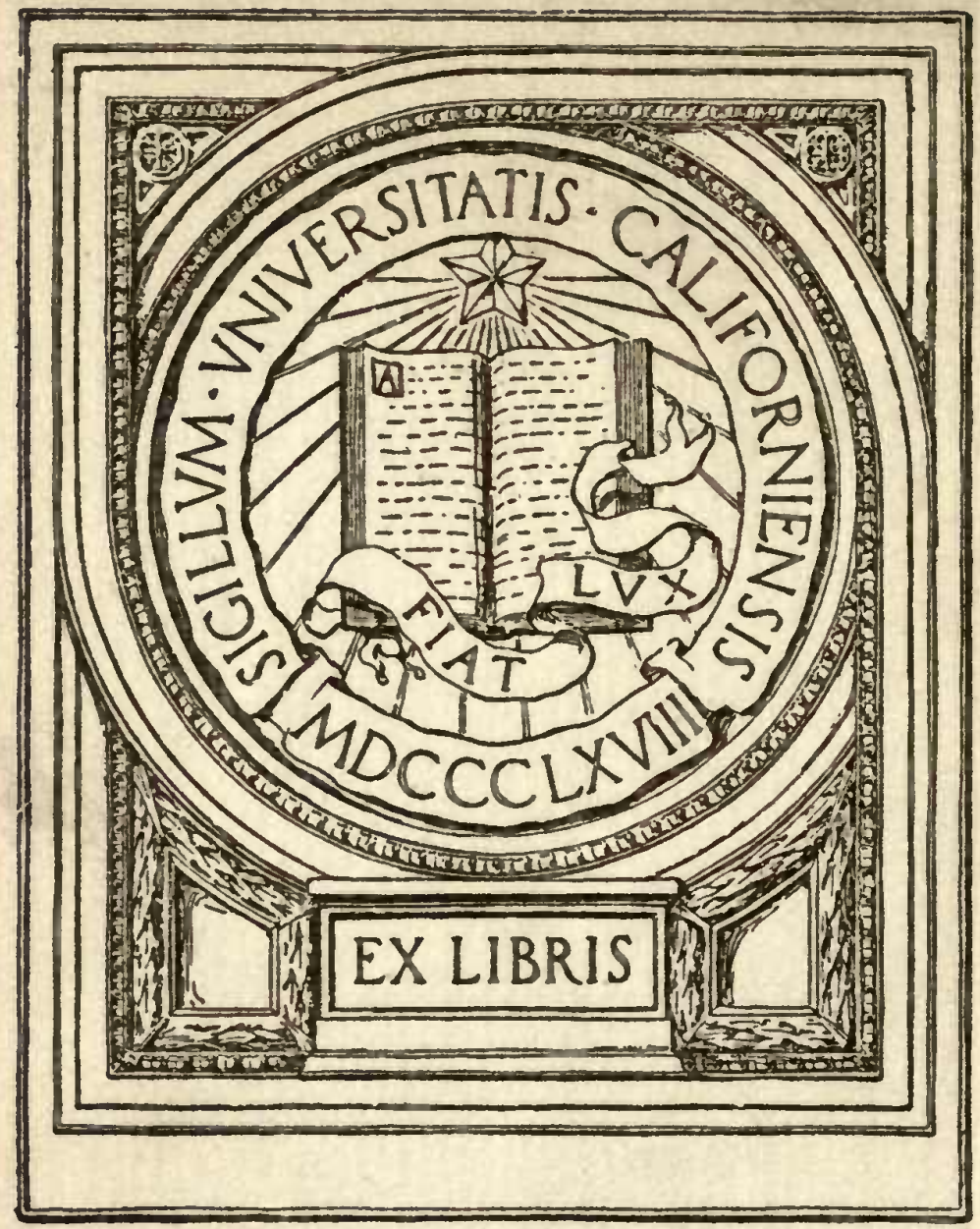
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PREFACE.

One of the most important inquiries that Congress has authorized the Bureau of Mines to conduct relates to health conditions among those engaged in the mineral industries. Investigations made early with a view to bettering these conditions demonstrated the need of prompt care of injured miners, as under the difficulties inherent to mining, wounds seemingly unimportant, if not treated promptly, may become infected and possibly cause permanent crippling or even death of the miner. In the past, many seriously injured miners have been brought out of mines by fellow workers ignorant of approved means of transportation, and have been handled in such a manner as to cause suffering and to accentuate injuries to such a degree as to bring about permanent disablement. Accordingly, the need of general instruction in first aid became apparent.

In this country education of the miners in first aid was probably first taken up systematically in the Pennsylvania anthracite mining district, and training was carried on actively in that district by Dr. G. H. Halberstadt and Dr. M. J. Shields, working with the cooperation of some of the large mine operators. Subsequently first-aid training was actively carried on by Dr. W. S. Rountree in Alabama and by Dr. A. F. Knoefel in Indiana. Meantime, a general campaign in first-aid training among industrial workers was carried on by the American Red Cross Society, but when the Bureau of Mines began its nation-

wide campaign of instructing miners in the use of mine rescue apparatus and in methods of first aid, the American National Red Cross turned over that part of its industrial training work to the bureau, but continued to cooperate by furnishing surgeons as judges in important first-aid contests and demonstrations. Also, the Red Cross assisted in determining the methods of training suitable for mining conditions.

It must be recognized that the conditions in and about the mines usually present difficulties not found in large industrial centers where experienced surgeons are available and hospitals close at hand. Many mines are isolated and, when an accident occurs several miles underground, there may be a serious lapse of time before the injured person can be brought to the surface and taken to the hospital, or given attention by a surgeon who may have to come a long distance. Under such conditions it has been frequently demonstrated that, if effective first aid is not given, the injured person may die or become permanently crippled. This factor in training miners has been recognized and accounts for any slight differences between the publications on first-aid issued by the Red Cross and those issued by the Bureau of Mines.

The bureau has had the active cooperation of the Red Cross in the preparation of these publications, and in connection with the preparation of his handbook Dr. M. J. Shields was detailed by the Red Cross to assist in standardizing the methods prescribed for the bureau's mine rescue corps.

In 1913 the bureau issued a miners' circular giving instructions on first-aid work. Subsequently, when the need appeared of another circular explaining in the simplest possible language

the rudiments of first aid for the miner, Miners' Circular 23 was prepared by Dr. W. A. Lynott, mine surgeon, and D. Harrington, mining engineer.

Early in 1916 it became manifest that there was need of an advanced course in first-aid instruction for miners' first-aid crews who had been thoroughly trained in the rudiments; also it was evident that the methods of giving instruction should be standardized, inasmuch as contests held in various parts of the country had disclosed that miners trained by different mine surgeons in the various districts had been given differing instructions. Consequently, it was deemed wise to appoint a representative committee to prescribe standard methods. Accordingly, Dr. G. H. Halberstadt, of Pennsylvania; Dr. A. F. Knoefel, of Indiana; Dr. W. S. Rountree, of Alabama; Dr. M. J. Shields, of the American National Red Cross; and Dr. W. A. Lynott, mine surgeon of the Bureau of Mines, all of whom had had wide experience in mine surgery and in giving first-aid instruction to miners, were invited to assemble at the bureau's Pittsburgh experiment station and formulate in detail methods of giving first aid for the various classes of injury that were likely to take place in mines, and methods of resuscitation from electric shocks, from drowning, and from suffocation by poisonous gases or through deficiency of oxygen. This handbook represents the fruits of their labors. Although there was necessarily some diversity of opinion as to minor details, all agreed as to the essential features of the methods outlined herein.

Although the Bureau of Mines is authorized by Congress to investigate both safety and health conditions in the mineral industries, it has become evident during the past few years that

to some extent the bureau's work relating to health conditions overlaps work of the Public Health Service. As the latter organization had a highly trained corps of specialists, it was agreed that inquiries requiring expert opinion on medical, surgical, or sanitary conditions should be conducted cooperatively by the assignment to the Bureau of Mines of medical officers from the Public Health Service, so that both bureaus might receive the benefits from the investigations carried on in conjunction with the first-aid training of the cars and stations in mine rescue operations and the health conditions found in mining and metallurgical establishments. This plan of procedure, which has already been carried out in the study of miners' consumption and health conditions in the Joplin zinc district and in the Butte, Mont., copper district, will be extended to the methods of instruction given by the first-aid and rescue corps of the bureau. Accordingly, this report was submitted to and approved by the Public Health Service, some slight revisions made being accepted by the committee.

VAN. H. MANNING, *Director.*

ADVANCED FIRST-AID INSTRUCTIONS FOR MINERS: A REPORT ON STANDARDIZATION.

By a Committee of Surgeons Consisting of G. H. Halberstadt, A. F. Knoefel, W. A. Lynott, W. S. Rountree, and M. J. Shields.

INTRODUCTION.

The primary work of the Bureau of Mines, as authorized by Congress, is to investigate safety and health conditions in the mineral industries, with a view to making recommendations for preventing fatalities and accidents.

Investigations made by the bureau strongly indicate that health conditions and environment are important factors in the occurrence of mine accidents. It is not the purpose of the bureau to criticize the work of physicians, miners, or mining men, but to cooperate with them in these investigations with a view to ascertaining wherein conditions may be improved. The main object in investigations is to exchange ideas with a view of gaining important information as well as imparting such knowledge as the bureau has obtained elsewhere.

The Bureau of Mines maintains various mine-safety and mining-experiment stations. The object of the mine-safety

stations is to give instruction, training, and demonstrations and to disseminate information regarding safe and unsafe practices in mining and to do whatever else can be done to aid in improving safety and health conditions in mining communities and in promoting the welfare of the miner.

The principal means of reaching the miner and interesting him in this safety work is through 13 mine-safety stations, some of which are stationary buildings, and some of which are movable cars. Each car has a foreman miner to give training and demonstrations in modern safety and rescue methods and a first-aid miner to give training and demonstrations in first aid to the injured, and from time to time each will have attached to it a district mining engineer and a surgeon to confer with mine operators, mine physicians, and others, and will look after the general problem of safety. Each station is in charge of a foreman miner, who gives both mine rescue and first-aid training.

The mine safety stations housed in buildings are situated at Pittsburgh, Pa., Jellico, Tenn., Birmingham, Ala., McAlester, Okla., and Seattle, Wash. The stations at Pittsburgh, Pa., Seattle, Wash., and Birmingham, Ala., are equipped with mine rescue motor trucks. The mine rescue cars move from place to place. Headquarters for the cars are Pittsburgh, Pa., Huntington, W. Va., Evansville, Ind., Ironwood, Mich., Pittsburg, Kans., Butte, Mont., Reno, Nev., and Raton, N. Mex.

This publication is to be used as a text for guidance of bureau teachers and is also to serve as a guide and reference book to miners and others. The imperative need of first aid in case of injury or sudden illness makes it the duty of every one to be able to render proper assistance until the doctor arrives on the scene or until the injured person can be taken to him.

The purpose of this handbook is to show the proper ways of caring for injured or sick persons.

In rendering first aid all that is necessary is to use common sense and to follow instructions. A first-aid man should not attempt work that should be done by a doctor or surgeon, but should simply make the patient comfortable so that he may be taken to his home or to a hospital and be less liable to suffer from a wound becoming infected or a broken bone pushing through the skin. The first-aid man should not touch an open wound with his hands or with an instrument, but should place a clean bandage compress over it and leave further treatment for the physician or surgeon.

Accidents are more common than they should be, and every man who studies first aid will realize the need of being cautious and careful in the performance of his daily work. One of the most important duties of a first-aid man is to learn to take charge of affairs at the scene of an accident as soon as he arrives and to give the necessary orders for insuring the relief of the injured person. When caring for an injury, he should consider how it has happened and afterwards take steps to prevent a similar accident. Prevention is better than cure.

FIRST-AID ORGANIZATION.

The purpose of a first-aid organization should be to instruct and train men to assist those who may be injured, sick, or rendered helpless, to promote good fellowship among its members, to study causes of accidents and means to prevent their occurrence, to enlist individual and public interest in the social betterment and the public health of the community, and to promote safety first.

To make first aid a success and to render it most efficient necessitates the interest, cooperation, and unqualified support of the mine owners, mine operators, mine surgeon, mine superintendent, foreman, and employees. The mine owners or operators can be of great assistance by providing a convenient meeting room and fitting it with first-aid equipment. The surgeon should aid by arranging lectures and acting as director and instructor in first-aid work. The superintendent and foreman should assist by encouraging the men to attend the meetings and by attending and taking an active part themselves.

The officers of the association should consist of a president, vice president, secretary-treasurer, and medical director. Their duties are similar to those of like officers in other associations.

The membership can be made up of active and associate members. The active members should be divided into squads or teams of six men, which include one captain, one subject, and four stretcher bearers.

The election or appointment of the captains of the different teams should, if possible, be so arranged as to have them well distributed about different parts of the mine. The associate membership should be made up of those of the community who are interested in lectures on public health and social welfare and are willing to help first-aid work but do not wish to take the practice drills. Semimonthly meetings should be held, at which lectures should be given, first-aid dressings demonstrated, and recent accidents discussed and means suggested to prevent their recurrence.

The following committees should be appointed: Executive committee, membership committee, and social committee, and other committees if necessary. The executive committee should

consist of the president of the association, the mine surgeon, the mine superintendent, and the captains of the different teams. The membership and social committees should be appointed by the president. The executive committee should have charge of the management of the association and of arrangements for contests and competitive drills among the different teams. The membership committee should encourage their friends and fellow workers to join the association. The social committee should arrange for entertainments to be held under the auspices of the association.

FIRST-AID EQUIPMENT.

SURFACE FIRST-AID DRESSING STATION.

At a suitable place on the surface and near the mine opening there should be a first-aid dressing station, which also can be used as a storeroom for first-aid supplies. In this building should be a stretcher, woolen blanket, waterproof blanket, and splints, all of which except the splints should be suitably protected from moisture and air in a sealed tin case, or its equivalent. Also there should be first-aid packets in germ-proof and waterproof wrappings suitably protected in sealed metal boxes, and first-aid cabinets.

CONTENTS OF FIRST-AID CABINET.

Each cabinet (fig. 1) should contain:

Twelve sterilized triangular (unprinted) bandages.

Twelve small bandage compresses, each 1 inch square when folded upon itself about 15 times, with muslin tails ½ yard long, the center being sewed to compress.

Twelve medium-size bandage compresses, each 2½ inches square when folded upon itself about 18 times, with muslin tails 1 yard long, the center being sewed to compress.

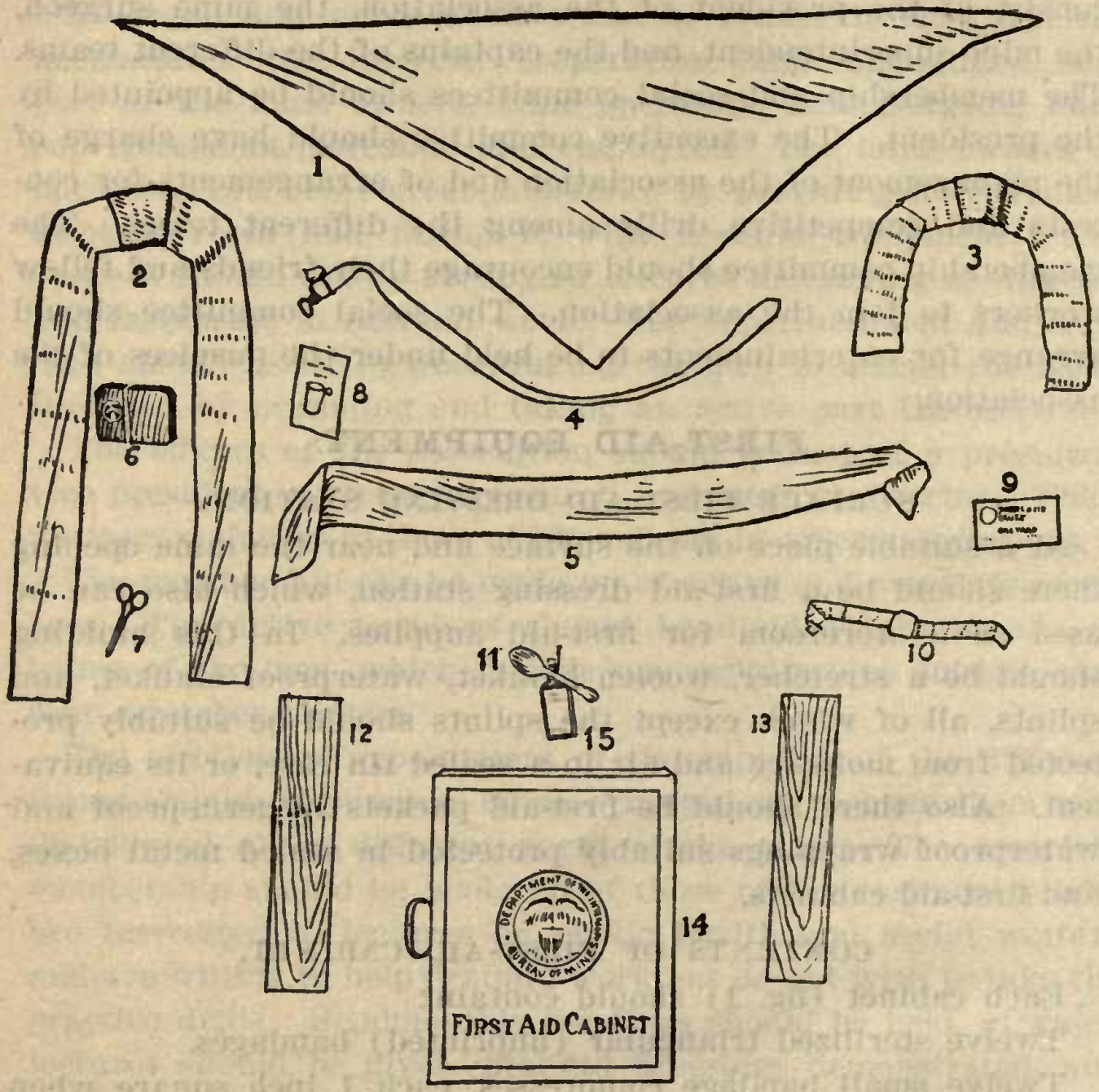

FIGURE 1.—First-aid cabinet and contents. 1, triangular bandage; 2, large bandage compress; 3, medium-size bandage compress; 4, tourniquet; 5, cravat bandage; 6, metal first-aid packet; 7, scissors; 8, paper cups; 9, picric acid gauze; 10, small bandage compress; 11, spoon; 12, 13, splints; 14, first-aid cabinet or case; 15, aromatic spirits of ammonia.

Six large bandage compresses, each 3½ inches square, and folded upon itself about 20 times, with muslin tails 2 yards long, the center being sewed to compress.

Six packages of sterile picric-acid gauze, each containing a piece of gauze 1 yard square.

Six yucca splints or similar material.

One 2-ounce bottle of aromatic spirits of ammonia.

Six paper cups.

One teaspoon (horn).

One tourniquet.

One pair of scissors.

The approximate cost (probably higher rather than lower) of each article is as follows:

Cabinet:

Metallic case	$1.00
12 triangular bandages (plain)	1.20
12 small compresses	.24
12 medium compresses	.48
6 large compresses	.50
6 picric acid gauze bandages (each 1 yard long, in hermetically sealed paper carton)	2.16
1 two-ounce bottle of aromatic spirits of ammonia	.10
6 splints	.35
1 tourniquet	.10
1 pair of scissors	.10
1 spoon	.05
Total	6.58

Metal packet:	
Metal case (similar to one used by American National Red Cross)	$0.10
Triangular bandage	.10
Medium compress	.05
Total	.25
Stretcher (United States Army type)	5.50
Woolen blanket	1.75
Rubber blanket	1.75
Splints	.75
Rubber bag	4.50
Total	14.25

UNDERGROUND DRESSING STATIONS.

First-aid dressing stations should be maintained near the bottom of the shaft or slope and at a central sidetrack. One first-aid cabinet should be available for every 100 men or less. At least one man out of every 10 employees should carry a first-aid packet, which should be refilled when necessary.

SURFACE HOSPITAL ROOM.

Where a large number of men are employed, there should be available on the surface a room provided with suitable hospital facilities and having a surgeon in attendance. The building should be as close as possible to the entrance to the mine and should be supplied with the following articles, all furniture and utensils, except perhaps the chairs, to be covered with heavy white enamel. The prices indicated are subject to fluctuation.

Operating table with cushions	$25.00
Instrument table	7.00
2 chairs	9.00
1 sterilizer for instruments	10.00
Instrument wall case	4.50
1 basin	.45
1 pitcher	.75
2 new galvanized-iron buckets	1.00
6 sterile sheets in wrappers	3.50
12 sterile towels in wrappers	2.00
10 yards of gauze	.75
1 box for holding sheets, towels, and gauze	.50
3 hand brushes	.15
1 pint of tincture of green soap	.50
250 c. c. of tincture of iodine	.75
1 pint of alcohol	.25
One-half pint of benzine for removing grease	.10
Total	66.20

A pair of tweezers for removing splinters and two 1-quart hot-water bottles might be included in the equipment prescribed.

SUGGESTIONS.

The authors of this report make the following suggestions:

1. That as far as possible first-aid training be given under the immediate supervision of a regularly registered and qualified physician;

2. That there be close cooperation with the first-aid department of the American National Red Cross in first-aid work;

3. That all examinations for first-aid certificates be held by a qualified physician and conform with such standards as may be laid down by the Bureau of Mines;

4. That it be an imperative rule that in all first-aid contests the judges shall be regularly qualified physicians trained in first-aid work;

5. That where it is possible every employee in a mine be trained in first-aid work, but if this is impossible that at least one out of every 10 employees, both underground and on the surface, receive such training.

CARING FOR THE INJURED.

Mining is one of the most hazardous employments; therefore it is especially important that miners know something about caring for the injured.

When an accident occurs in a mine it is usually under the worst conditions; the doctor and the hospital are far from the scene of the trouble; if caused by an explosion or fall of roof, the passageways may be so blocked by falls that it is impossible to get the injured man to fresh air promptly; it may be hours before the physician or surgeon sees the case. Hence it will readily be seen what might happen if nothing were done for the patient. Death may occur from bleeding or shock, a simple fracture may be converted into a compound fracture by ignorant or careless handling, and wounds may become infected. These conditions are in contrast with those that surround a man who has been injured and is under the care of a man skilled in first aid: The bleeding will be stopped, the shock treated, the wound dressed, the fracture properly splinted, the pain relieved, and the patient made warm; and he will be stronger and in a safer and better condition when he reaches the physician.

GENERAL DIRECTIONS.

When a person is injured some one should take command and render first aid. In the past many deaths have resulted from the fact that no one took charge of the injured person. The only way to prevent this is for every employee to acquire a knowledge of first aid. The person assuming charge should look the man over carefully to find how badly he has been injured and when fully satisfied he should proceed to give orders. Don't attempt any unnecessary movements of the patient's body or limbs. See that the injured part is in a position as nearly normal as possible, except in case of dislocation, which should be dressed in the line of deformity. Look for hemorrhage, wounds, shock, fractures, dislocations, burns, etc. In examining the injured person, do not take off his clothes in the usual way, as you may cause him unnecessary suffering and make his injury worse. If the injury is of the arm, leg, or body, rip or cut the clothing from the injured part, preferably by ripping the seams. Do not move the person until you are sure or have a clear idea of what the injury is. If hemorrhage is present, stop the flow of blood. If you find a broken bone, fix the parts without undue handling. The proper treatments for different kinds of injuries are discussed under separate heads.

Be calm and quiet. Keep onlookers away from the injured person. Don't wait a moment for a doctor, as delay is dangerous. Endeavor to make the patient comfortable by doing whatever is necessary and no more. Loosen all tight clothing, especially about the neck, chest, and waist. If the injured person has a flushed face, put something under his head to raise it. If his face is pale, his head should be lowered. If the patient

vomits, turn his head to one side so that the vomited matter will not get into his windpipe and choke him. Never give an unconscious person water, whisky, or other liquid, as it may enter his windpipe and strangle him; however, if the injured person is conscious give all the water he wants, but give it slowly and in sips. A seriously injured person should be kept lying down and covered with blankets, brattice cloth, or clothing of some sort. Don't give whisky or brandy as stimulants at any time, especially in connection with injuries of the head. If you have to give a stimulant to a person in shock, always use aromatic spirits of ammonia, hot coffee, hot tea, or hot water.

Look for and know exactly where the injury is before attempting to treat it. If necessary, remove some clothing, but do it by ripping the seams of the garment or by cutting the clothes. If the regular first-aid materials are not at hand, make your own splints, tourniquets, stretchers, etc., of material that is near the place of accident. When you find several injuries, treat the most severe one first.

Always cheer your patient and keep him hopeful. Keep him warm with blankets, brattice cloth, clothing, hot-water bottles, safety lamps, hot bricks, or hot stones; but hot objects should be protected so that they will not burn the patient.

WHAT A FIRST-AID MAN SHOULD DO.

Be calm.
Take command and give orders.
Find location of the injury.
Know what you want to do and do it.
Keep onlookers away from the patient.
Use a knife or scissors to remove clothing.

Look for red spurting blood and check it by tourniquet or by pressure of finger over blood vessel.

Look for shock; if present, lower head of patient, apply blankets and wrapped hot-water bottles; and give aromatic spirits of ammonia in water, if patient is conscious.

Look for fractures; never remove a patient, unless absolutely necessary, until splints have been applied.

Place bandage compress over compound fracture before applying splints.

Cover all wounds with bandage compress and bandage.

The fingers or instruments should not touch a wound.

Remove a foreign object from a wound, if you do not have to put your fingers into the wound or touch the edges of the wound.

Exclude air as quickly as possible from burned surfaces by using picric acid gauze or other material.

Leave reductions of dislocations or fractures for the surgeon, except dislocation of jaw or finger.

Only part of your work is completed when the patient is ready for the stretcher.

Unnecessary or rough handling of a patient may undo all your work.

Slowly place patient on stretcher, avoiding jerky movements, and carry him to safety.

DON'TS.

Don't touch a wound with your fingers or any instrument.

Don't put an unclean dressing or cloth over a wound.

Don't allow bleeding to go unchecked.

Don't move a patient unnecessarily.

Don't allow a patient with a fracture or suspected fracture to be moved until splints have been applied.

Don't fail to put plenty of padding between limb and splint.

Don't neglect shock.

Don't burn a patient with an unwrapped hot-water bottle or other heated object.

Don't fail to give artificial respiration when needed.

Don't fail to pull the tongue forward when giving artificial respiration.

Don't fail to remove false teeth, tobacco, and chewing gum from the mouth of an unconscious person.

Don't remove the clothing from the injury in the usual way.

Don't permit air to reach a burned surface.

Don't wash wounds.

Don't put drugs in a wound.

Don't reduce dislocations, except of the finger and lower jaw.

Don't put a quid of tobacco on a wound.

Don't leave a tourniquet on over 20 minutes without loosening.

ANATOMY OF THE HUMAN BODY.

In order to practice first aid properly one should know something about the bones, heart, arteries, veins, small blood vessels, principal organs, and muscles of the human body.

The human body is composed of solids and fluids. The blood is about one-thirteenth the weight of the body; for instance, if a man weighs 130 pounds he will have 10 pounds of blood.

SKELETON.

The human skeleton (fig. 2.) is the framework of the body and is composed of three parts: The head, the trunk, and the extremities. There are 202 bones in the body, but for the purposes of first aid only a few of these are here considered. There are long bones that support the body and act as levers; short bones for strength; flat bones to protect the vital organs and for muscle attachment; and irregular bones, as the backbone and the jaw.

The skull has 22 bones, of which 8 form the upper part, or cranium, and 14 the face.

The trunk is composed of the backbone, breastbone, ribs, and pelvis. The backbone is made up of 33 bones, which are joined together by ligaments, forming the spinal column, through which the spinal cord passes. The chest in front has a breastbone and 12 ribs on each side; behind, the backbone. The first 7 pairs of ribs are attached to the breastbone, the remaining pairs being attached in front to the cartilage. The lower two have no at-

tachment in front and are known as floating ribs. All of the ribs are attached to the backbone behind. The breastbone forms the front wall of the chest and is about 6 inches long. At the upper end it is broad and on each side has a depression that fits the end of the collar bone; below it tapers to a point.

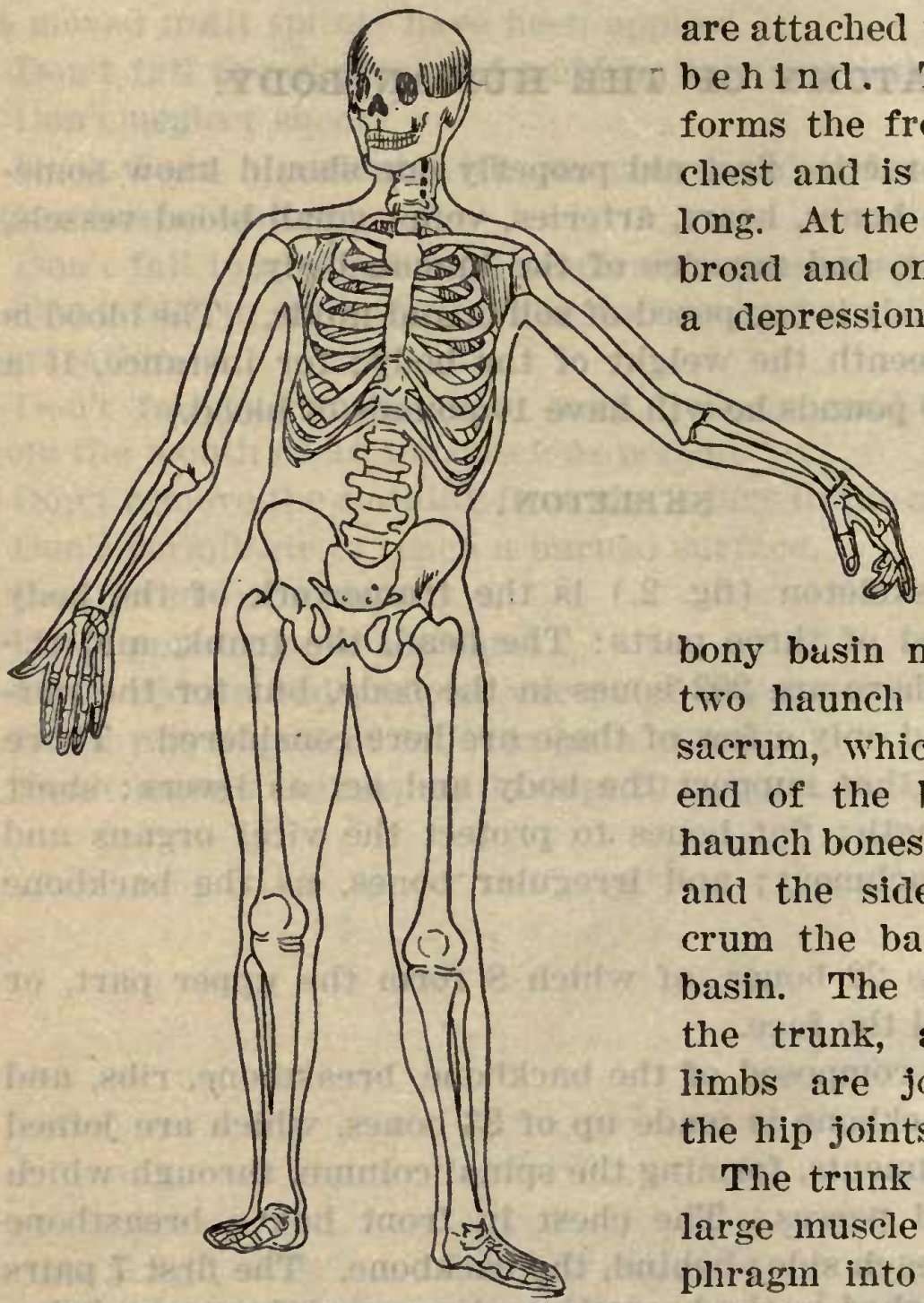

FIGURE 2.—The human skeleton.

The pelvis is a wide, strong, bony basin made up of the two haunch bones and the sacrum, which is the lower end of the backbone. The haunch bones form the front and the sides and the sacrum the back wall of the basin. The pelvis supports the trunk, and the lower limbs are joined to it at the hip joints.

The trunk is divided by a large muscle called the diaphragm into two cavities—chest and abdomen. The chest cavity contains the lungs, heart, gullet, windpipe, and large blood vessels. The abdomen contains the stomach,

large blood vessels, intestines, liver, kidneys, spleen, and bladder.

Each upper extremity has 1 collar bone, 1 shoulder blade, 1 arm bone, 2 forearm bones, 8 wrist bones, 5 hand bones, and 14 finger bones. Each lower extremity has 1 thigh bone, 2 leg bones, 1 kneecap. 7 ankle bones, 5 foot bones, and 14 toe bones.

FIGURE 3.—The surface muscles of the body.

JOINTS.

Where two or more bones come together they form a joint and are held in position by bands called ligaments.

MUSCLES.

Muscles or flesh give shape to the body, and by shortening or lengthening they cause the parts to which they are attached to move. (See fig. 3.)

TENDONS.

Tendons are strong, white, fibrous cords that attach muscles to bone.

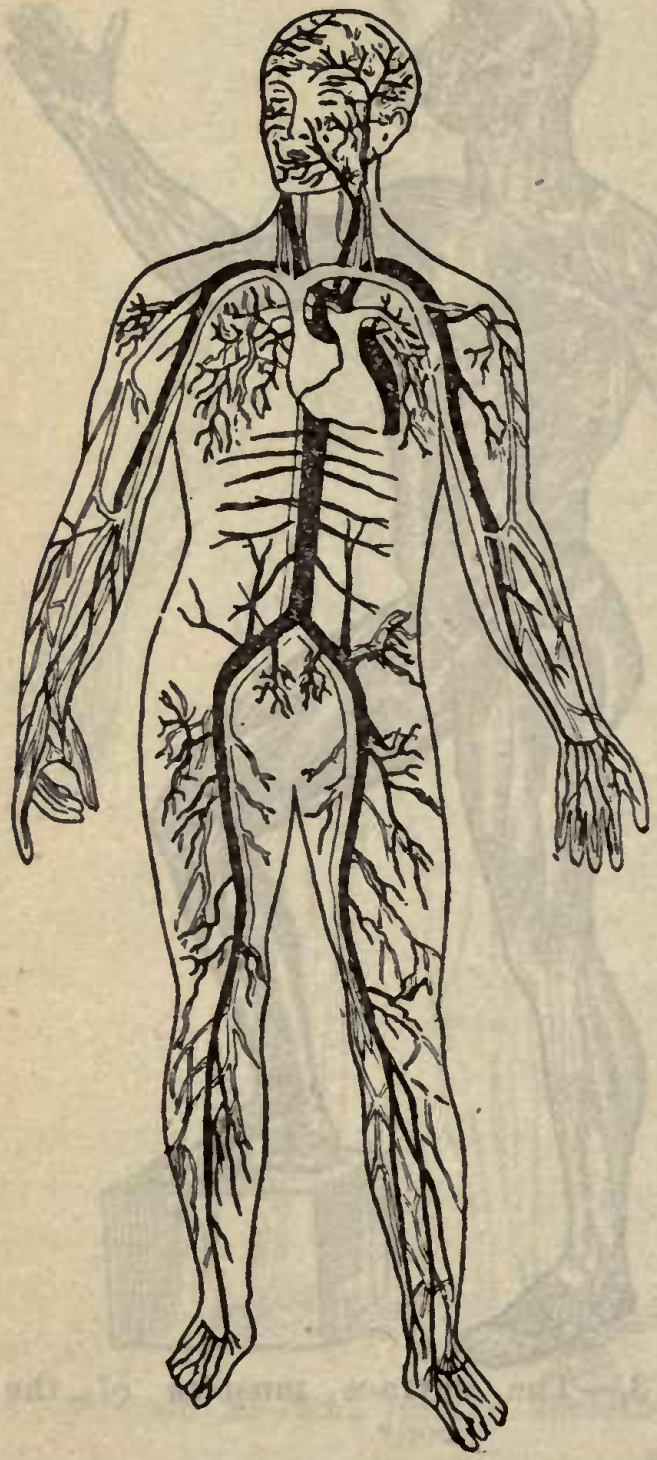

FIGURE 4.—The principal arteries and veins of the body.

SKIN.

The skin is the protective covering of the body and is the organ of the sense of touch. It also performs the function of getting rid of some of the impurities of the body. At the openings leading to or from the interior of the body it becomes the mucous membrane.

BLOOD SUPPLY.

The blood carries nourishment to the different parts of the body by means of closed tubes called blood vessels (fig. 4), and it is kept moving by the pumplike action of the heart. It also furnishes heat and oxygen to all parts of the body and carries waste matter from all the tissues to such organs as the lungs, kidneys, skin, and bowels, whose work is to separate it and send it out of the body.

HEART.

The heart is a hollow, muscular organ about the size of a man's fist, situated in the chest behind and somewhat to the left of the breastbone. It pumps pure blood through the arteries to all parts of the body, just as a fan forces pure air through a mine. The impure blood is carried through the veins back to the right side of the heart, which sends it to the lungs to be purified; it is then returned to the left side of the heart and sent through the body again. The heart acts like a double pump, one side of which forces the fresh blood through the body, the other side forcing the impure blood to the lungs. The heart contracts, or beats, about 72 times a minute.

BLOOD VESSELS.

The blood vessels are the arteries, veins, and capillaries, through which the blood is conveyed to and from all parts of the body. The arteries carry the blood from the heart, and they divide and subdivide until they become very small in size and are known as capillaries. These finally enlarge and join, forming the veins, through which the blood is returned to the heart. The rich, red blood flows through the arteries in spurts, forming the pulse beat, which is conveniently felt at the wrist and temples. When an artery is cut the blood spurts out in jerks and is bright red in color; when a capillary is cut the blood is brick red in color and oozes slowly from the wound; the blood in the veins is dark red and the flow is continuous. Figure 5 shows the relation of the principal arteries to the bones. The points at which pressure may best be applied to stop bleeding are indicated.

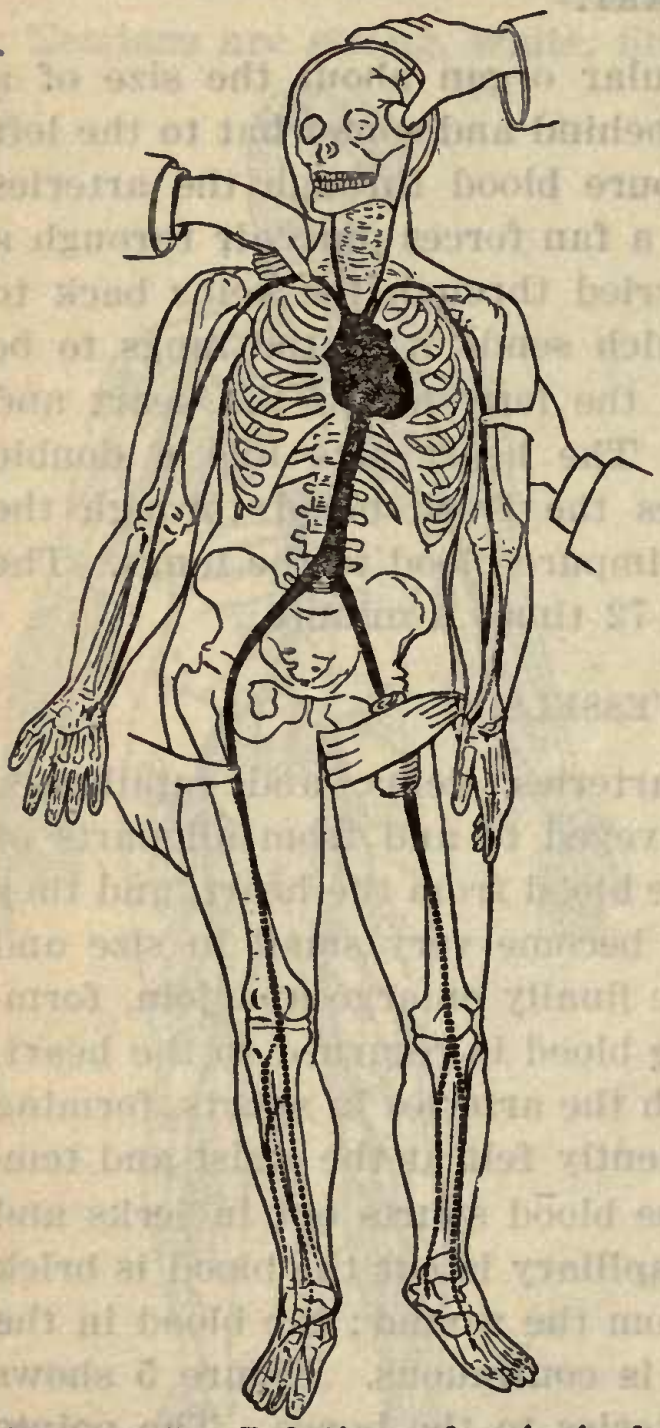

FIGURE 5.—Relation of principal arteries to the bones. Points where pressure may best be applied to stop bleeding are indicated.

RESPIRATION.

Respiration means breathing, taking in pure air and driving out the impurities that the lungs have separated from the blood. The breathing apparatus consists of the nose, throat, windpipe, and lungs.

The principal use of the nose is to warm, filter, and moisten the air before it reaches the lungs; in the nose also is the sense of smell which to a great extent warns a person of the presence of some harmful gases.

The throat is a continuation of the nose and the mouth, and at its lower end are two openings; the one behind, called the gullet, leads into the stomach; the one in front, called the windpipe, leads to the lungs.

At the top of the windpipe is the larynx, in which are the cords of speech by which the voice is formed. When swallowing, the larynx is closed by a flaplike covering known as the epiglottis, which prevents food and liquid from entering the windpipe.

LUNGS.

The lungs are two cone-shaped bodies, which are soft, spongy, and elastic. The outside of each lung is covered by a closed sac called the pleura. The inner part of the lungs communicates freely with the outside air through the windpipe. The outside of the lungs is protected from air pressure by the walls of the chest. The air pressure on the inside of the lungs expands them until they fill the entire chest cavity. If any air gets through the chest wall, or if the wall of the lung is pierced so that the air from the outside can communicate with the pleural sac, the lungs shrink, because the air pressure is equalized on the outside and inside of the chest cavity.

The purification of the blood in the lungs is readily effected, because only a very delicate wall is between the air on one side and the blood on the other, so that the gases are easily exchanged between the two. The blood in the veins from the system is brought to the capillaries of the lungs, where the air cells separate the carbonic acid gas and waste matter with which the blood is laden. A new supply of oxygen is taken up by the red blood cells.

Breathing is an act over which we have little control. It occurs in health about sixteen to twenty times per minute. Oxygen is absolutely necessary to human life. If a person breathes bad air continuously, his health will break down and disease will follow. To insure health a person requires 1,000 cubic feet of air space, which is equal to the space in a room 10 feet square and 10 feet high, and the air breathed should be frequently renewed through proper ventilation. This means that the air should be kept in motion, and the relative humidity and temperature should be approximately such as insure health.

DIGESTIVE SYSTEM.

The digestive system consists of a long tube which comprises the mouth, throat, gullet, stomach, and bowels, together with the liver and other glands. This tube is about 30 feet long and extends from the mouth to the rectum. Its functions are to separate the nourishment from the food, to expel the waste part from the body, and to arrange the nutritive material in a form that can be taken up by the blood and used for food by the tissues. (See pp. 127–134.)

EXCRETORY SYSTEM.

Excretion means the removing of all waste matter from the tissues. The waste may be removed by means of perspiring through the skin, by urine from the kidneys, in carbonic acid gas from the lungs, and by the bowel movements. Life and health depend upon the body throwing off these wastes or poisons. (See pp. 134–136.)

NERVOUS SYSTEM.

The different parts of the body are kept in touch with each other by the nervous system, and the functions of the organs are controlled and regulated by it. The nervous system is composed of nerves and nerve cells or centers; most of the latter are in the brain and the spinal cord. The nerves are round white cords consisting of nerve fibers, which form connections between the centers and the ends of the nerves. The fibers transmit nervous impulses and are of two kinds, according to the function that they perform. One carries sensations, such as pain, heat, and cold, and the other causes movements of the.

body. The nervous system plays an important part in injuries, as there would be no shock if the nerve centers were not affected.

EPILEPSY.

A person in a mine may have an attack of epilepsy, and frequently this condition is mistaken and the patient is mistreated and mishandled.

Epilepsey, or falling sickness, is a nervous disorder; the patient will have a fit or convulsion and fall to the ground. The person is usually warned of the oncoming attack. He may be depressed or joyful or there may be a change in his facial expression. Often he feels a breath of air blowing on some part of the body, passing upward to his head, with pain in his limbs or internal organs (stomach, etc.), or his muscles may tremble or contract.

If standing, he will cry out or scream and fall to the ground unconscious. His muscles become stiff, his head is turned to one side by jerks, and breathing for the moment is stopped; his face is at first pale, then livid. This stage lasts about one-half minute, followed by rolling of the eyes; he may bite his tongue and cheeks, and at the same time the bladder and bowels may act. This stage lasts a few minutes and the patient slowly regains consciousness and may then fall asleep.

Treatment.—Do not try to restrain his convulsive movements, but see that he does not injure himself as by falling into a fire or down a shaft. Lay the patient on his back. Remove from his mouth any foreign bodies, such as false teeth, tobacco, or gum. Cover him with blankets. Do not give him anything by mouth. Loosen all tight clothing about his neck, chest, and

abdomen. Place a piece of gauze or a pad between the teeth. Dash cold water on his face and chest. Carry the patient home and have him rest.

If a patient tells you that an attack is coming on, you may be able to ward it off by compressing his hand firmly.

SHOCK.

Shock is a profound impression made on the nervous system. It occurs in more or less degree following all accidents, and in case of fright, anger, or surgical operations. Shock is dangerous and should be given prompt attention. Allowing a person to see his own injury often causes shock, especially if there is much bleeding. When a person is suffering from shock, his face is pale and has an anxious expression, the eyelids droop, the eyes are dull and the pupils large, the skin is clammy and covered with cold sweat. The injured man is somewhat stupid and takes little interest in things about him. He may suffer from nausea and vomiting. He may answer questions slowly. He may be partly or totally unconscious, or his mind may wander. Usually he is perfectly quiet and will not move unless disturbed. Breathing is shallow and feeble; the pulse is rapid and weak, and may not be felt at the wrist. When this condition is observed, send for a doctor. Place the person in a comfortable position with his head low, unless there is a fracture of the skull or severe hemorrhage from the head. Remove from his mouth all foreign bodies, such as false teeth, tobacco, or gum. Wrap the person in warm blankets, clothing, or brattice cloth. If conscious, give aromatic spirits of ammonia—a teaspoonful in a half glass of water—hot coffee, hot

tea, or hot water. If he is unconscious do not give him anything by mouth, but pour aromatic spirits of ammonia on a cloth and place it under his nose. Place hot-water bottles, hot bricks, or lighted safety lamps around him under the coverings, but make sure that they are wrapped with cloth or paper so as to prevent burns. If the person is unconscious he can not tell you that the bricks, bottles, or lamps are too hot. Rub his legs and arms toward the body under the blankets, but do not uncover him. A light hot-water bottle, wrapped in cloth or paper and placed over the heart, is a good stimulant.

Although shock is dangerous and commonly follows injuries, it must not be forgotten that the patient may require treatment for something still more dangerous; as, for instance, severe bleeding, which must be checked.

ELECTRIC SHOCK.

Electricity causes shock by paralyzing the nerve centers that control breathing or by stopping the regular beat of the heart. Accidents from electricity are common in mines. Electric circuits used in mines carry 250 to 3,000 volts.

The symptoms of electric shock are sudden loss of consciousness, absence of respiration—which, if present, is slight and can not be observed—weak pulse, and burns at the point of contact with the conductor of electricity. Always rescue the person as quickly as possible, being careful not to get in contact with the live wire or other conductor. Lose no time in looking for a switch to turn off the current. In the event that there is no switch near, take a drill, mine auger, bar, or piece of wire and throw it quickly across the trolley and the rail, taking particular care to release your hold of the instrument before it touches the live wire. By so doing the circuit breaker in the power house will be thrown out and the current cut off. Leave the auger or other instrument across the wire, so that the circuit breaker will be thrown out continuously. Such action may cause injury to other working parts of the mine, but when a human life is at stake all the wires should be cut if necessary. Life should come first and the mine property afterwards. A dry, long-handled shovel will be of service in removing the patient from the wire.

If no wire, drill, or other instrument long enough to reach from the wire to the rail is at hand, one may proceed to remove the victim from the live wire, but first get a dry board or piece of

thick paper and put it under your feet, and protect the hand you use with your cap, coat, or any dry, nonconducting material, so as not to make a circuit. If possible, use one hand only, placing the other behind you. If both hands are used to remove the person from the wire, make sure that both your hands and your feet are well insulated, so that you will not be caught in the same contact. Another way is to take your belt, handkerchief, coat, or piece of dry rope and loop it over the victim's foot or head if he is lying on the wire, and thus pull him off. If an ax is near at hand, use it to cut the wire, but first make sure that the handle is dry, or wrap it with a coat or other dry nonconducting material. Or you may use a dry board, dry cloth, or dry rope to pull the wire away from the patient.

TREATMENT FOR ELECTRIC SHOCK.

After the person has been taken from the wire turn him over on his face, remove all foreign bodies from his mouth, such as false teeth, tobacco, or gum, pull and keep the tongue forward, turn his head to one side, resting it on his forearm so that his mouth and nose will not come in contact with the ground, and extend his other arm forward. Do not wait to loosen his clothing. Start the Schaefer (or prone) method of artificial respiration without delay.

SUFFOCATION OR ASPHYXIATION.

A victim of suffocation or asphyxiation becomes unconscious, his lips and ear lobes become blue, his pulse and breathing stop, and his pupils become dilated. The cause may be something blocking the windpipe and preventing the air from getting into the lungs, or inhalation of harmful gases. Due care should be

exercised by the rescuer to protect himself. Unless the air where the victim is found is good, immediately get the person to pure air and perform the Schaefer method of artificial respiration.

GAS POISONING.[a]

The most common gases found in a mine are black damp (a mixture of nitrogen and carbon dioxide), white damp (carbon monoxide), and fire damp (inflammable gas, chiefly methane).

Fire damp has no effect on the human system. Only when a sufficient amount has been generated to reduce the quantity of normal air present does it interfere with breathing. When present, however, in proper proportions, it is highly explosive. Therefore great care should be exercised in using naked lights.

The breathing of black damp and white damp, particularly the latter, is very dangerous. Black damp is usually recognized by its action on the flame of a safety lamp. In old and unventilated workings and at the bottom of sumps, in reopening old shafts, great care should be taken. When a person works in black damp he is affected not only by the damp but also from a lack of oxygen. The symptoms of danger from breathing black damp occur far in advance, but with white damp there may be no such warning. In bad air the amount of black damp would give warning of the next and more serious danger—want of oxygen. The man working in bad air will find that his usual work is more tiring than when working in pure air, and that he will be compelled to take frequent rests. A severe headache is made worse by stooping and is

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[a] For methods of detecting these gases see Bureau of Mines Miners' Circulars 12 and 14, listed on page 142.

often accompanied by a sick stomach. In severe cases the power of the limbs is interfered with, causing the victim to stagger. The face becomes flushed and the flush deepens and becomes bluish. Often, if only a small percentage of black damp is present and most of the oxygen has been replaced by nitrogen, the person exposed to such an atmosphere may collapse into unconsciousness with practically no warning. No man should be permitted to work where black damp is present.

CARBON MONOXIDE OR WHITE DAMP.

Many miners state that they are able to tell the presence of carbon monoxide by the sweetish odor present. This odor is due not to the carbon monoxide but to other decomposition products in the atmosphere, such as the volatile products given off by a fire, or such as are caused by wood rotting, or by the oxidation of coal. Although there may be only a very small percentage of carbon monoxide present in the air that is breathed, the action of the gas is cumulative; that is, the carbon monoxide is gradually but continuously taken up by the blood and displaces the oxygen, causing the body to suffer from oxygen starvation. The first decided symptoms, during rest, make their appearance only when the blood is saturated with about 30 per cent of the gas. Death occurs when the saturation attains about 80 per cent. This action of carbon monoxide accounts for many lives that have been lost.

Another feature is that, if one is working in such an atmosphere, his body will store up more carbon monoxide than if he is at rest. In rescue work men may have proceeded a considerable distance in foul air before becoming affected and have had insufficient oxygen-carrying elements in the blood to bear

them back to safety. White-damp poisoning steals upon its victim in such a way that he may become saturated with the damp before he is aware of it. In some cases the poisoning takes effect suddenly. In disasters, many men have been found dead in their places with their picks in their hands as if working, others have been found in positions indicating that they were taking food when overcome.

The symptoms are numerous, the more prominent being yawning, giddiness, ringing in the ears, weariness, and a fluttering or throbbing of the heart, which is a late symptom. If a person gets out of impure air into good air, usually these symptoms pass off, leaving perhaps a headache, but if no attention is paid to the symptoms and the person continues working, he becomes more affected and feels that his legs are beginning to go from under him and usually staggers around until he sinks to the ground in a semiconscious or unconscious condition.

All cases may not begin this way. The symptoms may come on so gradually that the body becomes full of the poison before the person is aware of it, and he falls unconscious. The person's condition from exposure to black damp is usually due to lack of oxygen in the air that he breathes. Exposure to white damp destroys the hemoglobin in the blood so that it will not carry oxygen to the tissues of the body. In treating a person that is suffering from either black damp or white damp, always administer oxygen when making use of artificial respiration. However, if the oxygen is not at hand, do not wait, but start the Schaefer method of artificial respiration after the person overcome has been removed to fresh air.

DROWNING.

The most important essential after rescuing a drowning person is to get the water out of his lungs and stomach. Rolling him on a barrel is desirable, but as a rule a barrel is not available. As a substitute, have one man get on his hands and knees, so that the victim can be placed over the kneeling man's back, or, if you are alone with the victim, place and lock your hands underneath the patient's stomach and lift him several times, thus bending his body and allowing the water to flow out of his mouth. Later resort to artificial respiration. Usually after a person has been immersed in water for five minutes life is extinct. There have been victims that have been revived after two hours of artificial respiration.

ARTIFICIAL RESPIRATION BY THE SCHAEFER OR PRONE METHOD.

Place the person on his abdomen; remove from his mouth all foreign bodies, such as false teeth, tobacco, and gum; pull and keep the tongue forward; turn his head to one side and rest it on his forearm, so that the mouth and the nose will not come in contact with the ground and extend the other arm forward. If the person is thin, prepare a pad of folded clothing, blankets, or brattice cloth and place it under the lower part of his chest. Do not make this pad too thick. Do not wait to loosen the victim's clothing but begin artificial respiration without delay. An assistant may remove all tight clothing from the victim's neck, chest, and waist; blankets, hot-water bottles, safety lamps, or hot bricks well wrapped in paper or cloth should be placed about the person by an assistant.

Kneel, straddling the person's thighs, and, facing his head, rest the palms of your hands on his loins—on the muscles of the small of his back—with your thumbs nearly touching each other and your fingers spread over his lowest ribs (see fig. 6); with arms held straight, swing forward slowly so that the weight of your body is gradually brought to bear on the person

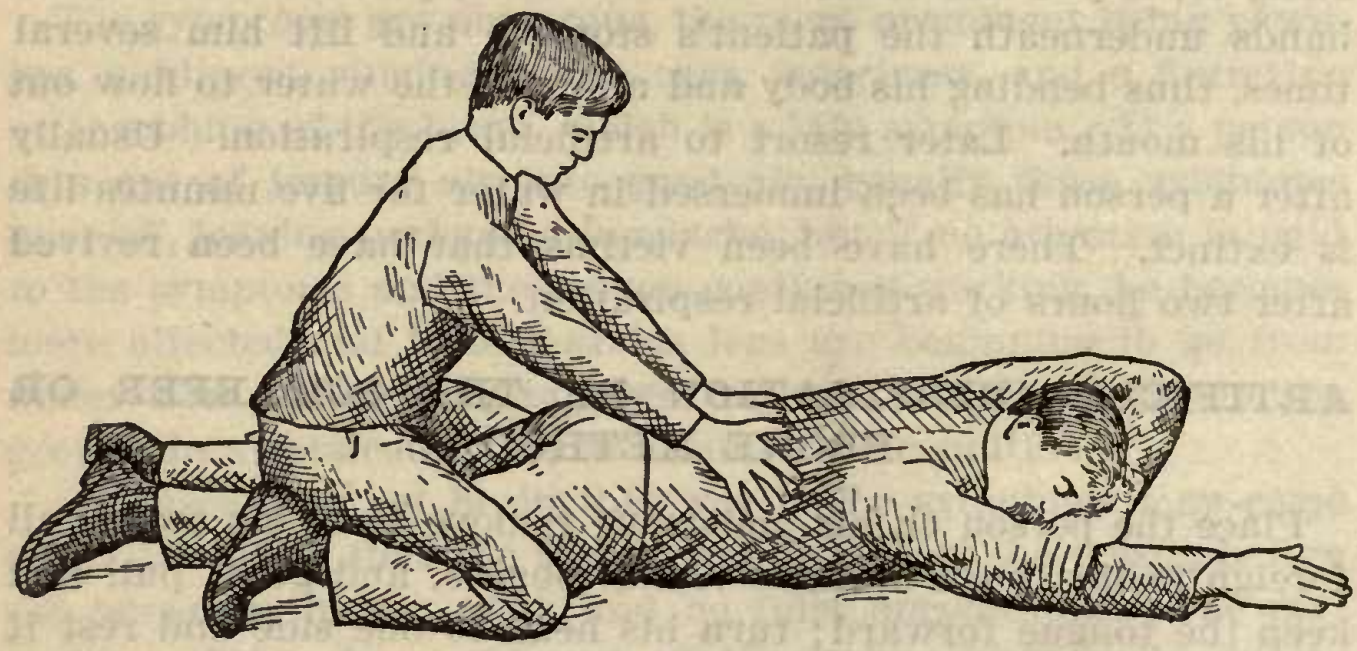

FIGURE 6.—Schaefer (or prone) method of artificial respiration—Inspiration.

(see fig. 7). This operation, which should take three to four seconds, must not be violent, lest the internal organs be injured. The lower part of the chest and also the abdomen are thus compressed and air is forced out of the lungs. Now, immediately swing back slowly so as to remove the pressure, but leave your hands in place, thus returning to the position shown in figure 6. Through their elasticity the patient's chest walls

expand and his lungs are thus supplied with fresh air. After two seconds swing forward again and repeat deliberately, 16 to 18 times a minute, the double movement of compressing and releasing—causing a complete respiration in about four seconds. If a watch or clock is not available, follow the natural rate of your own deep breathing, swinging forward with each expiration and backward with each inspiration.

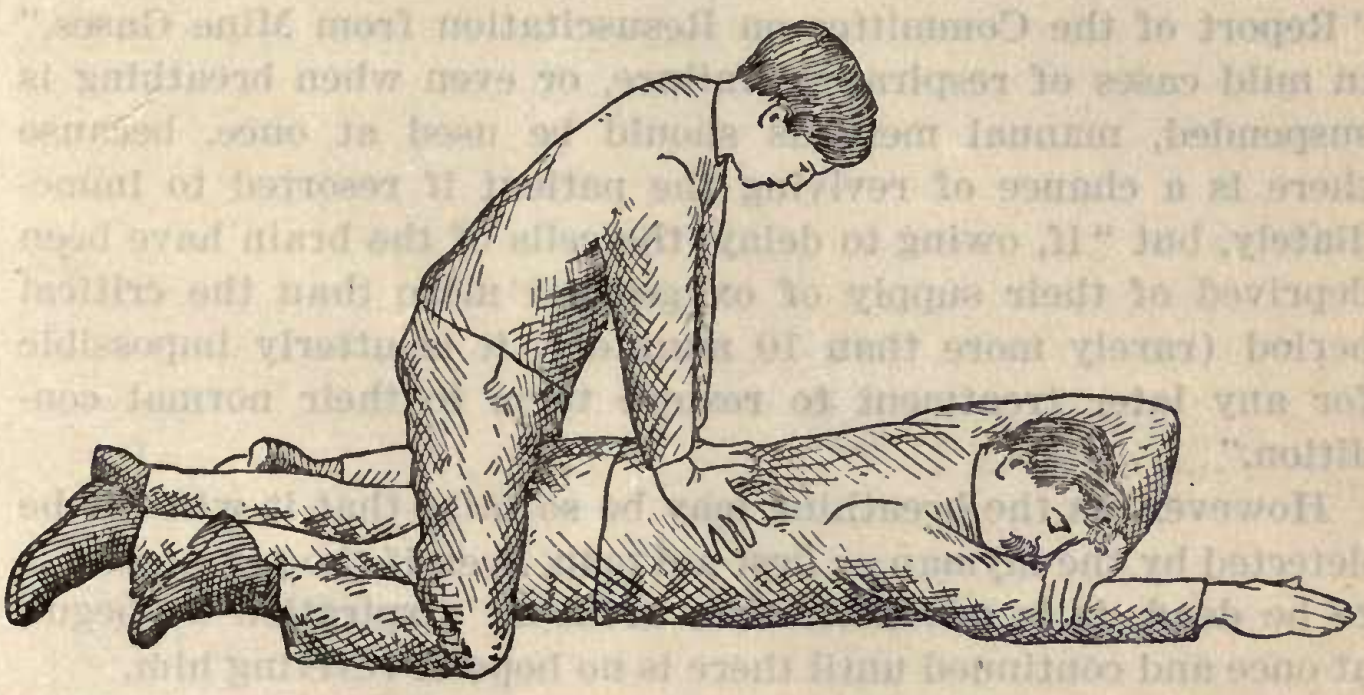

FIGURE 7.—Schaefer (or prone) method of artificial respiration—Expiration.

Continue artificial respiration, if necessary, for at least three hours without interruption until natural breathing has been restored or until a physician arrives. Even after natural breathing begins carefully watch that it continues. If it stops, start artificial respiration again.

Do not give any liquids whatever by mouth until the person is fully conscious, when you may give slowly aromatic spirits

of ammonia (a teaspoonful in half a glass of water), hot coffee, hot tea, or water.

Do not permit bystanders to crowd around. The assistant should not do anything that will interfere with the operator.

USE OF RESUSCITATION DEVICES.

As pointed out in Technical Paper 77 of the Bureau of Mines, "Report of the Committee on Resuscitation from Mine Gases," in mild cases of respiratory failure, or even when breathing is suspended, manual methods should be used at once, because there is a chance of reviving the patient if resorted to immediately, but "if, owing to delay, the cells of the brain have been deprived of their supply of oxygen for more than the critical period (rarely more than 10 minutes), it is utterly impossible for any later treatment to restore them to their normal condition."

However, as the breathing may be so faint that it will not be detected by the layman or first-aid man, even if the person seems to be dead, it is advisable that artificial respiration be begun at once and continued until there is no hope of reviving him.

When the quantity of fresh air supplied to the patient by such artificial respiration is small or insufficient, as is likely to be the case if the patient has been breathing poisonous gases, it is advisable that the manual method be supplemented by the release of pure oxygen from a container in proximity to the patient's nose or mouth, but avoiding creating any pressure that would cause injury or prevent free exhalation. When oxygen or oxygen and air are given the manual treatment should not be stopped, but should continue as long as there is hope of reviving the patient.

Various machines have been devised to compel or assist artificial breathing. The committee on resuscitation above referred to considered that devices that automatically forced respiration were dangerous, and at the time of preparing this report official approval has not been given to any resuscitation devices.

DRESSINGS.

Dressings consist of bandages, bandage compresses, and splints. (See fig. 1.)

BANDAGES.

Bandages are used to hold dressings and splints in place, to stop bleeding by pressure, and to serve as slings.

TRIANGULAR BANDAGE.

The triangular bandage is recommended by the Bureau of Mines because it is easily applied and can be handled by the first-aid man in such a way that the part applied to the wound will not be soiled, it does not tend to slip off when once applied, and it is usually made from unbleached cotton cloth, although any kind of cloth will answer the purpose, such as a handkerchief, a piece of shirt, or a napkin. The triangular bandage should be made from a piece 36 to 40 inches square, by folding this square diagonally from corner to corner, thus forming two triangles; cutting across the long side makes two triangular bandages.

CRAVAT.

The triangular bandage may be used in two forms—unfolded and folded. The bandage when folded is known as a cravat. This is made by bringing the point or apex of the triangle to the middle of the opposite side (the base). The bandage is again divided by being folded lengthwise along a line midway between the base and the new top of the bandage. This opera-

tion is repeated until the width desired is obtained. The method has the advantage that all bandages can be folded to a uniform width. To complete a dressing the ends of the bandage are tied together securely. Knots should be placed where they do not cause discomfort and where they may be easily removed. The reef knot (see fig. 10) is the one recommended.

BANDAGE COMPRESS.

A bandage compress is a special dressing, which may be of various sizes, to cover all open wounds. It consists of several thicknesses of sterile gauze sewed to the middle of a strip of muslin. Three sizes are used—large, medium, and small.

ARM SLING.

Place one end of a triangular bandage over the shoulder of the injured side, allowing the bandage to hang down in front of chest so that the apex will be behind the elbow of the injured arm; bend the elbow of the injured arm across the chest, thus bringing the forearm across the middle of the bandage. Then carry the lower end of the bandage over the shoulder of the uninjured side and tie behind the neck. Tuck the apex of the bandage in at the elbow.

CRAVAT SLING.

In making a cravat sling the center of a cravat bandage, sufficiently broad, is placed under the injured person's wrist and part of the hand, the inner end passing over the shoulder of the injured side and the other end passing over the shoulder of the uninjured side. Tie at the back of the neck.

TOURNIQUET.

A tourniquet (figs. 8 and 9) is an appliance used to check severe bleeding. If a regularly constructed tourniquet is not at hand, one can be improvised from a strap, belt, suspenders, a handkerchief, a towel, bandage, necktie, or piece of brattice cloth. A tourniquet must be of sufficient length to encircle the limb. A pad should be placed over the artery or vein so that when the tourniquet is tightened it will press this pad against the blood vessel, thereby stopping the flow of blood. The pad may be made from a smooth, round stone, a cork, a piece of coal, a knife, or some object of similar shape and size covered with a small piece of cloth, so that it will not bruise the skin. The tourniquet should be passed twice around the limb and tied securely at the outer side. Make two more knots tied loosely, and insert a stick between the last two knots and twist until the bleeding is stopped. If necessary, a cravat bandage may be looped over

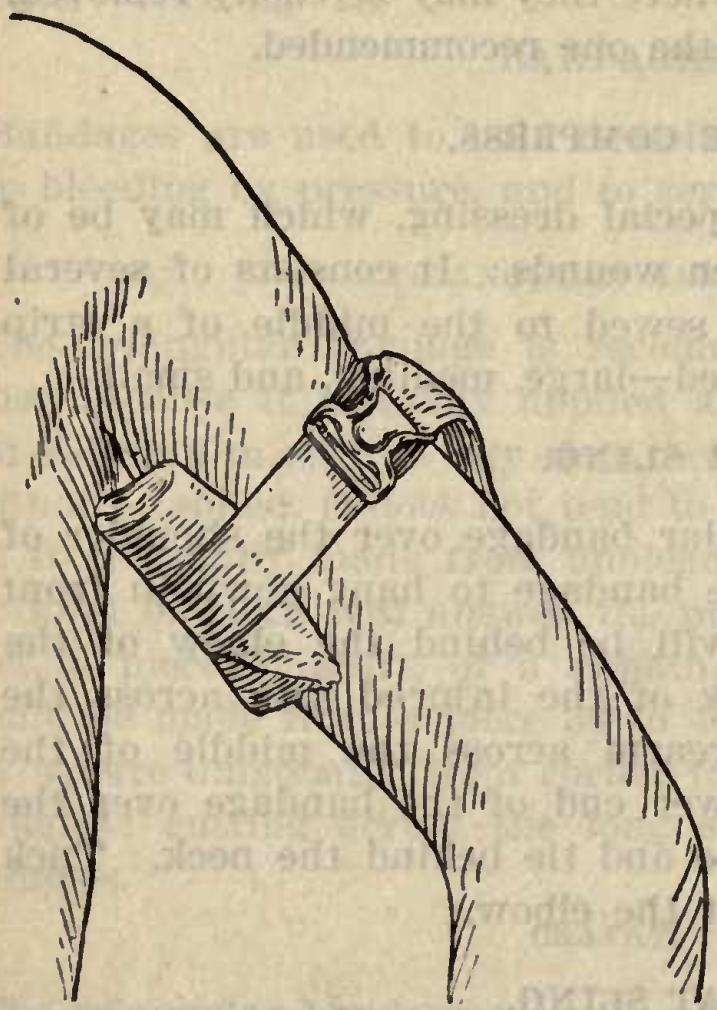

FIGURE 8.—Tourniquet applied to the arm.

the end of the stick to keep it from untwisting and relieving the pressure of the pad on the blood vessel. After putting the stick into the loop pull it away from the body when twisting to avoid bruising the skin or flesh. A tourniquet should not be used if the bleeding can be readily checked otherwise, because it stops circulation of blood in the limb. When the circulation of the blood is cut off for too long a time, death of the part may follow; therefore, loosen the tourniquet after it has been in place 20 minutes, but do not remove it. If bleeding does not start again, let the tourniquet remain loose. If bleeding persists, permit the artery to spurt five or six times and then tighten the tourniquet again. In all compound fractures place a tourniquet around the injured limb, but do not tighten it unless necessary. If spurting blood should be found when handling or transporting a patient, take time to check the bleeding.

FIGURE 9.—Tourniquet applied to the thigh.

SPLINTS.

Splints are used for broken bones and suspected broken bones, to prevent them from moving at the point of fracture, and at

the nearest joint. They must be of stiff material. Improvised splints may be made from pieces of wood, broom, pick or shovel handles, mine augers, drills, rules, laths, heavy cardboard, canes, umbrellas, sprags, cap boards, etc.

In making a splint always remember that, besides being firm and stiff, it should be long enough to prevent movement at the joints on both sides of the fracture, and, if possible, be as wide as the thickness of the limb to which it is applied. Splints should be well padded with some soft material on the inner side and at the ends that come in contact with the body. Clothing sometimes, when not removed from the injured part, answers this purpose.

NEED OF CAREFUL BANDAGING.

Bandage firmly, but never tightly. A tight bandage may cut off the blood supply and thereby cause death of the parts. In bandaging an arm or leg leave the tips of the fingers or toes uncovered so that they may be seen. Always place the part to be bandaged in the position in which it is to be left. Remember that swelling usually follows an injury, and that a tight bandage may cause death of the part. On the other hand, do not make a bandage too loose, as it may slip and expose the wound. If the patient complains that the bandage is too tight, loosen it and make it comfortable, but snug. Never apply a wet bandage, as when it dries it expands and becomes too loose.

REEF KNOT.

Tie a single knot. Take the end held in the right hand, turn it, and allow it to lie parallel to the bandage. Then take the end

held in the left hand and cross it over, around, and under the end that has been turned back; then put it through the loop formed by the two loose ends, and tie.

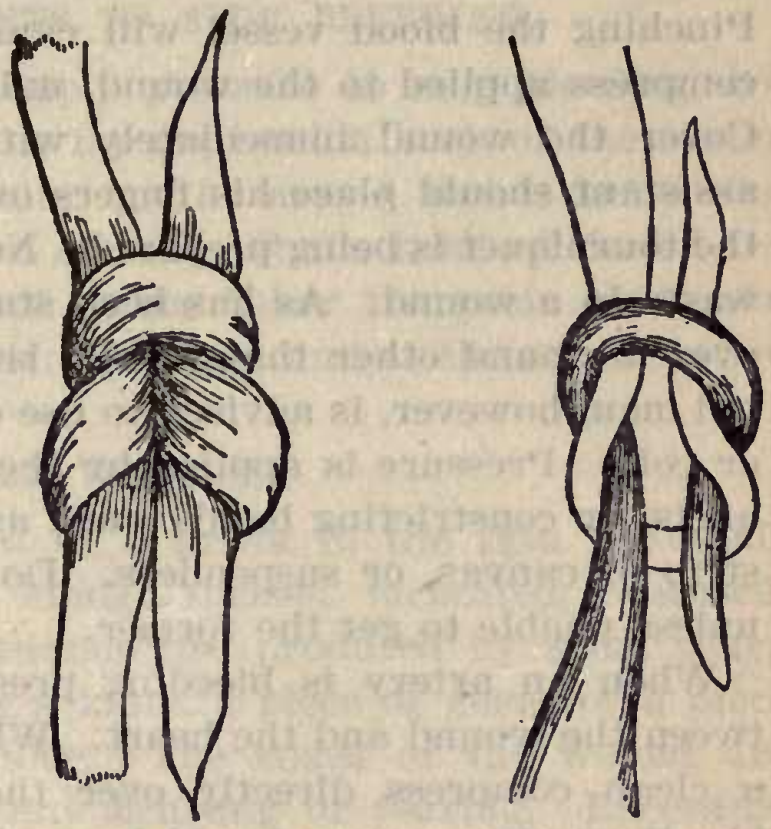

FIGURE 10.—Reef knot, tightened and loosened.

HEMORRHAGE OR BLEEDING.

Hemorrhage or bleeding is a flow of blood from an artery, vein, or capillary. When bright red blood spurts from a wound an artery has been cut. If the blood is red and oozes, it is from capillaries. When dark red blood is flowing in a steady stream it is from a vein. When the blood is just oozing there is no cause for hurry or alarm, but if it is spurting or flowing steadily check it as quickly as possible, for the patient may soon be beyond aid by reason of the loss of blood.

While the blood is flowing through the body it is fluid, but as soon as a blood vessel is severed nature provides a safeguard by which the blood thickens or clots and tends to stop flowing. If this did not occur, the slightest scratch would result in the loss of all the blood in the body. The blood of some persons will not clot. They are called "bleeders," and frequently bleed

to death from a slight injury. A spouting stream of blood will not clot. This is one reason why arterial bleeding is so dangerous. In order to clot, the blood must be comparatively at rest. Pinching the blood vessel will cause a clot to form, as will a compress applied to the wound, unless there is severe bleeding. Cover the wound immediately with a bandage compress; an assistant should place his fingers over the pressure point while the tourniquet is being prepared. Never use cobwebs, tobacco, or waste in a wound. As has been stated, never put any material over a wound other than sterile bandage compress. The first-aid man, however, is advised to use only pressure, position, heat, or cold. Pressure is applied by the fingers, compresses, tourniquets, or constricting bands, such as a handkerchief, belt strap, strip of canvas, or suspenders. Do not use wire, rope, or cord unless unable to get the former.

When an artery is bleeding pressure should be applied between the wound and the heart. When capillaries are cut apply a clean compress directly over the injury. When a vein is bleeding compression should be made on the side of the wound away from the heart. Usually bleeding from a vein can be checked by applying a large bandage compress directly over the bleeding place. Elevation of the bleeding parts always aids in controlling the hemorrhage. Place the person in such a position that he will be least affected by loss of blood. Lay him down with his head lowered (unless there is severe bleeding from the head), so the brain will get as much blood as possible. He should be kept at rest, as violent movements of the body may dislodge the clot. Give him plenty of fresh air, and give him water slowly if he is conscious. Warm him, but give him no stimulants while he is bleeding, as they increase the

force of the heart. Avoid their use as much as possible until bleeding has been checked.

PRESSURE POINTS TO STOP BLEEDING.

The points at which to apply pressure to stop bleeding are as follows: At the temple, at the depression back of the center of the collar bone, at a point on the arm 4 inches below the armpit along the inner seam of coat; at the bend of the elbow, at the wrist, at the thigh, 4 inches below the groin along the inner seam of trousers; under the knee, and at the ankle. (See fig. 5.)

OPEN WOUNDS.

A wound may be defined as a break in the skin. Wounds may be divided into four kinds: Incised, lacerated, contused, and punctured. Incised wounds are produced by some sharp cutting instrument, such as a knife, a piece of glass, or a piece of sharp coal, slate, or stone. The edges of the wound are smoothly divided without any bruising or tearing. Lacerated wounds present ragged edges and are the result of tearing the skin and tissues by blunt instruments or machinery. Contused wounds are those in which the skin is not divided, but is severely bruised. Such wounds are caused by heavy blunt instruments. Punctured wounds are produced by pointed instruments, such as needles, splinters, nails, or pieces of wire. They are usually small in size, but may be very deep.

The chief duty of a first-aid man in treating a wound is to prevent germs from getting into it. If pus germs do not enter there will be no inflammation and the parts will heal quickly, but should such germs get in blood poisoning is apt to follow. Rip or cut the clothing so that the injury may be seen. Do not

touch the wound with your hand, clothing, or any instrument, and do not pour water or any drugs into it. Place a bandage compress over the part and tie it in place. If there is severe bleeding always check it first by the use of a tourniquet. Considerable shock sometimes follows wounds, especially when much blood is lost. Do not forget about the danger of leaving on a tourniquet too long. (See p. 41.)

PRECAUTIONS AGAINST INFECTION OF WOUNDS.

Germs, which are minute in size and can not be seen by the naked eye, often get into wounds and cause infection. They are found everywhere—in the air, on the clothing, on the surface of our bodies, on our hands and fingers, in our mouths, in dust, in water, and on all kinds of instruments not boiled, etc. These germs may irritate the tissues and destroy them, or they may get into the circulation and cause blood poisoning. To prevent infection, keep your hands, clothing, and instruments away from the wound. Cover it with a bandage compress, and leave the work of cleaning the wound to the doctor.

INTERNAL HEMORRHAGE.

Internal hemorrhage may result from a deep wound that cuts large blood vessels of one or more of the internal organs or from bursting internal vessels. In internal hemorrhage the bleeding may not be seen, but you may be able to determine the condition of the person by the symptoms.

Symptoms of internal bleeding are faintness, cold skin, pale face, dilated pupils, thirst, feeble and irregular breathing, clouded vision, sighing, weak pulse, dizziness, and later loss of consciousness. The severity of the symptoms depends on how much and how rapidly the blood is lost.

Treatment.—Lay the patient down, with his head lower than his body. Apply ice or cold cloths to the body at the point from which you think the bleeding comes.

Do not give stimulants unless absolutely necessary, but you may give ice water or cold water slowly if the patient is conscious. Always get him to the doctor as quickly as possible.

DRESSINGS FOR WOUNDS AND BLEEDING.

WOUND AND BLEEDING OF SCALP.

A wound of the scalp may be treated by placing a bandage compress over the injury carrying the ends under the chin and up over the compress, and tying. Then apply a triangular bandage to the head, having the base fit over the forehead snugly just over the eyebrows. Bring the two ends of the bandage around the head just above the ears and cross under the bony prominence on the back of the head, then return the ends to the middle of the forehead and tie just above the eyebrows. The apex should be folded at the back of the head and tucked under. (See fig. 11.)

FIGURE 11.—Bandage for top of head for bleeding, wound, or fractured skull.

WOUND AND BLEEDING OF TEMPLE.

Place the middle of a bandage compress over the temple; carry one end under the chin and the other end over the top of the head; cross the ends above the ear on the opposite side;

carry one end over the forehead and the other end back of the head, and tie over the compress. Cover the compress with a cravat bandage applied in the same way. (See fig. 12.)

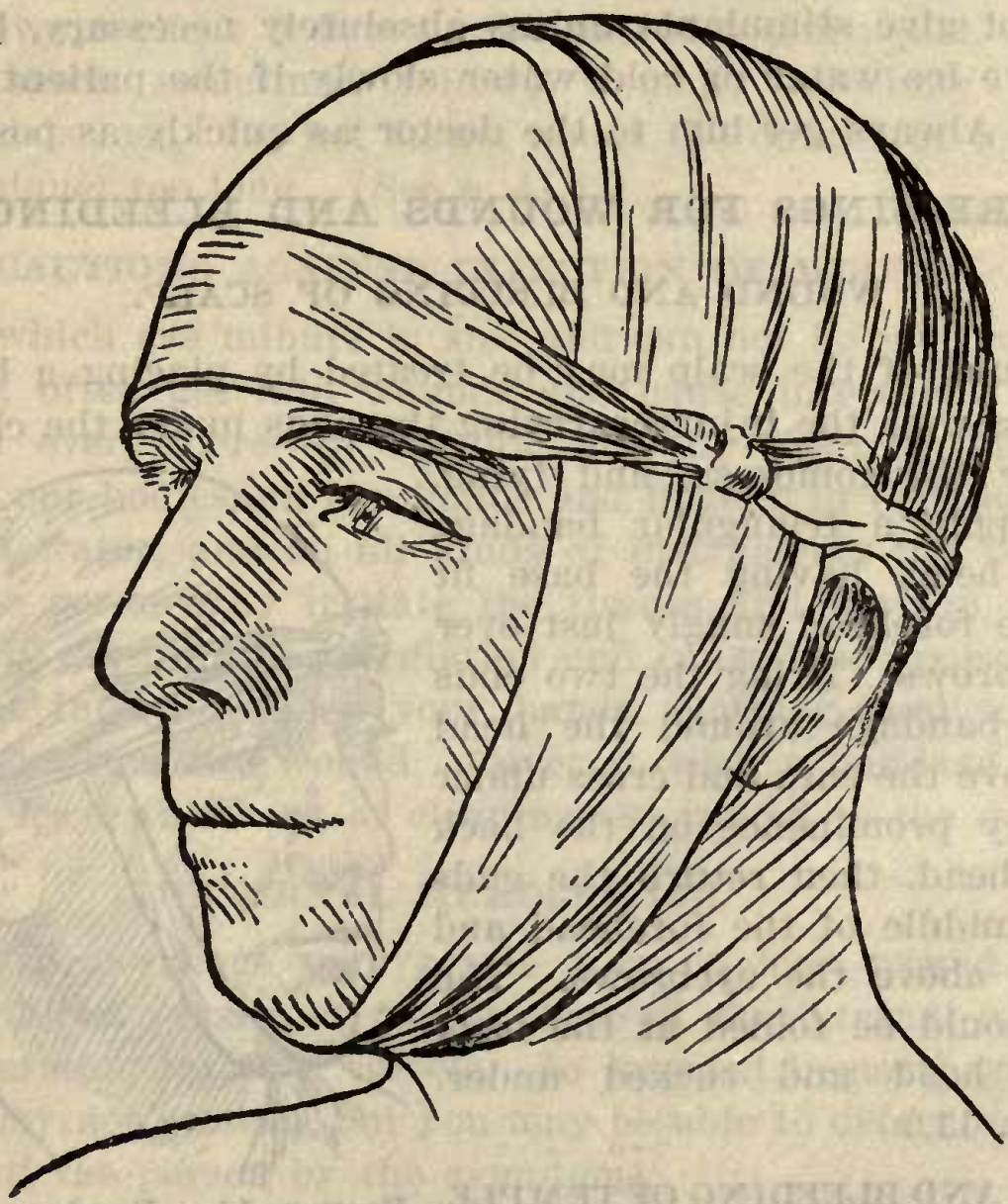

FIGURE 12.—Dressing for wound of temple.

WOUND AND BLEEDING OF FOREHEAD.

A wound of the forehead may be treated by applying a bandage compress over the injury and holding it in place by means

of a cravat bandage 3 or 4 inches wide. Pass the ends of the bandage compress around the head, crossing them behind under the bony prominence, bringing them forward, and tying them in front over the wound. Apply the cravat bandage in a similar manner. (See fig. 13.)

FIGURE 13.—Dressing for bleeding and wound of forehead.

WOUND AND BLEEDING OF EYE.

Foreign bodies, such as particles of dirt, sand, cinders, coal, emery dust, or fine pieces of metal, are frequently blown into the eye and lodge there. They not only cause a feeling of discomfort, but if not removed set up an inflammation that is painful as well as dangerous. Fortunately nature through an increased flow of tears dislodges most of these substances before any harm is done. In no case should the eye be rubbed, as such a procedure is apt to drive any foreign particles deeper into the tissues, so that later their removal is difficult. If the foreign body lodges under the upper lid, it may sometimes be removed by drawing the upper lid down over the lower lid, and as the upper lid returns to its nor-

mal position on being released its under surface will be drawn over the lashes of the lower lid and any particles will be dislodged.

Another method is to grasp the eyelashes between the thumb and forefinger of one hand and turn the lid up over the tip of the finger or over a match or a pencil, thus exposing its under surface, from which any particle may be carefully removed by means of a corner of a handkerchief or a camel's-hair brush.

FIGURE 14.—Dressing for wound and bleeding of eye.

Particles lodged under the lower lid may be removed in the same manner by simply pulling down the lower lid and exposing the inner surface.

Should a foreign body become lodged on the eyeball, place a bandage compress over the eye and hold the compress in place with a cravat bandage and send the person to a doctor at once. For all injuries to the eye a bandage compress and a cravat bandage should be used, as follows: Place a bandage compress over the eye, carrying the ends to the back of the head and

tying; hold it there by a cravat bandage 3 inches wide, applied as follows: Place the middle of the bandage over the injured eye, passing the end on the injured side below the ear to the back of the head and passing the other end above the ear on the opposite side and tie in a single knot below the bony prominence on the back of the head. Bring both ends over the top of the head, passing the longer end under the bandage, raising it above the uninjured eye and then tying it to the other end. (See fig. 14.)

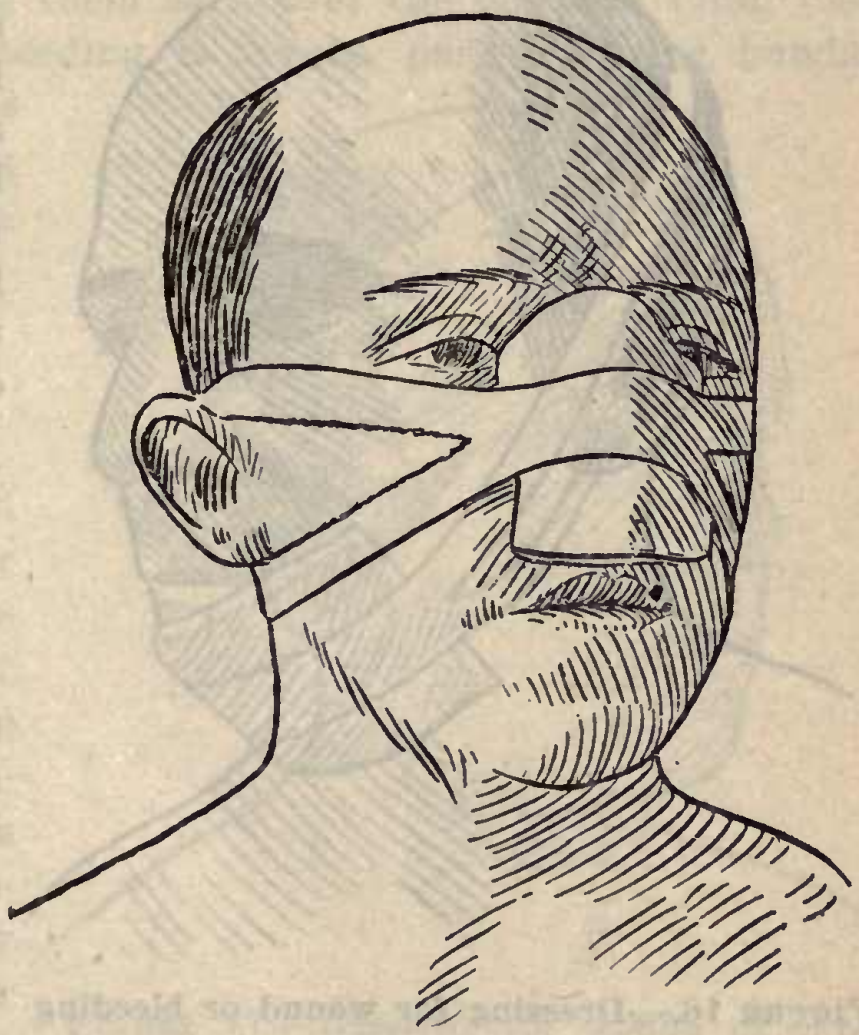

FIGURE 15.—Dressing for wound or fracture of nose.

WOUND AND BLEEDING OF NOSE.

For a wound of the nose split the tails of a bandage compress. Then apply the pad of the compress to the wound, passing the ends of the bandage above and below the ears on each side and tying them back of the head.

Usually nose bleeding is of small consequence, but it may endanger life. The person should be in a sitting position, with the head thrown slightly back. Apply ice or cold water to back of head, bridge of nose, and forehead. Have him avoid blowing of the nose for several hours. If these measures fail call a physician. (See fig. 15.)

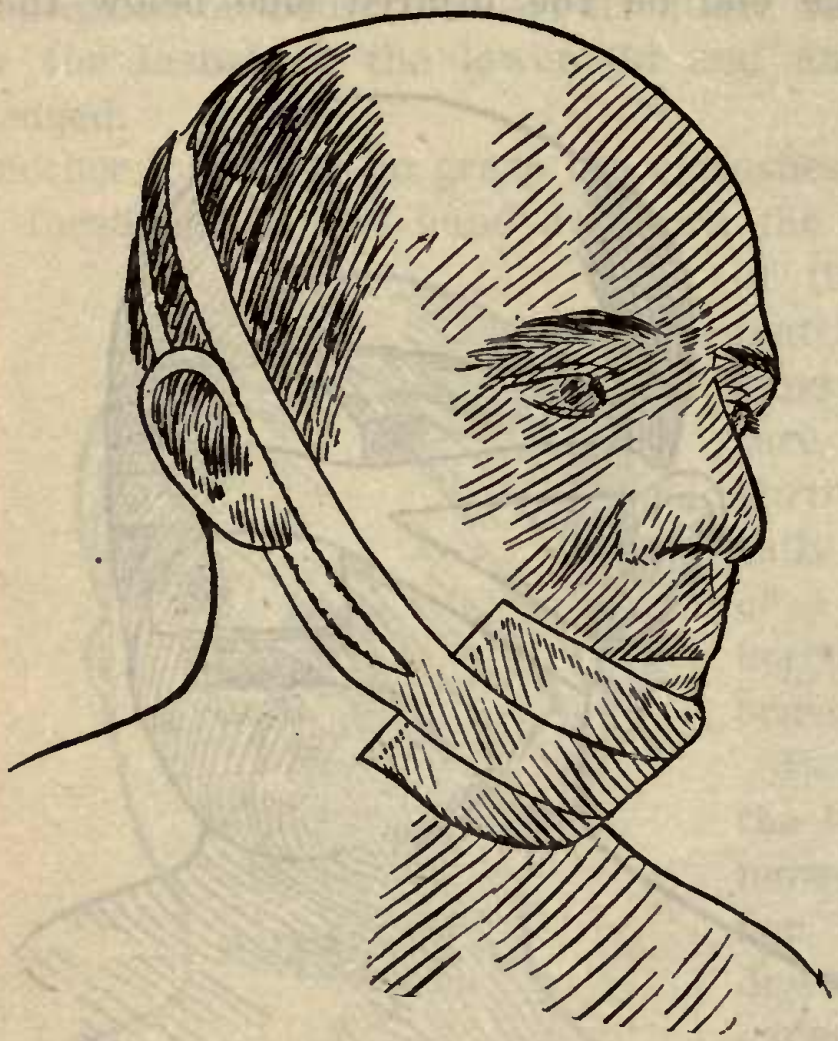

FIGURE 16.—Dressing for wound or bleeding of chin or face.

WOUND AND BLEEDING OF FACE OR CHIN.

Split the tails of a bandage compress and apply the compress to the wound, passing the ends above and below the ears on each side, and tying them back of the head. (See fig. 16.)

WOUND AND BLEEDING OF NECK OR THROAT.

If bleeding of neck or throat is severe, it may be checked by pressure of the fingers wrapped with gauze or clean cloth and placed directly in the wound. Later cover with a bandage compress, tying it loosely.

WOUND AND BLEEDING OF EAR.

Apply the pad of a bandage compress behind and over the ear, passing the ends around the head, crossing them above the opposite ear, bringing them back over the pad and tying them. (See fig. 17.) If bleeding is severe, pass a cravat bandage around the head as directed for dressing bleeding from temple. (See fig. 12.)

FIGURE 17.—Dressing for wound of ear.

WOUND AND BLEEDING OF SHOULDER.

For bleeding and wound of shoulder place a bandage compress directly over the wound, bring the ends under the armpit, and cross and tie them under the opposite armpit. Cover with a triangular bandage, along the base of which a hem has been folded, as follows: Place apex high up on shoulder, place the base below the shoulder on the upper part of the arm, and carry the ends around the arm and tie them on the outside. To hold the apex in place take a cravat bandage, and place its center over the apex of the triangular bandage, and carry the ends to the opposite

armpit and tie them. Tuck the apex over bandage. (See fig. 18.) The forearm should be placed in a sling made of a cravat bandage (sling not shown in the figure).

FIGURE 18.—Dressing for wound and bleeding of shoulder.

WOUND AND BLEEDING OF ARMPIT.

Apply bandage compress over wound, crossing the ends over shoulder and tying under opposite arm. If the hemorrhage is severe, over the compress place some hard material, about the size of an egg, such as a piece of coal, stone, or wood, covered with cloth, and push it well up into the armpit, holding it in place by a cravat bandage, the center of which is placed over the hard material, the ends being brought over the shoulder and tied in a single knot. Then pass the ends around and tie them under the opposite armpit. Then bring the arm down and secure it firmly to the chest wall by a cravat bandage passed around the arm and chest and tied securely on the opposite side. Place forearm in sling. (See fig. 19.)

ARM TORN FROM BODY.

When an arm has been torn from the body at the socket there is profuse bleeding from the larger blood vessels which are

torn; therefore treatment should be prompt. Cover your hand thoroughly with gauze, if it is available, and pass the hand right up into the wound and pinch the blood vessels. Then pack the wound with gauze and bandage firmly. However, if there is no gauze at hand, do not wait, but place your fingers in the wound and pinch the blood vessels. While doing this have an assistant prepare gauze, and when ready let go of vessels, push the gauze firmly into the wound, and bandage. Place a bandage compress over the seat of the injury, passing the ends around the chest and back and tying securely under the opposite arm. Then apply a cravat bandage about 6 inches wide over this bandage compress, the ends crossing the chest and back, and tie under the arm on the opposite side.

FIGURE 19. — Dressing for wound of armpit.

WOUND AND BLEEDING OF ARM.

Apply the pad of a bandage compress over the wound, passing the ends around the arm and tying them over the pad. Cover this with a cravat bandage of sufficient width to cover the wound, pass the extremities around the arm, and tie them on the outer side of the arm. For severe bleeding from any part of the arm, except the wrist, press the artery on the inner side of the arm against the bone at a point just behind the

inner border of the large muscle of the arm that corresponds to the seam of the coat sleeve, apply a tourniquet, not forgetting to use the pad, and cover the wound with a bandage compress. (See fig. 20.) Place the forearm across the chest and hold it in place with a triangular bandage.

FIGURE 20.—Dressings for wounds of arm and forearm.

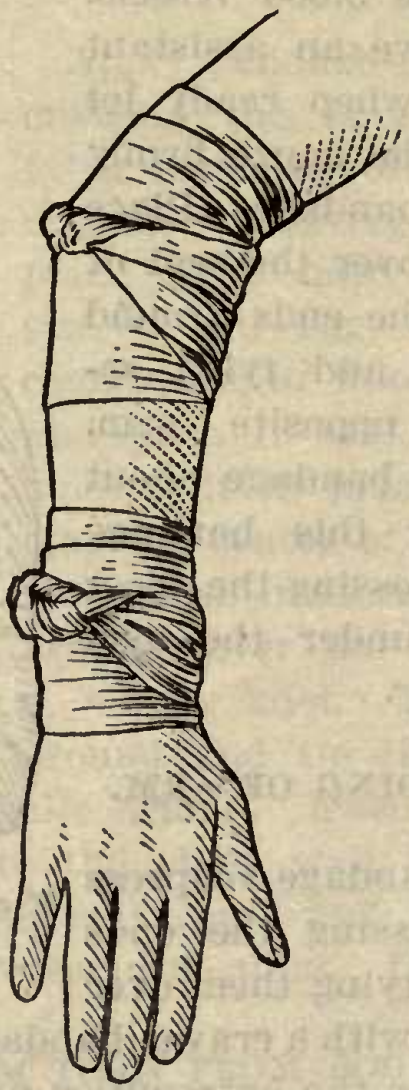

FIGURE 21.—Dressings for wounds of elbow and wrist.

WOUND AND BLEEDING OF ELBOW.

Place a bandage compress over the wound and tie it in place. Cover with cravat bandage of the desired width, as follows: Place the center over the point of the elbow, pass ends around and cross them at the bend of the elbow, crossing them again above the point of the elbow, carrying them around the arm and tying them at the outer side below the point of the elbow. (See fig. 21.)

WOUND AND BLEEDING OF FOREARM OR WRIST.

Place a bandage compress over the wound and tie it firmly in place. Then apply a cravat bandage of proper width, as follows: Place the center of the cravat over the pad, carry both ends around the forearm, bringing them around the second time and tying them on the outer side over the wound. If this dressing does not control the bleeding, put some hard material about the size of a small egg well wrapped in gauze or cloth in the bend of the elbow and bend the forearm tightly against it, bandaging in this position by placing the middle of a cravat bandage on the outer side of the arm, passing twice around arm and forearm, between elbow and wrist, near the latter, and tying on the outside, or apply tourniquet as for bleeding of arm.

If there is bleeding at the wrist, place a bandage compress directly over the wound and tie. Then pass a cravat bandage several times around the wrist, tying the ends securely over the seat of the injury. If this does not control the bleeding, apply dressing directed for bleeding of arm or forearm. (See figs. 20 and 21.)

WOUND AND BLEEDING OF BACK OF HAND.

Apply a bandage compress over the wound and tie it firmly in place. Cover with a triangular bandage, as follows: Place the base on the inner side of the wrist, bringing the apex down over the palm of the hand; returning it around the tips of the fingers, over the back of the hand to a point above the wrist; cross the ends one on either side of the wrist and bring them to the forearm and tie them on the back of the wrist; bring the apex down over the knot and tuck it under. For severe

bleeding from the hand alone, first cover the wound with a bandage compress. Pressure should then be made on the vessels at the wrist in the following manner: Tie two knots in the middle of a cravat bandage about a quarter of an inch apart and place them over the vessels on the palm side of the wrist, the bandage passing around the wrist several times; then tie the ends securely over the knots. Use a triangular sling to hold the forearm across the chest. (See fig. 22.)

FIGURE 22.—Dressing for wound of back of hand.

WOUND AND BLEEDING OF PALM OF HAND.

Place a bandage compress over the wound and tie it firmly in place. Cover with a cravat bandage, as follows: Place the around the wrist and across the palm, bring- one end between the thumb and the fore- finger and the other end around the little- finger side of the hand, and cross the ends at the back of the hand; bring the ends around the wrist and across the palm, bring- ing one end between the thumb and the forefinger and the other on the little-finger side, crossing the ends on the back of the hand and passing them around the wrist and tying them on the back of the wrist. (See fig. 23.) In severe bleeding from the palm of the hand, place a bandage compress over the wound and tie it securely. Then place a piece of coal or similar hard

object wrapped in gauze over the compress, and fold the patient's fingers over the object. Take the middle of a cravat about 2 inches wide and place over the patient's fingers, carrying the ends of

FIGURE 23. — Dressing for wound of palm of hand.

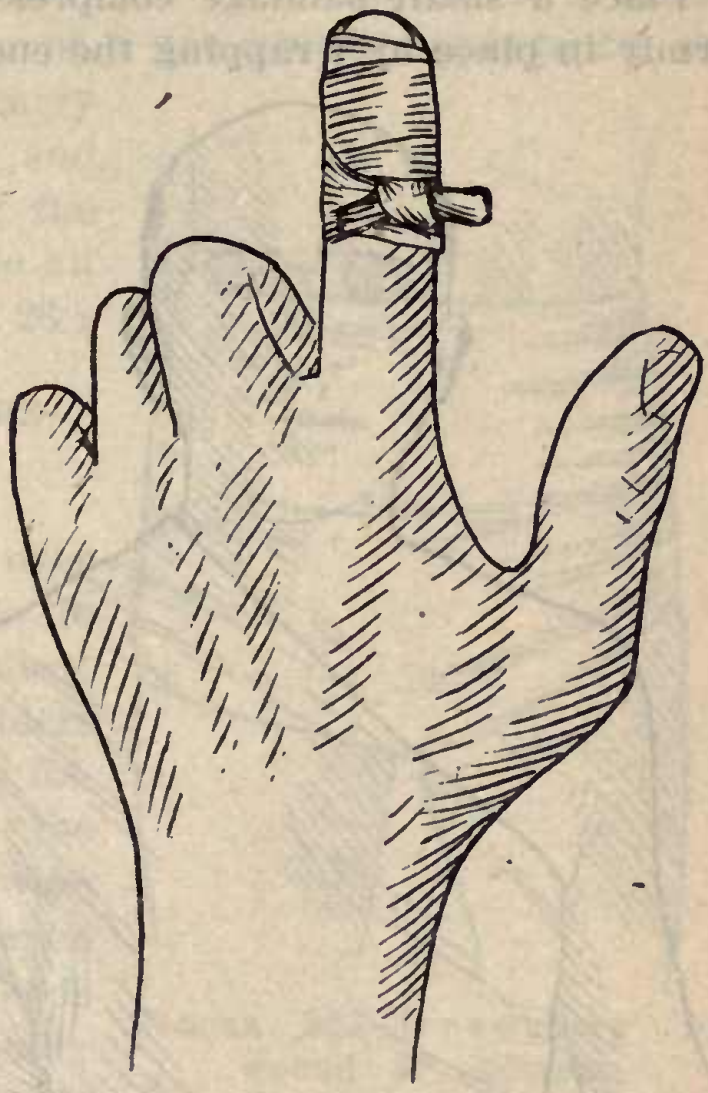

FIGURE 24.—Dressing for wound of finger.

the bandage to the back of the patient's hand, cross them and bring them over his fingers, cross them and bring them to back of hand, cross them again and bring them to wrist, and tie on back of wrist.

WOUND AND BLEEDING OF FINGER.

Place a small bandage compress over the wound and tie it firmly in place by wrapping the ends around the finger. Where a number of fingers are badly injured apply a small bandage compress to each finger as directed above, then apply open triangular bandage as directed for a wound of the hand. (See fig. 24.)

FIGURE 25.—Dressing for wound of side of chest.

WOUND AND BLEEDING OF SIDE OF CHEST.

Apply a bandage compress over the wound and tie firmly in place. Cover with triangular bandage as follows: Place the base diagonally across the chest, the upper end passing over the shoulder and down the back; tie the apex and lower end at center of back; tie the end coming over the shoulder also at this place. (See fig. 25.)

WOUND AND BLEEDING OF ABDOMEN.

Apply a bandage compress over the wound and tie it in place. Place the center of the base of a triangular bandage on the upper part of the abdomen, carry both ends around the body and tie them on the back, bring the apex between the legs, and tie all the ends at the back. (See fig. 26.)

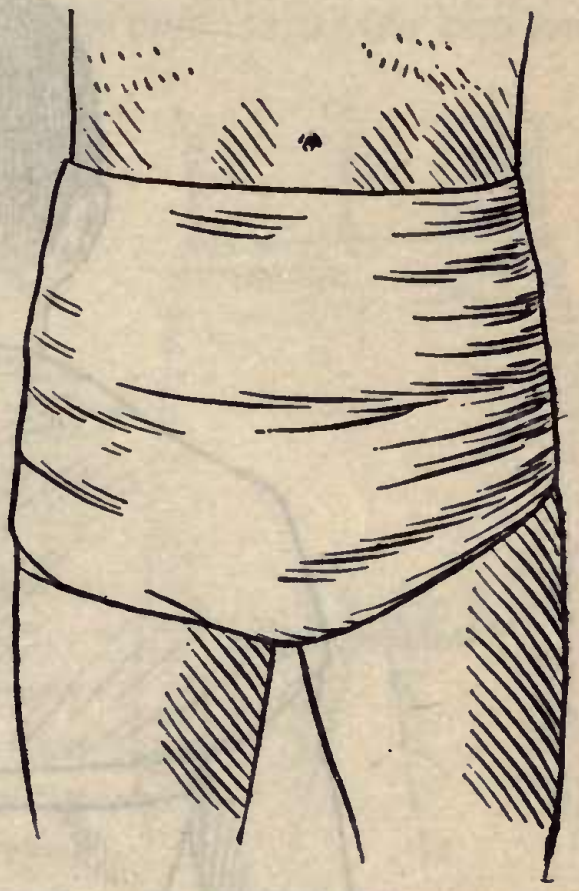

FIGURE 26.—Dressing for wound of abdomen.

WOUND AND BLEEDING BETWEEN SHOULDERS.

Apply a bandage compress over the wound and tie the ends to hold the compress firmly in place. Cover the compress and shoulders with a triangular bandage as follows: Place the center of the base back of the neck, allowing the apex to drop down between the shoulders; carry the ends over the shoulders and under the armpits and around the back, and tie a knot over the apex; turn apex up and tuck it under the knot. (See fig. 27.)

WOUND AND BLEEDING OF BACK.

For a wound of the upper part of the side of the back apply a bandage compress held in place by having the ends passed

around the body and tied. Cover this with a triangular bandage, the base of which is placed diagonally across the back, one end passing over the right shoulder. Bring the two lower ends

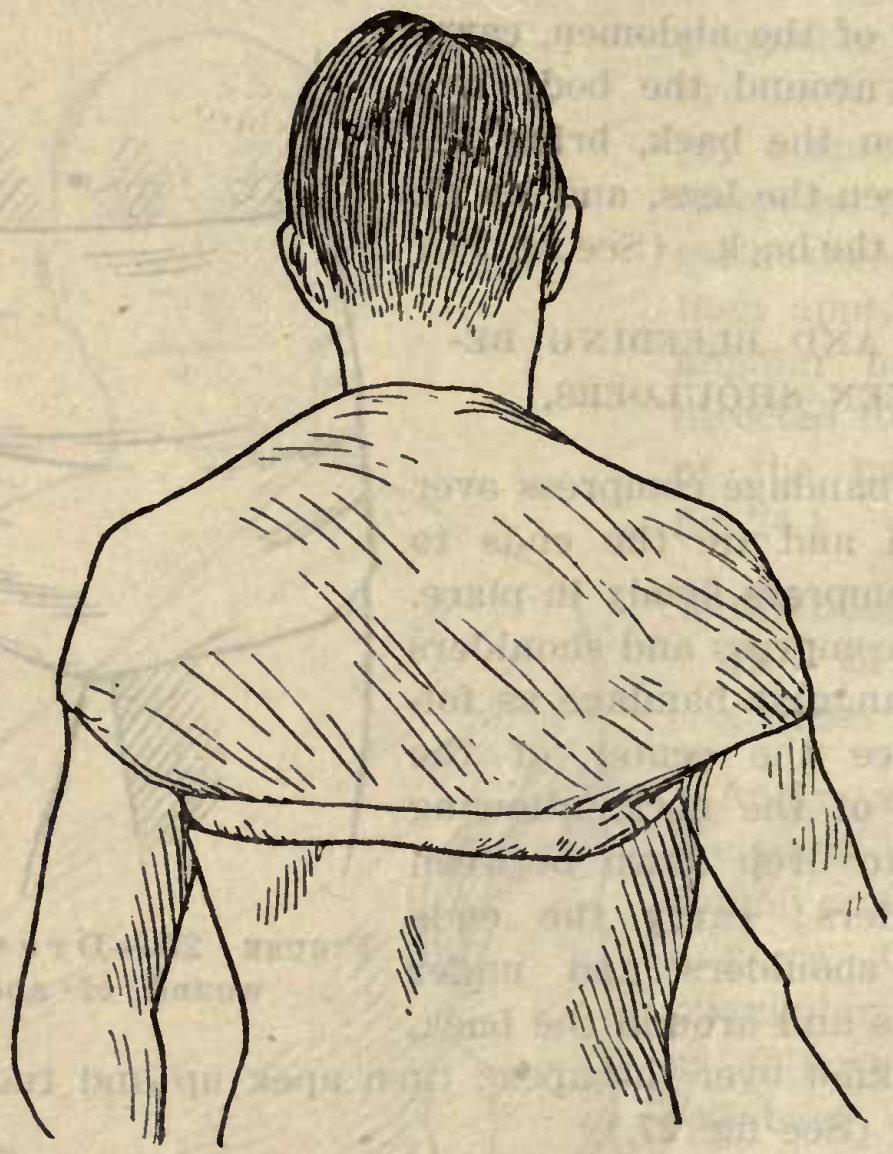

FIGURE 27.—Dressing for wound between shoulders. Reverse dressing for wound of center of chest.

together in front of the body and tie. Tie the end passing over the shoulder in the same place. Apply a similar bandage with the upper end passing over the left shoulder. (See fig. 54, p. 99.)

For a wound and bleeding of the lower part of the back or the buttocks apply a bandage compress over the wound, holding it in place by passing the ends around the body and tying them. Cover the compress with a triangular bandage, as follows: Place the center of the base in the middle of the back, tying the two long ends in a single knot in front, pull the apex forward through the crotch, and tie it to the ends in front. (See fig. 28.)

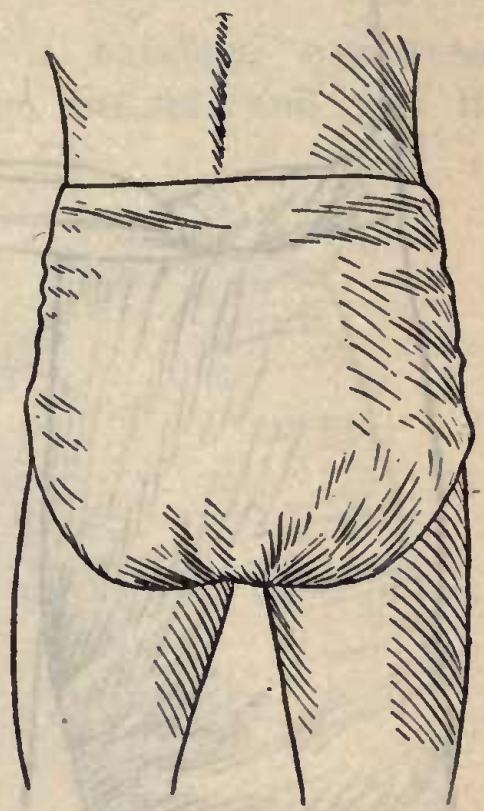

FIGURE 28.—Dressing for wound of lower part of back.

WOUND AND BLEEDING OF GROIN.

Place a bandage compress over the wound, carry the ends to the hip, cross them and carry them across to the opposite side of the body and tie them. Apply the middle of the base of a triangular bandage to the inner part of the thigh about 4 inches below the groin, with its apex toward the knee, and secure the bandage by tying the ends. The apex should be carried far up on the abdomen and held in position by a cravat bandage passed around the body and tied. The apex should then be tucked around the knot. (See fig. 29.) To control arterial bleeding at this point where the body joins with the extremities, tie the ends of two cravat bandages. Place the knot over a bandage compress placed over the wound. Carry one end to top of hip and other end between legs, cross ends at point of hip on injured side, carry them around the body and tie them in front.

WOUND AND BLEEDING OF HIP.

Place a bandage compress over the wound and tie it in place. Cover it with a triangular bandage, as follows: Place the base well up on the thigh with the apex pointing toward the armpit, bring the ends around the thigh, and tie. Pass a cravat bandage around the body and tie a knot over the apex, tucking the apex over the knot. (See fig. 30.)

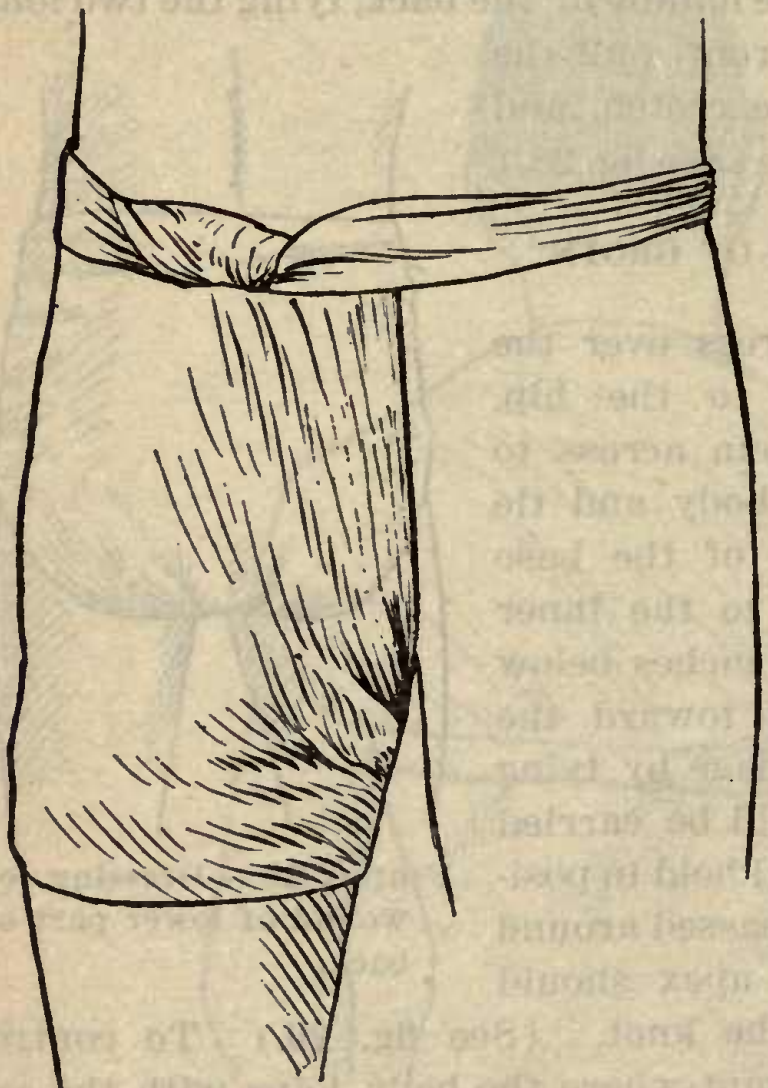

FIGURE 29.—Dressing for wound of groin.

WOUND AND BLEEDING OF THIGH.

Apply a bandage compress to the wound and tie it firmly in place. Cover the compress with a triangular bandage, the center of the base of which is placed over the thigh far up, the ends being passed around the thigh, crossed, and tied above the knee. Bring the apex up and tuck it over the knot. (See fig. 31.)

Severe bleeding from the thigh may be checked by making pressure with the fingers placed four finger breadths below the fold of the groin, at a point over which the inner seam of the trouser leg would pass. Then place roll or pad over the part and apply a

tourniquet. (See "Tourniquet," p. 40.) Now place a bandage compress over the wound and keep in place by a triangular bandage as described for wound of thigh.

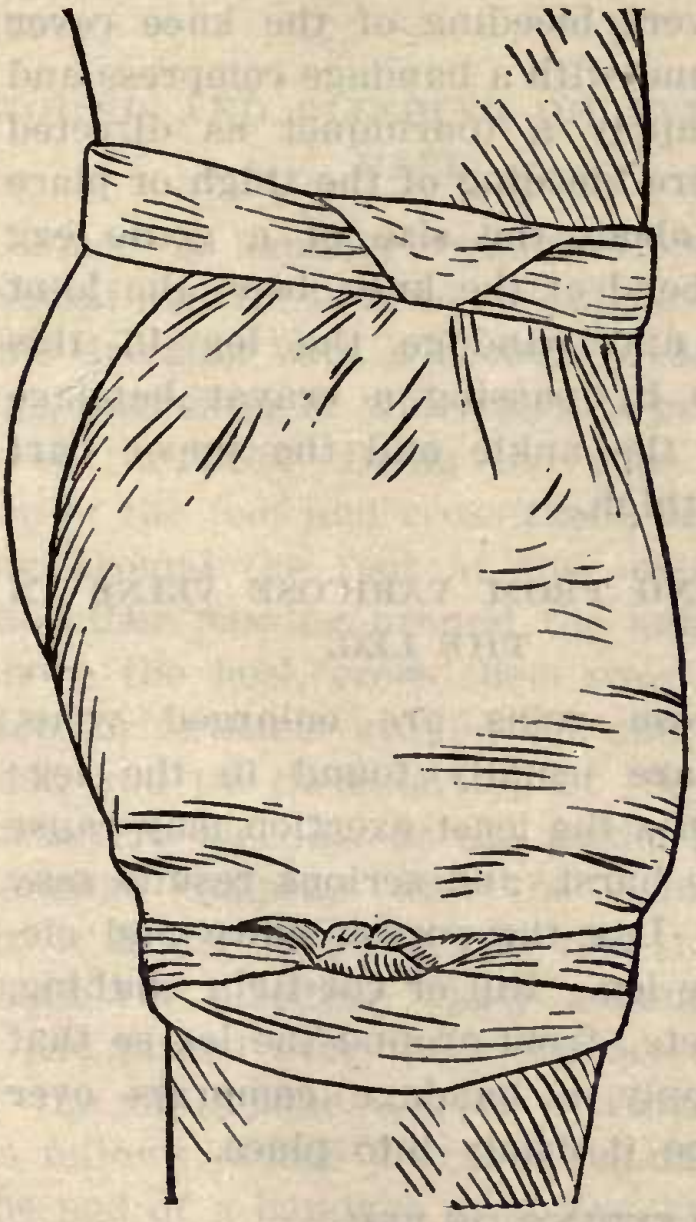

FIGURE 30.—Dressing for wound of hip.

WOUND AND BLEEDING OF KNEE.

Place a bandage compress over the wound and tie it

FIGURE 31.—Dressing for wound of thigh.

firmly in place. Fold a broad hem along the base of a triangular bandage for a covering and place the center below

the knee, the apex resting above the knee. Bring the ends of the bandage around either side of the leg, cross them at the back of the knee, pull them forward, and tie them above the knee. Pull the apex down and tuck it around the knot. (See fig. 32.)

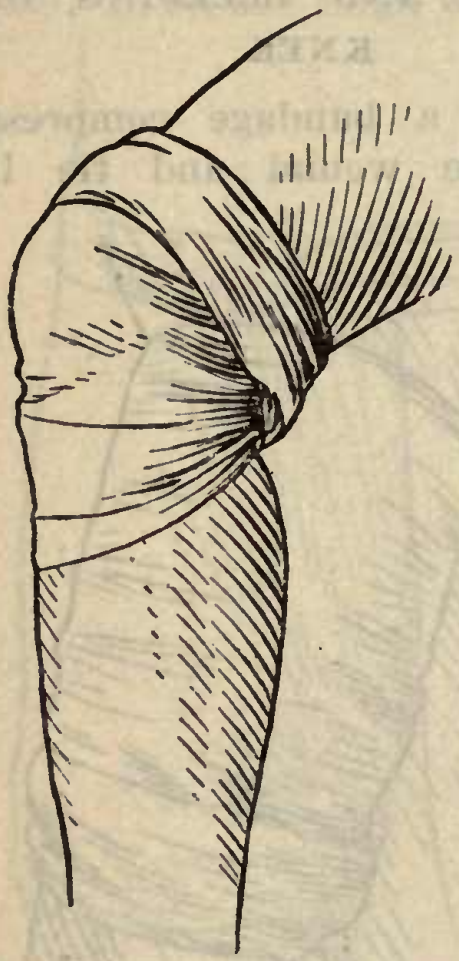

FIGURE 32.—Dressing for wound of knee.

For severe bleeding of the knee cover the wound with a bandage compress and either apply a tourniquet as directed for severe bleeding of the thigh or place a pad about the size of a goose egg in the bend of the knee, bend the joint on it, and bandage the leg in this position by passing a cravat bandage around the ankle and the upper part of the thigh.

BLEEDING FROM VARICOSE VEINS IN THE LEG.

Varicose veins are enlarged veins, which are usually found in the leg; oftentimes the least exertion may cause them to burst, and serious results may follow. Lay the person down and elevate the leg. Rip or cut tight clothing, bands, etc., from around the leg so that the injury may be seen. Apply a bandage compress over the bleeding point and bandage it firmly into place.

WOUND AND BLEEDING OF LEG.

Apply a bandage compress over the wound and hold it firmly in place by applying a cravat bandage over this dressing, placing the center over the compress. Then pass the ends

around the leg, one on each side, several times and tie on either side of the shin bone. (See fig. 33.) For severe bleeding of the leg, apply a tourniquet as directed for severe bleeding of the thigh, and cover wound as described above.

FIGURE 33. — Dressing for wound of leg.

WOUND AND BLEEDING OF ANKLE OR HEEL.

Place a bandage compress over the wound and tie it firmly in place. Cover this dressing with a broad cravat bandage, the center of which should be placed over the heel. Bring the ends to the top of the foot and cross them, one passing around the foot at the instep and the other passing around the ankle just above the heel, cross them over the instep, bring them around the sole of the foot, and tie them on top of the instep. In severe bleeding at the ankle, place a bandage compress over the wound and tie it firmly in place. If this does not check the bleeding, apply a tourniquet, making pressure on a pad placed over the blood vessel just behind the inner side of the ankle bone. Apply a cravat bandage over the compress, as follows: Place a cravat bandage about 3 inches wide over the pad of a bandage compress, bring the ends over the instep, cross them, and pass them around the foot, tying them on top of the foot. Care should be taken not to cover the tourniquet. (See fig. 34.)

WOUND AND BLEEDING OF FOOT.

Apply a bandage compress to the wound and tie it firmly in place. Cover this with an open triangular bandage in the following manner: Place the base of the triangle on the back of the ankle and bring the apex under the sole of the foot, over the toes, back over the instep and up the leg to a point above the ankle in front; then pass the ends around the ankle to the front and tie. Fold the apex around the knot. To check arterial bleeding place a pad about the size of a small egg on either side of the ankle below the ankle bones, holding it in position with a cravat bandage. (See fig. 35.)

FIGURE 34. — Dressing for wound of ankle or heel.

FIGURE 35.—Dressing for wound of foot or toe.

WOUND AND BLEEDING OF FOOT OR ANKLE.

Apply a bandage compress to the wound and place the center of a cravat bandage folded wide over the instep, cross the ends under the sole of the foot, and bring them up and across over the instep, passing them around the back of the

ankle and tying them in front. In case of severe bleeding check it as in bleeding from the foot. (See fig. 36.)

WOUND AND BLEEDING OF TOE.

Place a small bandage compress over the toe and tie it firmly in place. If several toes are injured, apply a small bandage compress to each toe and tie securely. Then apply a triangular bandage as follows: Place the base of the triangle on the back of the ankle and bring the apex under the sole of the foot, over the toes and the instep, and up the leg to a point above the ankle in front; then bring the ends around the ankle to the front and tie them. Fold the apex around the knot. For severe bleeding a compress firmly tied about the toe will check the flow of blood. (See fig. 35.)

FIGURE 36.—Dressing for wound of foot or ankle.

FOREIGN BODIES IN EAR.

Small insects, as ants, flies, or bugs, or pieces of coal, may gain access to the ear. Other bodies, as corn, peas, buttons, or small seeds are often introduced into the ears by children. Such substances as seeds absorb moisture and are thus dangerous as they swell up after entering the ear, making dislodgment difficult, and they often produce a painful inflammation.

The only instrument that should be employed by one unskilled in such work is the syringe. On no account should pins or pieces of wire be inserted into the ear to dislodge a foreign body. Insects may be killed by dropping a little sweet oil into the ear

and then may be removed by syringing the ear with warm water. To remove seeds, water should not be used, but some liquid like dilute alcohol, which will cause the seed body to shrink, should be employed. If the syringe fails, attempt nothing more, but obtain medical aid.

FOREIGN BODIES IN NOSE.

Foreign bodies rarely need remain long in the nose, as violent sneezing, induced by snuff or irritation of the opposite nostril, will generally dislodge them. Violent blowing of the nose with one nostril closed may dislodge a foreign body. Should the means mentioned fail, consult a doctor.

FOREIGN BODIES IN WINDPIPE OR THROAT.

Pins, coins, needles, fishbones, false teeth, and particles of food often become lodged in the windpipe or the throat. Although there is not, as a rule, a complete obstruction of the air passages, symptoms of suffocation more or less severe are present, the victim's face becomes livid, he gasps for breath, and he has violent fits of coughing.

Particles of food are frequently sucked into the windpipe by a sudden inspiration while eating; hence a person should be careful not to laugh while he has anything in his mouth.

In all cases an attempt should immediately be made to remove the obstruction. Frequently by simply passing a finger into the throat the body may be felt and easily removed. Substances deeper down can not be felt in this way, but may be dislodged by producing coughing or by slapping the person on the back. If this means fails, the patient should be inverted, or literally stood on his head, with the hope of dislodging the substance. If still

unsuccessful, send immediately for a physician. In the meantime, if there is danger of the person choking, perform artificial respiration.

FOREIGN BODIES IN STOMACH.

Children, adults, or insane persons sometimes swallow pins, coins, nails, etc. The article swallowed may be lodged in the tube leading to the stomach, producing difficulty in swallowing, but more often it passes on into the stomach and appears later in a passage of the bowels.

It is dangerous to attempt to dislodge the foreign body from the stomach by producing vomiting. Avoid also giving purgatives, as they cause an increased movement of the bowels, and in the case of a pin or sharp object a hole in the bowels may result.

The best plan is to consult a physician immediately.

BRUISES.

Bruises are the most common injuries and are due to a fall or a blow. When a person falls and strikes some part of the body, or is struck by something, often the skin is not broken, but the force of the blow or fall injures the tissues under the skin, breaking many of the small blood vessels. In deep bruises the outer skin is not damaged, but the skin over the bone is apt to show a black-and-blue spot. If a larger blood vessel is injured much blood gathers under the skin, causing great swelling and discoloration.

The symptoms are immediate pain from injury to the nerves, swelling, black-and-blue mark, and later pain from pressure of the blood on the nerves, which is increased by movement.

Little treatment is necessary. The aim should be to limit swelling and to decrease pain. Apply an ice bag or towels wrung out in cold water and rest the injured part as this diminishes the pain. Always make sure that there is no other injury, such as a broken bone or a dislocation. For a severe bruise it is best to call a physician.

STRAINS.

A strain means overstretching of the muscles. The most common strains are those of the back, shoulder, ankle, and wrist. A strain may be caused by a sudden wrench, as in lifting heavy weights. In severe strains small blood vessels may be broken so that blood escapes into the muscles.

The injured man should be made to rest for a time. Rub the parts gently with alcohol and water or witch hazel to deaden the pain. If the strain is severe the patient should consult a physician.

SPRAINS.

A sprain means an injury to a joint. It results from violent stretching, twisting, or partial breaking of ligaments about a joint, and is often mistaken for a fracture of the bones. Twisting of the foot or an unnatural movement of a joint may cause a sprain.

The injured joint should be elevated and placed at absolute rest, as often a sprain is accompanied by a fracture. Apply hot or cold towels over the injury several times. Place a cravat bandage firmly around the joint and send the injured man to the doctor.

DISLOCATIONS.

A dislocation is a slipping of a bone out of its socket. The ligaments are always torn, except where the patient has suffered many dislocations at the point of injury, in which case the ligaments are stretched and free from injury. The shoulder joint is the one most frequently dislocated, but the hip joint and the fingers are often dislocated. You can always tell a dislocation by comparing the injured with the uninjured side of the body, as a deformity will appear on the injured side, and you can usually feel the head of the bone. The limb in which the joint is located may be either longer or shorter than the uninjured limb. It is impossible to place the limb in its natural position. The injured person will suffer pain and sometimes there will be swelling and shock.

Do not attempt to reduce the dislocation unless it is a simple one, as of a finger or the lower jaw. In attempting reduction of other dislocations you might destroy blood vessels, ligaments, etc. Apply dressings or splints in the line of deformity.

DISLOCATION OF LOWER JAW.

A dislocated jaw is painful. The mouth is open and the jaw is rigid and can not be closed. To reduce this dislocation both thumbs must first be wrapped in several layers of cloth, so that they will not be liable to injury. Then place the thumbs in the injured person's mouth, resting them on his lower teeth well back on each side, while the fingers seize the lower jaw outside. Press first downward and then backward. As soon as the jaw starts into place the thumbs should be slipped off the teeth to the inside of the cheeks, so they will not be caught between the

teeth when the jaw springs into place. A cravat bandage should be placed over the front of the chin and tied at the back of the head, the ends being left long. Have the patient open his mouth and place a bandage compress, lead pencil, or like object between the teeth to prevent the next bandage from being placed too tightly. Take another cravat bandage, placing its center under the patient's chin, and bring the ends to the center of the top of the head and tie, leaving the ends long. Then tie the ends of both cravats. Now remove the wedging object from between the patient's teeth. (See fig. 37.) The patient should consult a doctor.

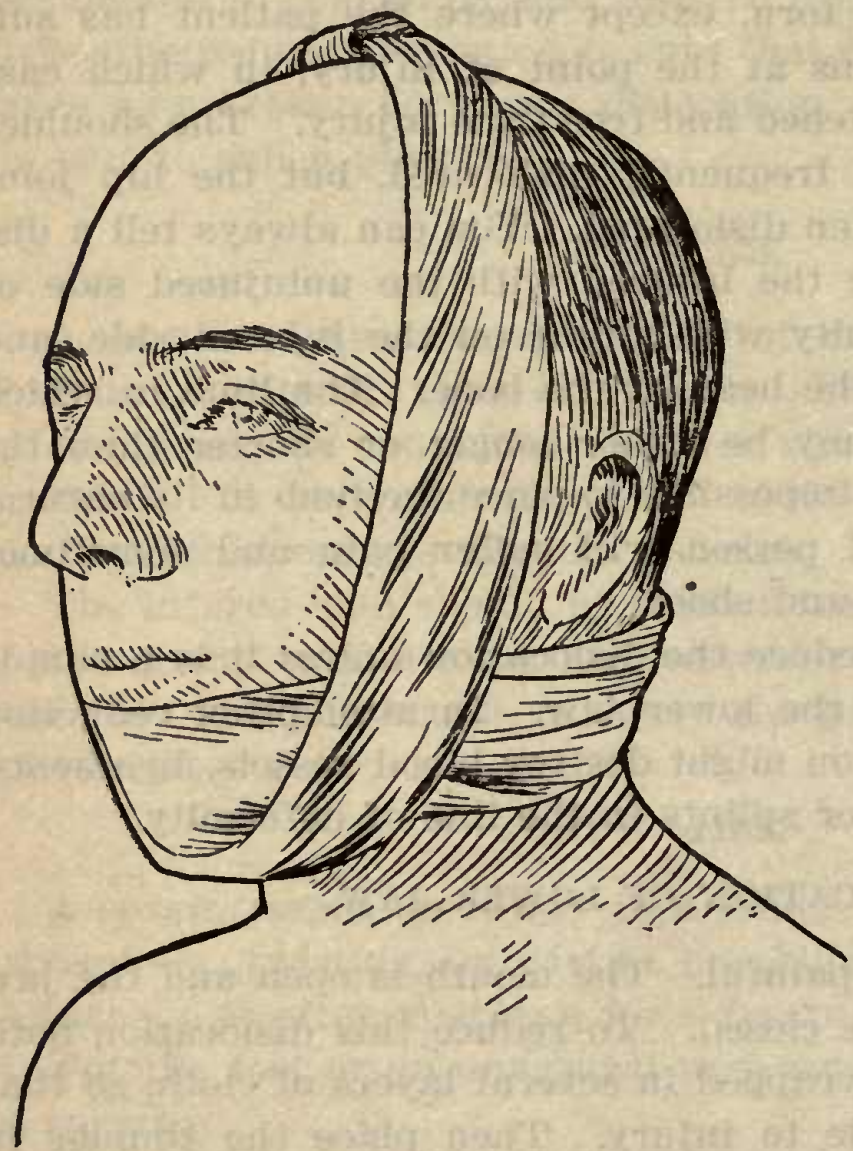

FIGURE 37.—Dressing for dislocation or fracture of lower jaw.

DISLOCATION OF SHOULDER.

The shoulder joint is dislocated more frequently than any other joint in the body. This injury may be produced by falls or blows on the shoulder or by falls on the hand or elbow.

With this dislocation the arm is held rigid, the elbow stands off a distance of 1 or 2 inches from the body, the shoulder appears flat, and there is a marked depression beneath the point of the shoulder. In addition, there is pain and swelling at the seat of the injury. By placing the fingers in the armpit the head of the bone may be felt in an abnormal position as compared to the uninjured side. The injured man will be unable to bring the elbow of the injured side in contact with the chest when the palm of the hand of the injured side is placed near the top of the opposite shoulder.

FIGURE 38.—Dressing for dislocation of shoulder.

Place the hand on the injured side on the opposite side of the chest and hold it in this position by means of a cravat sling tied around the neck. A large pad, made from a coat or jumper, should be placed under the arm, from the armpit to the elbow, so that the

elbow will be held away from the side of the body. The center of a cravat bandage is then applied just above the elbow and carried around the body; the end in front crosses the forearm and runs below the wrist and is tied on the opposite side. Another cravat bandage, the center of which is placed below the pad, is passed over the forearm and around the back and tied on the opposite shoulder. (See fig. 38.)

DISLOCATION OF ELBOW.

Dislocation occurs at the elbow joint as a result of a direct force or blow at the joint, also occasionally by a fall on the hand. It can usually be recognized by deformity at the joint, great pain, and inability to bend the limb at the joint. It should be treated as for fracture of the elbow (see p. 84).

DISLOCATION OF FINGER.

To treat a dislocated finger, grasp the hand, with the back upward, then pull the end of the finger straight out away from the hand and the bone will usually slip into place. No bandage is required. Do not attempt reduction if there is an open wound near the joint.

DISLOCATION OF KNEE OR KNEECAP.

Dislocation of the knee or the kneecap occurs as a result of direct force applied at the knee or from a fall on the knee. There are the usual signs of deformity, great pain, and inability to use the knee. It should be treated as for fracture of the kneecap, care being taken not to tie the cravats too tightly over the knee.

DISLOCATION OF HIP.

Dislocation of the hip is usually the result of a fall from a height onto the foot or knee, or may be caused by a direct blow, with the thigh at an angle with the spine. There are several varieties, described according to the direction the head of the thigh takes, but for all practical purposes they may be divided into forward and backward dislocations. A backward dislocation is by far the most common. In either kind of dislocation the limb is held rigid and the pain is marked. In a forward dislocation the thigh is somewhat flexed and held outward, the foot being also turned out. The limb may be either lengthened or shortened. In a backward dislocation the foot is turned inward and the thigh is drawn toward or across the opposite limb. Shortening of the limb is also marked.

Place the injured person on a board about 12 inches wide and 7 feet long or on a framework similar to that used in dressing a broken back. (See p. 89.) If there is no shock, support the patient's head on a pillow made of clothing. Make a large pad of clothing or blankets of sufficient size to support the limb in the line of deformity. Place a small pad between the feet. Pass a cravat bandage around the board and the upper part of the chest, on which a small pad should be placed. Then tie the ends of the bandage over the pad. Pass a second cravat bandage around the board and the body at the hips, tying the ends over a small pad in front. Pass a third bandage around the board and the thigh just above the knees and tie on the injured side near the board. Another bandage should be passed around the ankles and the board and tied near the board on the injured side. Take another cravat bandage, place the center over the insteps, cross

the ends under the soles of the feet, and bring them back to the insteps, tying loosely. (See fig. 39.)

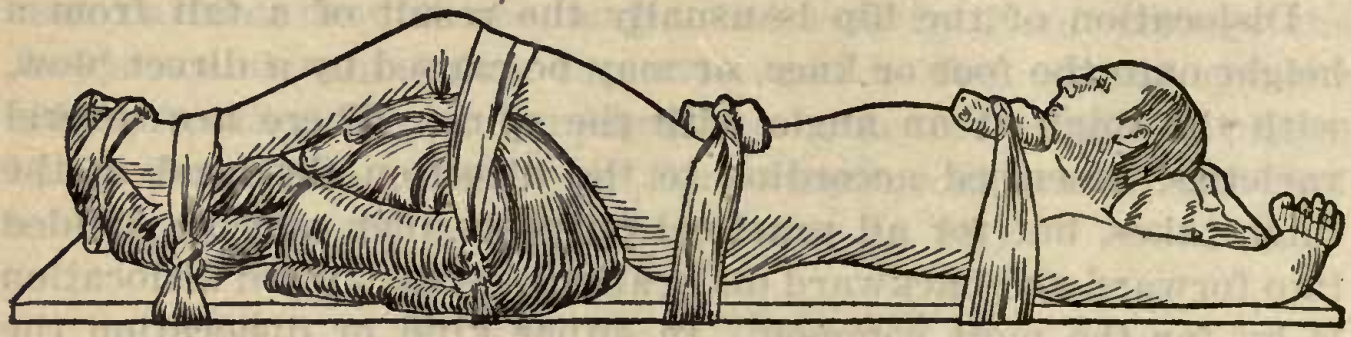

FIGURE 39.—Dressing for dislocation of hip.

FRACTURES.

Fracture means the breaking of a bone. For practical purposes in first-aid work only two kinds of fracture are handled—simple and compound. These fractures are further divided into greenstick, comminuted, impacted, transverse, and oblique, depending on the way in which the bone is broken. A simple fracture is one in which the bone is broken but does not break the skin. In a compound fracture there is a wound in the skin communicating with the bone. A simple fracture may be converted into a compound fracture by careless handling, as a broken bone usually has sharp, saw-tooth edges, and just a little twist may push it through the skin. A person handling a fracture must always bear this danger in mind.

You will recognize a fracture by the following signs: The person will complain of pain and tenderness at the point of fracture and may be unable to move the broken limb; in handling the limb a grating sensation may be felt, but do not twist a limb in order to produce this grating sound; also, the limb will be either shortened or bent as compared with a similar

part on the uninjured side. A person suffering from a fracture may be able to move his toes and fingers. Shock may be present to a greater or less degree, so treat accordingly. If the injured person is lying down, leave him where he is until you have made a thorough examination, and do your splinting, if possible, before he changes his position. In a simple fracture there is no chance for germs to get into the break, as there is no wound in the skin; but if there is an opening from the outside, there is an avenue of infection that is dangerous, so be careful not to convert a simple fracture into a compound one. If the fracture is a simple one, place the limb in a position as nearly natural as possible by taking hold of the lower part of the limb and pulling gently and steadily. At the same time an assistant should support the under part of the limb on either side of the break in order to steady the bone. If the bone is protruding, cover it with a bandage compress, but do not attempt to pull the limb, but place it in a position as nearly normal as possible before applying splints. These should be applied as for a simple fracture.

FRACTURE OF SKULL.

Fracture of the skull means a break in the bone or bones of the top, side, or back of the head. The injured person may or may not be unconscious. If the base of the skull is broken, blood and serum (a liquidlike water) may flow from the ears. Bleeding may be noticed in the eyes, nose, and mouth. Usually, if there is an open wound, you will find severe bleeding. Check the bleeding by placing a bandage compress over the wound and tying it firmly in place. Do not put much pressure on this wound, as it may force the broken bones into the brain; how-

ever, some pressure must be made. Fracture may be present and still no wound be in evidence. Apply a triangular bandage as described for treatment of wounds of the head. Do not give stimulants if the man is bleeding, but keep him warm. Rest his head by placing it on a folded blanket or coat. This should always be done in injuries to the head and in sunstroke. Shock is usually present. (See fig. 11.)

FRACTURE OF NOSE.

This fracture is usually not difficult to detect. It may be simple or compound. Symptoms: Pain, bleeding, swelling, and deformity.

Apply a bandage compress with the pad over the nose. Split the tails, passing the upper pair over the ears and tying them back of the head; pass the lower pair around below the ears and tie them on the back of the neck. This dressing should not be applied so tightly that it will cause too much pressure on the nose. Send the patient to the doctor at once. (See fig. 17.)

FRACTURE OF UPPER JAW OR CHEEK BONE.

In fractures of the upper jaw or the cheek bone, where there are open wounds, treat as for wounds of the face. (See p. 52.)

FRACTURE OF LOWER JAW.

In fracture of the lower jaw the mouth is usually open and the patient generally has difficulty in talking. Place the center of a cravat bandage over the chin and pass the ends around to the back of the neck and tie. Another cravat bandage, the center of which is placed under the chin, is taken to the top of

the head and tied, the ends of the upper and lower bandages being then tied together firmly. (See fig. 37.)

FRACTURE OF COLLAR BONE.

Take a cravat bandage about 4 inches wide, and place the center over a pad on the point of the shoulder; bring one end over the shoulder and one under the armpit to the center of the back. Apply a similar bandage over a pad on the opposite shoulder; draw all ends tight, pulling the shoulders well back and tie the ends in the center of the back. The forearm on the injured side is carried across the chest at right angles to the body and held in position by a sling made from an open triangular bandage. (See figs. 40 and 41.)

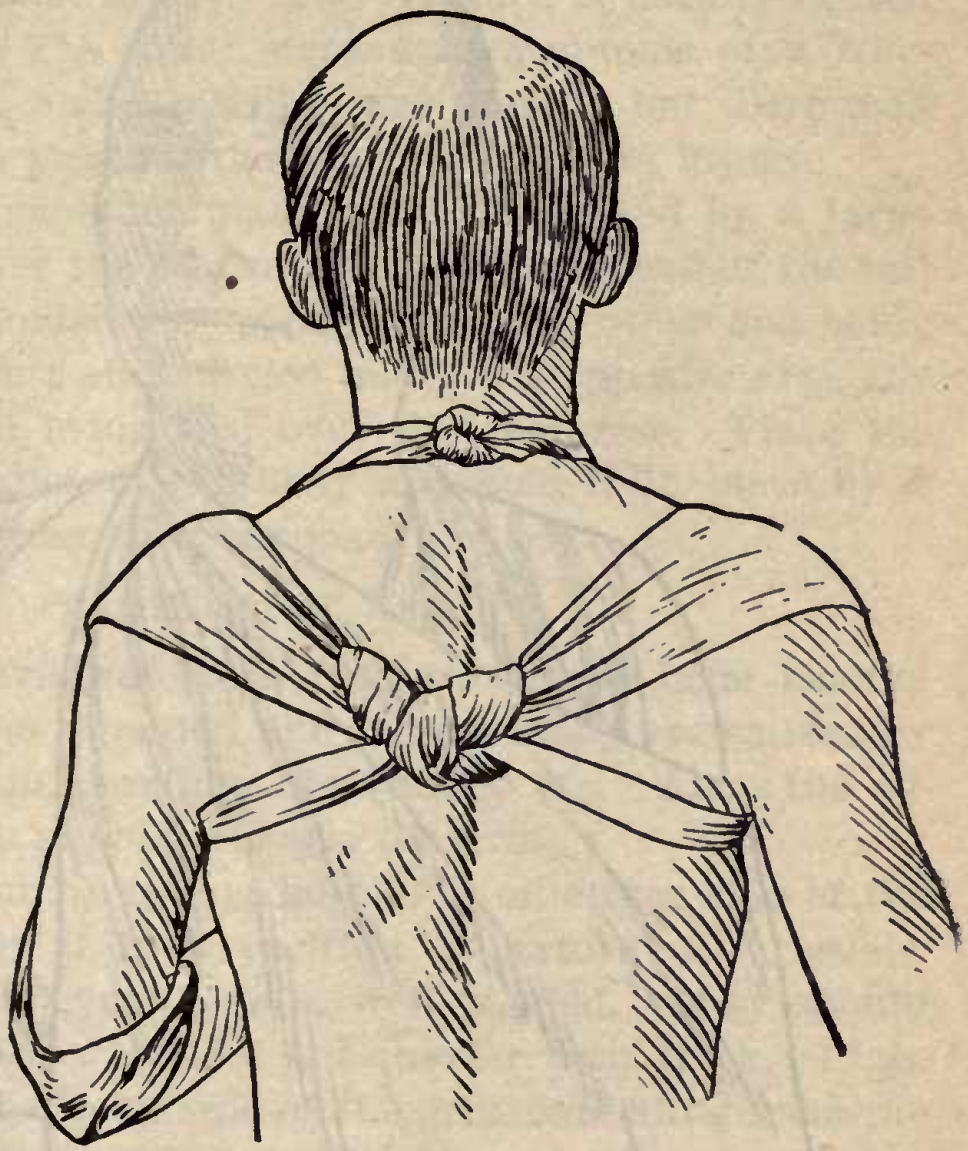

FIGURE 40.—Dressing for fracture of collar bone, back view.

FIGURE 41.—Dressing for fracture of collar bone, front view.

FRACTURE OF SHOULDER BLADE.

This is not a common injury. The fracture is usually caused by direct violence. The usual signs and symptoms of a fracture—pain, swelling, and disability—are present, but there may be some difficulty in locating the exact seat of the injury.

Fractures of the shoulder blade are best treated by a large bandage compress over the seat of the injury, one end of the tail being crossed back under the opposite arm, the other end being placed across the chest and carried under the opposite arm, the two ends of the tail being tied over the compress. Place the forearm at right angles to the body and hold it in place by a sling made from a triangular bandage.

FRACTURE OF ARM.

Fracture of the arm refers to fracture of the bone leading from the elbow to the shoulder, and can be easily recognized by the usual signs—pain, swelling, deformity, etc. Also, the injured person may be unable to move his arm.

Straighten the limb by taking hold of it on either side of the fracture and putting it in a position as natural as possible. Use two splints of unequal length, well padded. They should preferably be 4 inches wide and one-quarter inch thick. Place the shorter one on the inner side of the arm, extending from the armpit to the elbow; place the other and longer one on the outer side of the arm, extending from the point of the shoulder to the elbow. Pass one cravat bandage around the splints and the arm at the upper end and tie on the outside, and another at the lower end and tie on the outside. Then fold a triangular bandage into a cravat and use as an arm sling. If there is a compound fracture, first place a bandage compress

over the wound and tie it in place; then apply dressings as suggested. If a bone is protruding apply a bandage compress lightly so as not to force the bone into the tissues. If an artery is bleeding and the bandage compress does not check the hemorrhage, apply a tourniquet. (See fig. 42.)

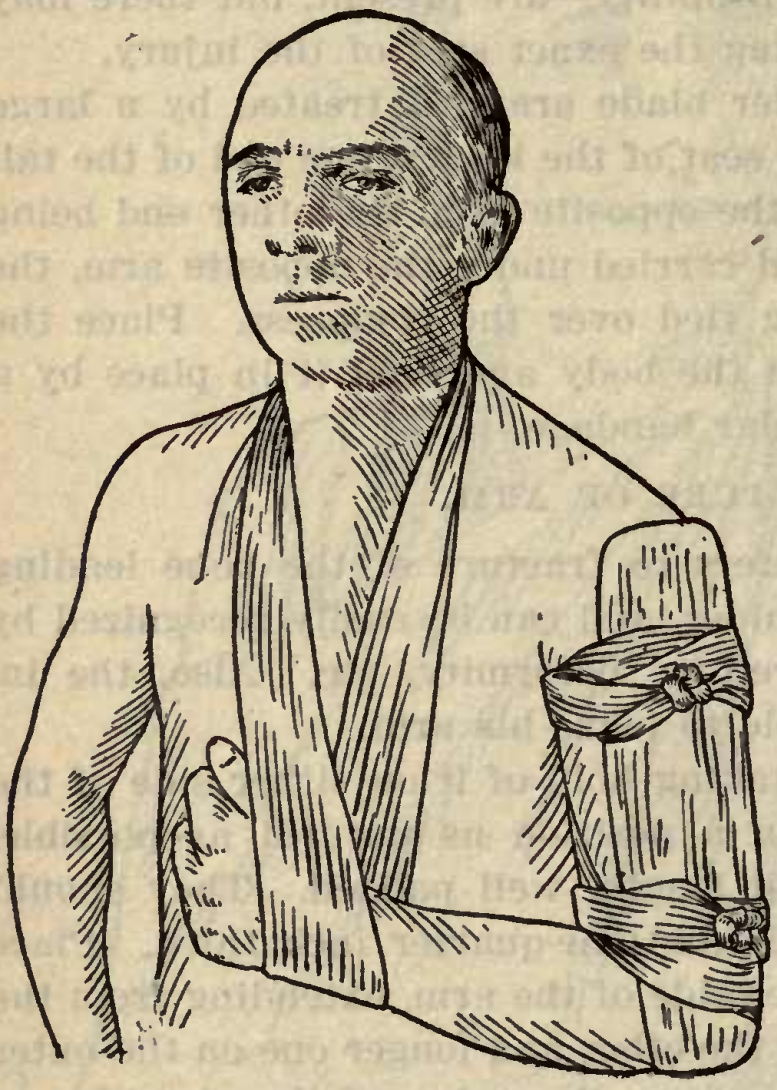

FIGURE 42.—Dressing for fracture of arm.

FRACTURE OF ELBOW.

Tie or nail two boards together, forming an L-shaped splint. The boards should preferably be 4 inches wide and one-quarter inch thick. One board should reach from the armpit to the elbow, the other from the elbow to the tips of the fingers. Pad the splint well and place it on the inner side of the arm and the forearm.

Pass one cravat bandage around the upper end of the arm and the splint and tie on the outside; pass a second cravat bandage around the splint and the arm just above elbow, crossing it in front of the bend of the elbow and then carry it around

the forearm and the splint, cross in back, and bring the ends to the front and tie on the outside; pass a third cravat around the splint and the wrist, bring bandage up to wrist, cross at the back of the hand, bringing one end between the thumb and the forefinger and the other end over the little-finger side of the hand, crossing at the palm; bring the ends around the wrist, and tie. Support the forearm in a sling made from a cravat bandage. (See fig. 43.)

FIGURE 43.—Dressing for fracture of elbow.

FRACTURE OF FOREARM.

Fracture of the forearm means the breaking of either one or both bones leading from the elbow to the wrist. As in fracture of the arm, you can easily detect a broken bone or bones at this point. In applying a splint always have the patient's hand extended and his thumb pointing upward. The assistant should hold the bones on either side of the fracture. In treating a fracture of the forearm use two splints 3 or 4 inches wide, one-quarter inch thick, and of unequal length, one being long enough to extend from

the bend of the elbow to the hand, so as to cover all but the last joints of the fingers, and the other long enough to extend from the elbow to the first joints of the fingers. Pad the splints and place them in position. Use three cravat bandages to hold the splints in place. Place the center of the first cravat on the outer splint as close to the elbow as possible; wrap the ends around the forearm two or three times, and tie on the outside. Place the second cravat bandage in the center of the forearm and apply in the same manner. Place the third cravat over the outside splint, bring it around the wrist, cross on the back of the hand, pass one end between the thumb and the forefinger and the other end around the little-finger side, across the palm, and around the hand between the thumb and the forefinger, and tie the two ends on the back of the hand. Use a cravat sling.

FIGURE 44.—Dressing for fracture of forearm.

In case of a compound fracture, first apply a bandage compress to the wound and tie the bandage firmly in place; then apply splints. (See fig. 44.)

FRACTURE OF WRIST.

For a fracture of the wrist use the same dressings and splints as described for fracture of the forearm.

FRACTURE OF BONES OF HAND.

Prepare two splints of a length to reach from just above the wrist to the tips of the fingers; pad each splint thoroughly, the part of the pad that is placed in the palm being somewhat thicker than the rest. Fasten the splints with a cravat bandage. Place the middle of the cravat over the splint on the inner side of wrist, pass the ends around the wrist, crossing them on the back of the hand, and pass them around the hand and the splint, one side passing between the thumb and the forefinger, cross them on the palm side, and bring them to the back and tie. Use a cravat sling.

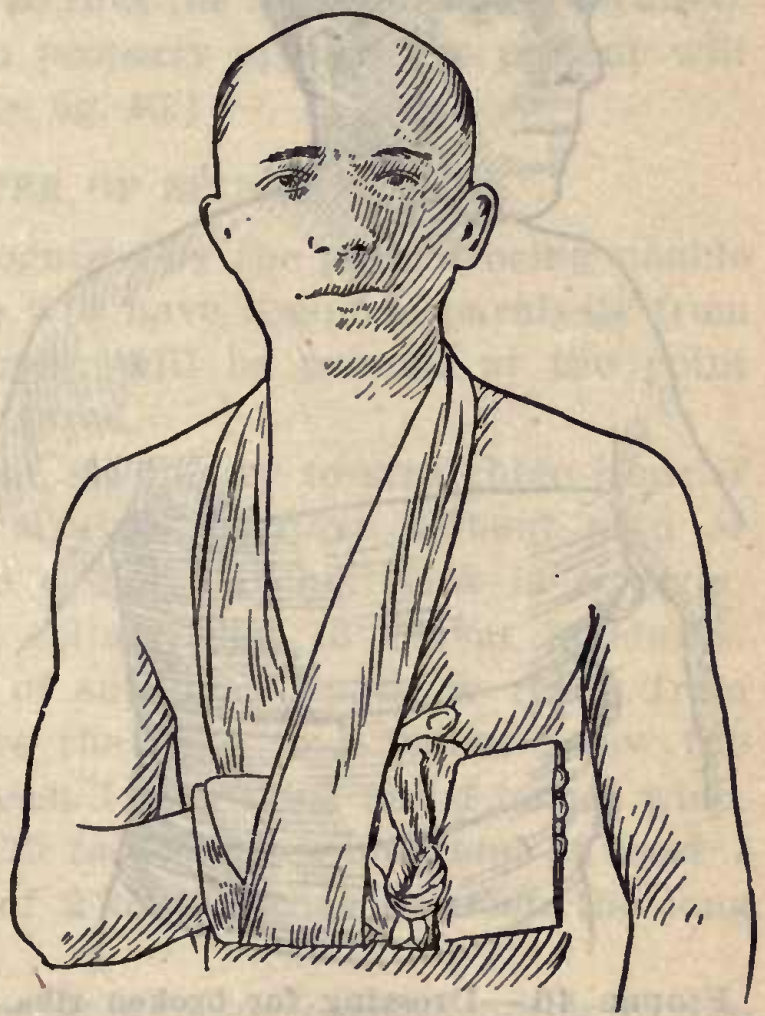

FIGURE 45.—Dressing for fracture of hand.

In case there is a compound fracture of these bones, place a bandage compress over the wound and tie firmly in place. Then apply splints. (See fig. 45.)

FRACTURE OF FINGER.

The usual symptoms of fracture are present—pain, swelling, and deformity. Put a narrow padded splint under the broken finger and hold it in place with a narrow strip torn from a triangular bandage. Support the hand in a narrow sling. If there is a compound fracture, apply a small bandage compress to the wound; then apply splints as suggested above.

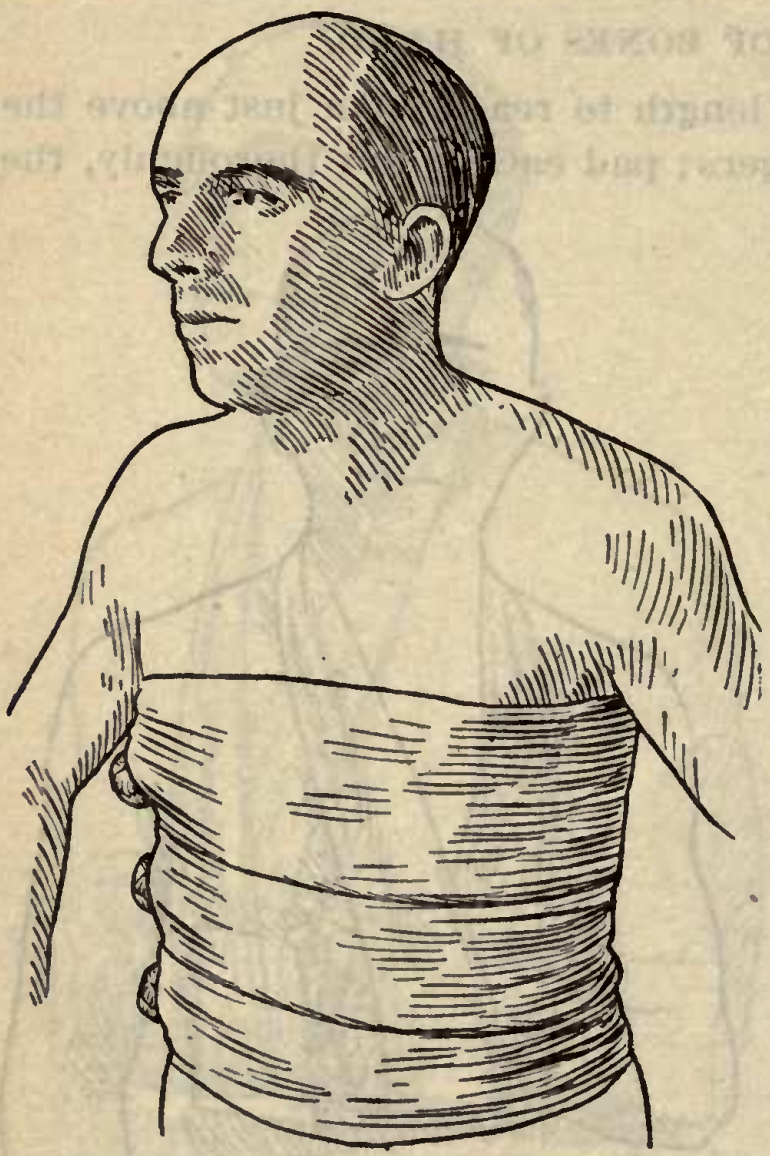

FIGURE 46.—Dressing for broken ribs.

FRACTURE OF RIB.

The fracture of a rib is usually caused by a direct blow or severe squeezing and can occur at any point along its length. Symptoms are severe pain on breathing, tenderness over the suspected fracture, inability to take a long breath on account of pain produced. In a thin person the fracture can be seen underneath the skin. Oftentimes grating can be felt by placing the hand over the seat of the injury. If the lung of a person

suffering from a fractured rib has been punctured, he may cough up blood.

Locate the fracture, then place the center of one broad cravat bandage over that point and carry the ends around the body and tie a half knot loosely. Then have the patient expel the air from his lungs. As this is being done, pull the two ends to tighten the bandage, and tie. Use at least three wide cravat bandages. Under each knot place a pad so that the skin will not be bruised. When the dressing has been properly applied the patient will breathe with less strain. (See fig. 46.)

FRACTURE OF SPINE.

A broken back may be recognized by the patient being unable to move his legs; in fact, he will have complete paralysis from the waistline down. Deformity will be present at the point where the spine has been fractured.

If the patient's back is bent, do not try to straighten him; if he can not be placed in a straight position without pain or without force, send for the doctor. If his back is straight, use 2 long splints, 3 short splints, and 13 cravat bandages. The long splints should be of sufficient length to reach from a point about 8 inches above the head to 8 inches below the heel, and they should be at least 1 inch thick and 4 inches wide. The short splints should be 15 to 18 inches long and at least 1 inch thick. Have a space of 2 or 3 inches between the long splints.

Place the first short splint at a point corresponding to the shoulders of the patient. The second short splint should be placed at a point corresponding to the patient's hips. The third short splint should be placed at a point corresponding to his ankles.

Fasten these cross splints securely to the long splints with cravat bandages, wire, or nails. Pad each long splint well with blankets, canvas, or clothing. Have four men kneel, three on one side and one on the opposite side, each man kneeling on the knee nearest patient's feet. They should gently lift him at the word of command. Then slip the prepared splint under him and have the men gently lower the patient onto the splint. If no shock is present, use a folded coat or blanket for a pillow under the head. See that the backbone is between the long splints. Tie the body to the splints with 13 cravats as follows:

Pass the first cravat around the splints and the body just head. See that the backbone is between the long splints. Tie

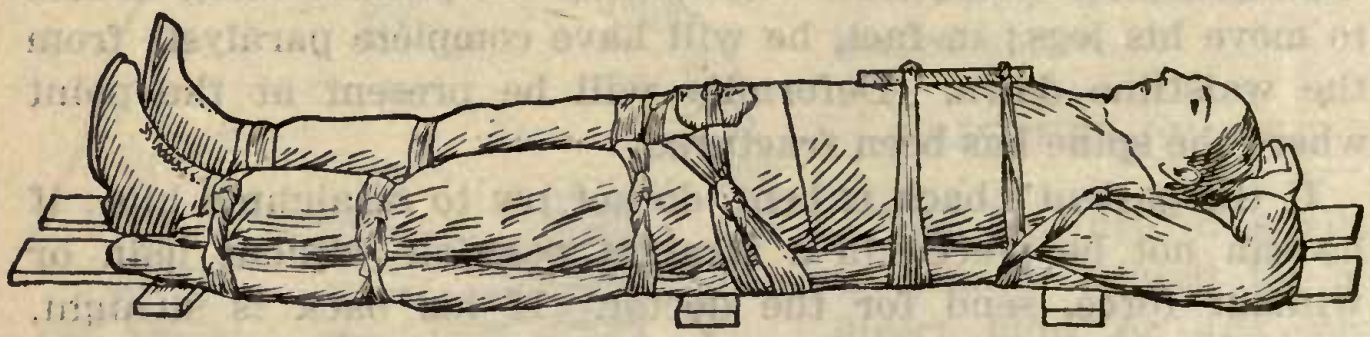

FIGURE 47.—Dressing for broken back, front view.

chest; pass a second cravat around the splints and the back and carry the ends over the lower part of the chest, tying them in front over a pad; pass the third cravat around the splints and the patient's hips, tying in front; pass the fourth cravat over one shoulder to the inner side of a long splint, crossing the short splint; carry it forward under the armpit on the same side of the body, tying the ends in front a little below the shoulder; pass the fifth cravat in a similar manner around the other shoulder; pass the sixth cravat around one hip, across both short and long splints on one side, and forward

in the crotch, and tie the ends in front; apply the seventh cravat in a similar manner around the other hip; pass the eighth cravat around the splint and the upper part of one thigh, tying the ends on the outer side; apply the ninth cravat in a similar manner on the other thigh; pass the tenth cravat around the long splint and one leg below the knee, and tie on the outer side; apply the eleventh cravat in a similar manner around the other leg; pass the twelfth cravat around the long splint and one leg at the ankle, and tie on the outer side; apply the thirteenth cravat in a similar manner around the other ankle. Cover the patient with

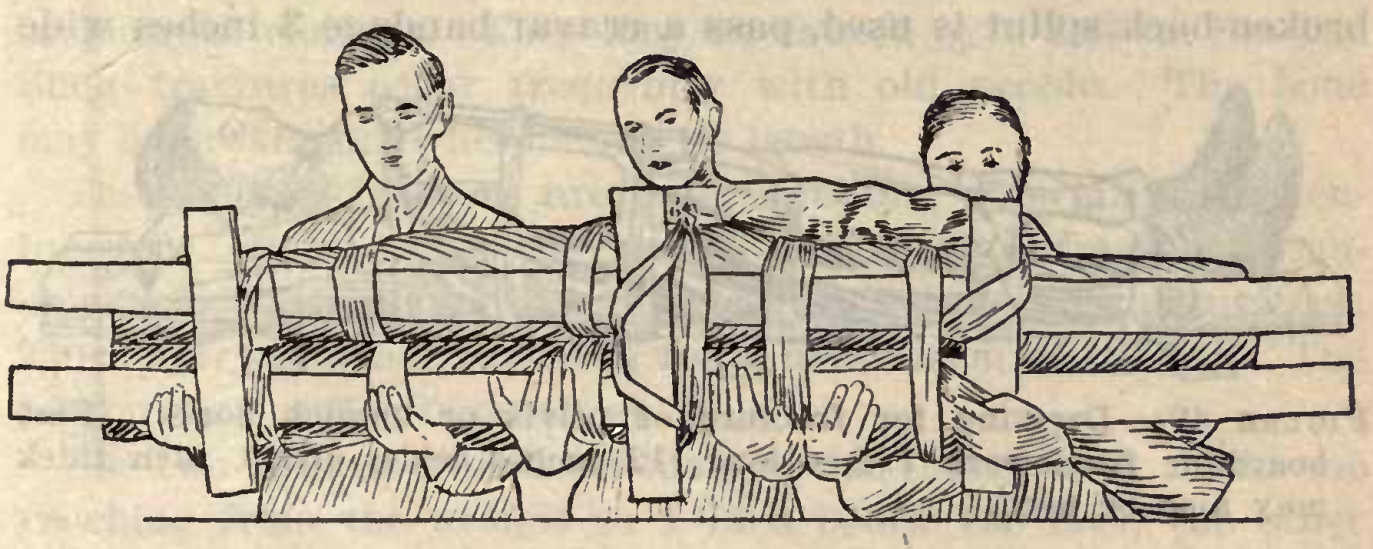

FIGURE 48.—Dressing for broken back, rear view.

blankets and treat for shock. The splint prepared as described will serve as a stretcher. (See figs. 47 and 48.)

FRACTURE OF PELVIS OR HAUNCH BONE.

Fracture of the pelvis occurs as a result of a squeeze through the hips or of a direct blow. The break most frequently occurs in front and along the midline of the body where the two sides of the pelvis join. Much importance is attached to the injury for the reason that it is so frequently accompanied by rupture

of the bladder, which lies just behind the bones that make up the front wall of the pelvis. The symptoms of this fracture are not easily detected. Therefore when the injured person complains of great pain through the pelvis, it is well to keep him lying flat on his back. Pass a bandage at least 6 inches wide around his pelvis and tie it tight to prevent movement of fractured parts. (This bandage is not shown in fig. 49.) He should be placed on a broken-back splint or a board about 7 feet long, 12 inches wide, and 1 inch thick. A pad or a padded splint extending from the chest to the abdomen should also be used. If a broken-back splint is used, pass a cravat bandage 3 inches wide

FIGURE 49.—Dressing for fracture of pelvis or haunch bones. Flat board or framework 7 feet long, 12 inches wide, and 1 inch thick may also be used.

around the upper part of each thigh and tie on the outer side; place a cravat bandage around each splint and each leg just below the knees and tie the ends on the outer side over the splint. Place another cravat bandage around the ankle of each leg and splint and tie on the outer side. Pass another cravat bandage over the upper part of the chest and tie over the pad in the center of the chest. Pass another cravat bandage at the lower part of the chest and tie on the center of the chest over the pad. Pass another cravat bandage over hips and tie in center over pad. (See fig. 49.) If a board instead of a broken-back splint

is used, instead of bandaging each leg separately, the three lower bandages should be passed over both legs and be tied near the board on the injured side. Treat the patient for shock and get him to the doctor or a hospital without delay, for in rupture of the bladder it is only in the first hour or two that an operation gives any hope of success.

FRACTURE OF THIGH.

Fractures of the hip or the thigh are usually caused by direct or indirect violence. They may be caused by a fall on the leg. Such fractures occur frequently with old people. The bone may be broken anywhere along its length.

The signs of fracture are pain, swelling, deformity, shortening, etc. Practically every person with such a fracture is unable to move the limb. Usually the foot will be turned outward. This injury is often mistaken for a dislocation of the hip. The person may suffer from shock.

Use two splints, 4 inches wide and one-fourth inch thick, one reaching from the armpit to 1 inch below the heel, the other reaching from the crotch to 1 inch below the heel. Pad well and use extra padding near bony prominences. While an assistant is gently pulling the limb into a position as nearly normal as possible the broken bones should be supported by placing the hands underneath on each side of the break. Use seven cravat bandages. Apply the first bandage above the seat of the fracture. Place the next bandage below the seat of the fracture. Place the third cravat below the knee. Place the fourth bandage above the ankle. Place the fifth bandage around the upper part of the chest and back, and the sixth bandage around the body at the lower part of the chest. Place the final bandage

around the body at the hips. Tie all knots on the outer edge of the splint. (See fig. 50.)

To place these bandages fold the cravat bandage at its center over the end of a thin splint and by means of this splint push the bandage under the body or limb. All body bandages should be pushed under the body at the small of the back and the bandage slid up or down to its proper position. In a similar manner bandages to be placed around the leg should be pushed under the leg at the knee and then slid up or down to their proper positions. There are arches or curves in the body at these two points and consequently bandages can be pushed

FIGURE 50.—Dressing for fracture of thigh.

through at these places without moving the patient or causing him discomfort.

The injured and the uninjured limbs should not be bound together in dressing this fracture. If the uninjured leg is left free, the patient can move or shift himself with the uninjured leg when his position becomes uncomfortable. However, when the patient is to be transported on a stretcher out of mine, his feet should be tied together.

Never place a bandage over point of fracture. It may be necessary to change the position of these bandages according to the extent of the injury. Treat for shock.

FRACTURE OF KNEECAP.

Fracture of the kneecap is caused by a direct or indirect blow, or by muscular action. It can be easily recognized by the following symptoms: Pain, swelling, and deformity; usually a groove or separation is felt in the kneecap.

Straighten the limb. If shock is present, treat it. Prepare a splint 4 inches wide, ¼ inch thick, and of sufficient length to extend from the middle of the thigh to 1 inch beyond the heel; pad thoroughly, placing extra padding under the knee, above the heel, and at the upper end of the splint. Place the splint under the limb. A cravat bandage should be passed around the

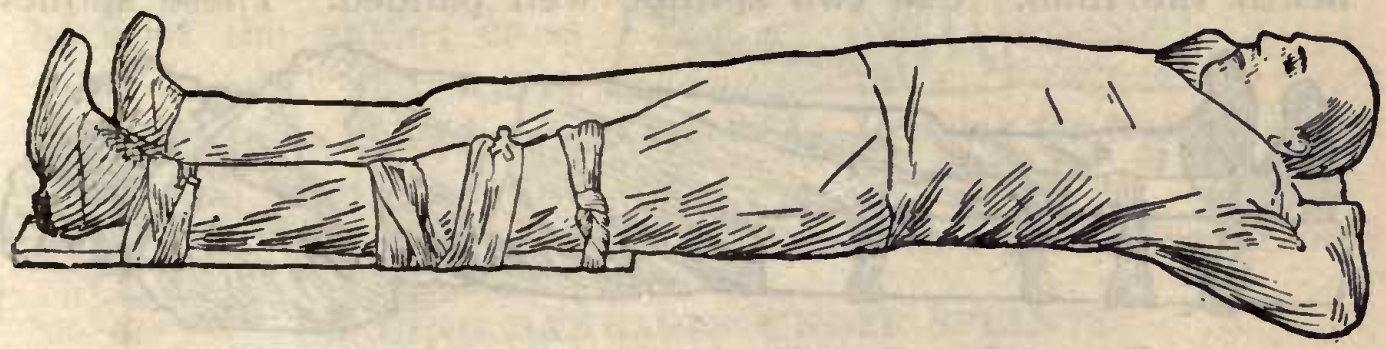

FIGURE 51.—Dressing for fracture of kneecap.

thigh and the splint and tied at the upper end of the splint. Place the center of a second cravat bandage over the thigh, just above the kneecap; bring the ends down around the limb, crossing them at the bend of the knee; then bring them forward and tie them below the kneecap. Place the middle of a third cravat bandage below the kneecap over the knot of the first bandage, pass the ends around the leg, crossing them underneath the knee, and bringing them around the lower part of the thigh, and tie them above the kneecap. Place a fourth cravat bandage around the limb and the splint at the ankle. (See fig. 51.)

FRACTURE OF LEG.

By a fracture of the leg is meant a break of the bone or bones leading from the knee to the ankle. This fracture can usually be easily detected. It may be caused by direct or indirect violence. The symptoms are pain, swelling, and deformity. There may be shock. For the reason that the shin bone is directly underneath the skin, especial care must be taken with this fracture as it is easily converted into a compound fracture.

Grasp the foot and place the limb in as nearly normal a position as possible. At the same time the bones on both sides of the fracture should be supported by placing the hands underneath the limb. Use two splints, well padded. These splints

FIGURE 52.—Dressing for fracture of leg or ankle.

should be of sufficient length to reach from the middle of the thigh to an inch beyond the heel. Apply splints to either side of limb, and use four cravat bandages as follows: Place the first bandage just above the fracture; the second just below the fracture, the third at the upper part of the splints, and the fourth around the ankle. All knots should be tied over the outer splint. (See fig. 52.)

FRACTURE OF ANKLE.

The symptoms of this fracture are pain and swelling, and usually there is deformity. Apply dressing as for a fracture of the leg. (See fig. 52.)

FRACTURE OF FOOT OR TOE.

Such fractures may be caused by direct or indirect violence. The symptoms are pain and swelling; there may or may not be deformity.

Apply a well padded splint, 4 inches wide and one-fourth inch thick, reaching from one-half inch beyond the toes to one-half inch beyond the heel. Place the middle of a cravat bandage over the splint at the sole of the foot, carry the ends to the instep, across it, and to the back of the ankle; cross them again and carry them again to the instep; then cross them under the sole of the foot, carry them to the instep, and tie. (See fig. 53.)

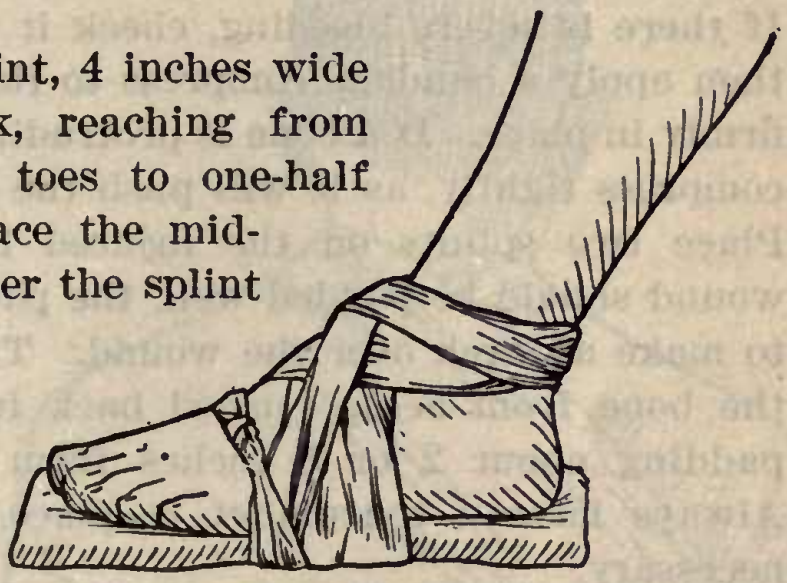

FIGURE 53.—Dressing for fracture of foot or toes.

PLACING BANDAGES UNDER SPLINTS.

In passing cravat bandages beneath splints in dressing a fractured thigh, leg, ankle, or knee, there is no objection to placing a thin narrow stick of wood in the middle of each bandage, pushing the bandage under the splints, and then removing the stick. Catch the loop thus made and pull it with the fingers until it reaches the upper part of the splint on the inner side. Place one of the ends of the bandage to the left side of the loop, put the other end through the right side of the loop, and pull the loop until the two ends can be tied in a knot midway between the top and the bottom edges of the outer splint.

COMPOUND FRACTURES.

In a compound fracture the bone is broken and the skin and tissue are punctured or torn. Such a fracture is very dangerous. If there is severe bleeding, check it by means of a tourniquet; then apply a bandage compress to the part and tie the bandage firmly in place. If a bone is protruding, do not apply the bandage compress tightly, as it will push the bone back into the tissues. Place two splints on the injured limb; the one nearest the wound should be padded well, the padding being arranged so as to make an arch over the wound. This precaution will prevent the bone from being pushed back into the tissues. Keep the padding about 2 or 3 inches from the wound on each side. Always have a tourniquet in place, ready to be tightened if necessary.

BURNS OR SCALDS.

A burn is an injury caused by the application of heat, either dry or moist. Included in the dry form are fires, gas explosions, electric current, etc. Moist heat, from steam, hot water, etc., produces what are known as scalds.

Remove all loose clothing, but do not try to remove clothing that adheres to the skin—cut around it. For all cases of burns, the air should be excluded from the burned surfaces as quickly as possible by the application of 0.5 to 1 per cent picric acid gauze, moistened if possible with steam or clean water. In applying this gauze you must be careful not to bandage together open surfaces, such as fingers or toes or the ears to side of head. If the patient is suffering from shock, treat it. The danger from a burn depends upon its depth and extent and the age and general condition of the person injured. For all burns of the body, except of the chest, back, head, or face, for which

there are special dressings, first apply picric acid gauze and then cover with a triangular bandage, encircling the limbs as in the ordinary dressing for a wound. Do not pull the bandage tight.

BURNS OF BACK.

Cover all burned surfaces with picric-acid gauze. Then cover with triangular bandages as follows: Place the base of the triangle of one bandage diagonally across the back, reaching from one side of the body across the top of the opposite shoulder; bring the long end forward to the chest; then bring the two lower ends around the waist and tie all the ends together in front. Place a second triangular bandage in a similar manner on the opposite side. This dressing may also be applied to burns of the shoulder. (See fig. 54.)

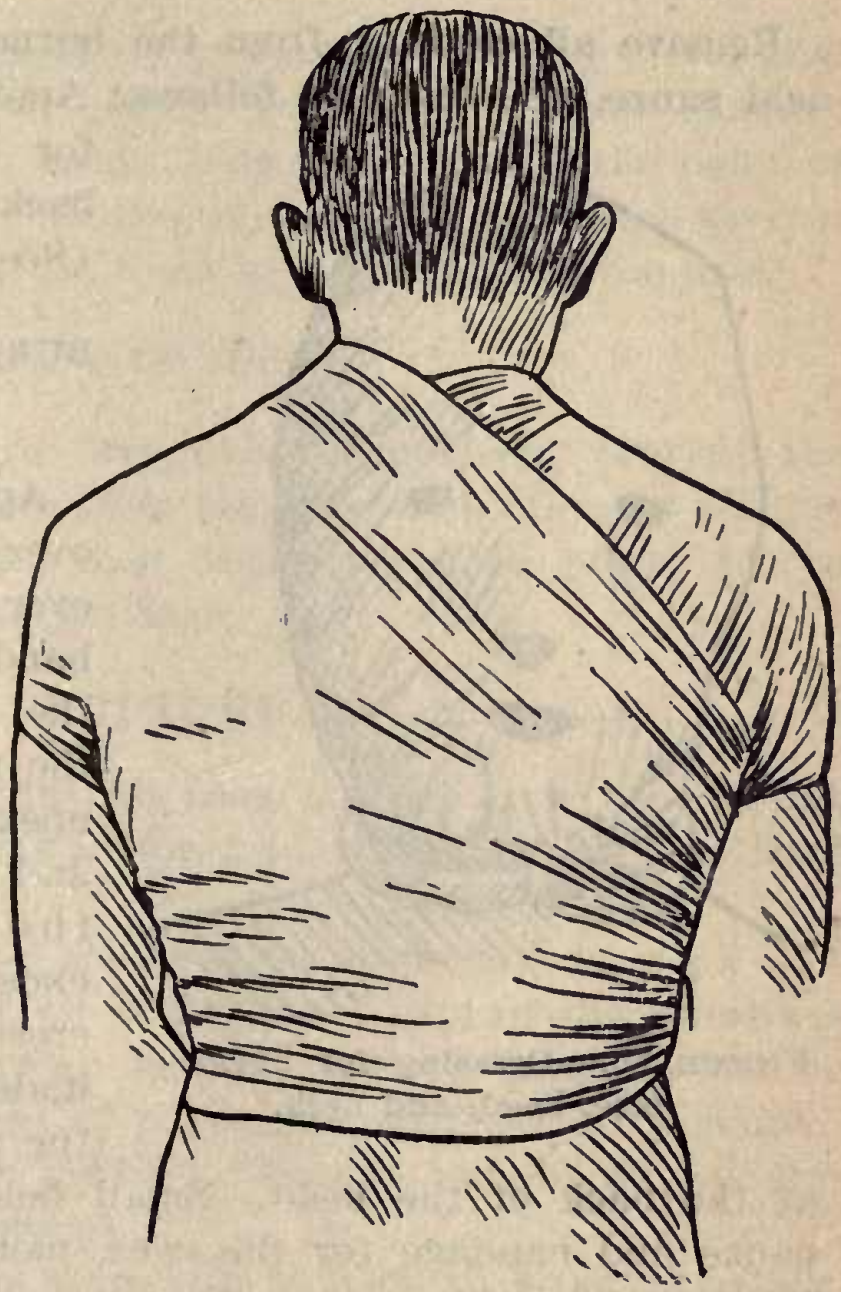

FIGURE 54.—Dressing for burns of back. Picric-acid gauze applied underneath bandage.

BURNS OF CHEST.

Remove all clothing from the burned surfaces, apply picric acid gauze, and cover as follows: Apply bandages as described for treating burns of the back, only in reverse order. (See fig. 54.)

FIGURE 55.—Dressing for burns of face, head, and neck.

BURNS OF FACE, HEAD, OR NECK.

Apply picric acid gauze over the burned surface, and over this place a triangular bandage, as follows: Place the base of the bandage on the neck below the chin, the apex passing over the face and the head to the back of the head. Then pass the ends to the back of the head, cross them, return them under the chin, and tie. Pull the apex down and fasten it at the back of the head. Small holes should be cut in the gauze and bandage for the eyes, mouth, and nose. (See fig. 55.)

BURNS OF ARMS.

A burn of the arm should be dressed by applying picric acid gauze, and then bandaged loosely, an open triangular bandage encircling the arm being used. Place the apex on the point of the shoulder and the base at the wrist, encircle the limb several times with the ends, and tie them in the middle of the arm.

BURNS OF HANDS.

Place picric-acid gauze over burned surfaces; prevent the raw surfaces of the fingers from touching each other by placing the gauze between them; then dress as for an injury to the hand, using a triangular bandage.

RUPTURE.

Rupture is mentioned in this book because it is usually due to severe muscular efforts incident to violent exercise or hard labor.

The lower part of the abdomen on each side is weak and occasionally muscular strain will force a part of the intestines through one of these weak places. Thus a rupture will be caused. The only method of prevention that can be suggested is the avoidance of such muscular strains, but, of course, this suggestion is hardly practical.

When a rupture occurs there will be a sharp, stinging pain, a faint feeling, sickness at the stomach, and a feeling that something has given away; a lump will appear in the groin. As this

lump contains intestines or bowels, or the covering of the bowels, it must be handled with the greatest gentleness, as rough handling may cause a dangerous injury to the intestines and probably inflammation of the bowels.

The patient should be placed on his back with his knees well raised toward the abdomen and the legs supported with a pillow or folded jacket. Cloths wet in cold water should then be placed over the hernia, or lump, and a doctor should be sent for immediately. If the patient should be removed before the doctor's arrival, carry him in the position suggested above. Never force him to lie in a straight position.

POISONS.

It is not expected that a first-aid man shall become perfectly familiar with treating persons affected by all the different kinds of poisons, or be able to recognize the symptoms of each kind, but it is absolutely essential that he should be able to treat for all the more common ones, and in a general way, at least, to give first-aid treatment to all cases, irrespective of what poison has been taken. Only the poisons that are swallowed are here considered. The following outline will enable a person to arrive at some intelligent conclusion:

CORROSIVE POISONS.

The corrosive poisons when swallowed will leave a stain on the lips or mouth. They also, as the name implies, corrode or eat away the tissue with which they came in contact. Belonging to this class are the following:

Hydrochloric acid.
Sulphuric acid.
Nitric acid.
Potash or caustic potash.
Soda or caustic soda.
Ordinary lye or lime.
Strong ammonia water.

A person who has swallowed one of these poisons, which are the more common corrosive poisons, will, as has been stated before, have a stain on his lips or on the inside of his mouth.

He will also complain of intense burning pain in his throat, gullet, and stomach if he is conscious. When such a case is seen and the class of poison is recognized, the following plan of procedure is recommended:

1. Counteract the poison. If the person has swallowed an acid, give baking soda in solution, lime off the walls mixed with water, dilute ammonia water, or the like. If an alkali has been taken, dilute acids are necessary, such as vinegar or lemon juice.

2. Soothe the corroded parts. Use oils especially.

3. Treat for shock. Give stimulants freely if the patient is conscious.

In this class of poisons do not use any emetics, because the poison when vomited will corrode coming up just as much as going down; also the belching will be liable to rupture the stomach.

IRRITANT POISONS.

The irritant poisons when swallowed irritate the throat and the stomach. They are also absorbed in the stomach and poison the system in that way. The more common are:

Bichloride of mercury or antiseptic tablets.
All the combinations of lead.
All the combinations of copper.
All the combinations of zinc.
Rat poison, which is a compound of arsenic.
Matches or phosphorus
Tartar emetic.
Fly poisoning.

The symptoms are pretty much the same as for the corrosive poisons except that the lips and mouth are not stained.

TREATMENT.

1. Give an emetic (make patient vomit). Run finger down throat. Have patient drink large quantities of warm water. Have patient drink salt water. Have patient drink mustard water. Have patient drink alum water.

2. Soothe the parts and counteract the poisons. Give white of eggs, oils, epsom salts, or the like. Give no oils for poisoning from matches.

3. Treat for shock. Stimulants should be given freely.

NERVE POISONS.

There are two classes of nerve poisons, as follows: (1) Poisons that cause deep sleep or unconsciousness; (2) poisons that cause convulsions.

Poisons that cause deep sleep or unconsciousness include the following: Opium, morphine, laudanum, paregoric, sleeping powders, ether, chloroform.

TREATMENT FOR POISONS THAT CAUSE UNCONSCIOUSNESS.

1. Try to keep the patient awake by slapping him with wet towels and giving him strong black coffee, but do not exhaust patient by walking.

2. Give an emetic.

3. Give stimulants.

4. If patient stops breathing, give artificial respiration.

Poisons that cause convulsions include strychnine and belladonna.

TREATMENT FOR POISONS THAT CAUSE CONVULSIONS.

1. Give an emetic.

2. Give artificial respiration if breathing stops.

ALCOHOLIC POISONING AND APOPLEXY.

Of the many cases of poisoning alcoholic poisoning is one of the most common. As not a few cases have occurred among miners, this kind of poisoning is here discussed in some detail. The following symptoms are usually present:

Unconsciousness, partial or complete.

In most cases the patient can be aroused to some extent.

Face flushed or bloated, but sometimes pale.

Skin cool and moist.

Pupils natural or large; eyeballs red but not insensitive to touch.

No paralysis.

This condition is often confounded with apoplexy. The points of difference are the state of the pupils (in apoplexy they are of unequal size), the sensitiveness of the eyeballs, and the paralysis that occurs in apoplexy. The odor of liquor is of no value as a symptom of alcoholic poisoning.

TREATMENT FOR ALCOHOLIC POISONING.

1. Give an emetic.
2. Afterwards give strong coffee or aromatic spirits of ammonia.
3. Make applications of heat around patient.
4. Rub body to increase circulation.

TREATMENT FOR APOPLEXY.

1. Have patient rest in a dark room.
2. Keep his head and shoulders high on pillows.
3. Apply cold cloths to his head.
4. Give no stimulants.

CARBOLIC ACID POISONING.

Carbolic acid poisoning is also common. This acid is frequently taken with suicidal intent as well as accidentally. The following points will greatly aid in discovering the nature of the poison.

1. The bottle that contained the poison may be found.
2. Patient will vomit and suffer great pain.
3. There will be a strong smell of carbolic acid, which is familiar to every one.
4. Lips, tongue, and mouth of patient will be burned white by pure acid, and black by impure acid.

TREATMENT.

1. Give alcoholic liquors (whisky, brandy, etc.) or equal parts of alcohol and water freely to dissolve the poison. In the absence of alcoholic liquors, give vinegar, soapsuds, or raw whites of eggs in water.
2. Produce vomiting by having the patient run his finger down his throat or by drinking any of the following liquids: Warm water in large quantity; salt water; mustard water; or alum water.
3. Give a solution of Epsom or Glauber salt or sodium phosphate well diluted to hasten elimination of acid that may have entered the circulation.

Milk, gruel, flaxseed tea, or elm-bark tea may then be given. Apply hot-water bottles, hot bricks, or lighted safety lamps to the extremities, but make sure that they are wrapped so that they will not burn the patient. For collapse give strong coffee. Apply artificial respiration if breathing stops.

Do not give oils or glycerin.

TRANSPORTATION OF INJURED.

After an injured man has been treated, only half of the first-aid man's work is done. The next thing to do is to carry the injured man to a hospital or a doctor by placing him on a stretcher and transporting him without causing him any unnecessary pain or injury. No matter how well you prepare an injured man for the doctor, your work may all be undone by bad transportation.

ONE-MAN CARRY.

In lifting an unconscious man, the bearer turns the patient over, face downward, and then places himself at the patient's head, facing him. He passes his hands under the patient's armpits and lifts him to his knees. The bearer's hands should then be shifted lower down and clasped behind the patient's back. With this grip the patient may be raised to a standing position. The bearer supports the patient while he stoops down and places himself so that his right shoulder comes under the patient's abdomen, the upper part of the patient's body lying over his shoulder. The bearer then grasps the patient's right wrist in his left hand and brings it down and around under his left arm from behind, while he passes his right arm through between the thighs; he then shifts the patient's right hand so that it is clasped by the hand which passes between the thighs. The bearer then rises. By this method the patient will be securely held over the bearer's right shoulder. (See fig. 56.)

TWO-MAN CARRY.

The bearers kneel on each side of the injured person, near his hips and raise him to a sitting position. Each then passes one arm around the patient's back and the other under his thighs, the bearer on the patient's right grasping with his right hand the left wrist of his companion, the bearer on the left grasping with his left hand the right wrist of the first bearer. Both rise slowly from the ground and lift their disengaged hands to each other's shoulders, thus forming a back rest for the patient; or, unless the pa-

FIGURE 56.—One-man carry.

tient is helpless, he may support himself by placing an arm around the neck of each bearer. (See fig. 57.)

FIGURE 57.—Two-man carry.

HOW ONE PERSON MAY REMOVE AN INJURED OR UNCONSCIOUS PERSON IN LOW COAL OR A THIN VEIN.

Place the injured person on his back; tie the ends of two cravat bandages together, making a loop; pass this over the person's head and down so that it will be under his back and around his sides at the armpits; then get on your knees, straddling the injured person, pass the loop over your head, and then, by crawling, you can drag him out. Occasionally this purpose is accomplished by tying the person's wrists together. The rescuer then passes his head between the arms. Another method is to crawl with an injured person on your back, having first tied his wrists together and passed your head through the loop formed by his arms

STRETCHERS.

The ordinary stretcher, known as the Army stretcher (see fig. 64, p. 121), consists of two long poles with a bed, usually made of canvas, between them, and crosspieces to keep the long poles apart and thus to stretch the canvas. The poles are long enough to afford handholds for the bearers at each end of the stretcher.

Satisfactory stretchers may be improvised—that is, may be put together on the ground with the materials at hand. A good stretcher may be made from three or four coats. The sleeves of the coats are turned inside out, and through them are passed the two poles. The flaps are then turned down around the poles and buttoned underneath.

In making a stretcher from a blanket or canvas, place one of the poles on the unfolded blanket about 1 foot from its center. Fold the short side of the blanket over the pole toward the other side; place the second pole on the two thicknesses about 2 feet from the other pole; fold the remaining side of the blanket over the last pole toward the first pole. By this method, when the injured person is placed on the blanket, the folds are locked by the friction.

Bags and sacks may be used for stretcher beds. The bottoms of the bags should be ripped so that the poles may be passed through them, and a sufficient number of bags should be used to give the length of bed required.

TYPES OF STRETCHERS.

Among the types of stretchers used in first-aid work are the following:

An improvised stretcher made with two long poles and brattice cloth, blankets, or coat jumpers.

Stretcher of the Army type. (See fig. 64, p. 121.)

A stretcher, known as the Stokes Navy stretcher, consisting of woven-wire basket made to fit the human body. The patient, after having been strapped to the basket, may be placed in a vertical position and carried on a cage or skip. This type of stretcher is used almost exclusively in metal mines or in coal mines where the coal bed has a steep pitch.

Shields stretcher.

Williams stretcher (hammock shape).

Homesteak stretcher (used only in metal mines).

It is well always to test these stretchers by placing an uninjured man on them. Great care must always be exercised in placing an injured man on a stretcher, otherwise the patient will be subjected to unnecessary suffering. The bearers should work together on command of the captain or of the man in charge. Whenever possible a mine car should be used in transporting the injured out of a mine, the stretcher being either fastened or held in the car to prevent unnecessary shaking of the patient. The car should be taken out alone and not with the loaded trip, and such a car should always have the right of way. No matter how well trained may be the men who have charge of the injured, it is impossible to carry an injured man along the roadbed in a mine without irregular stepping and jolting. Some of the coal companies have met this problem of transportation of the injured out of mines in an efficient way by providing special ambulance tramcars. It is hoped that this method may soon become universal. In handling an injured man, with or without stretcher, the bearers should move together and as gently as possible.

STRETCHER DRILL.[a]

The stretcher squad shall consist of four men under the command of a captain, whose words of command shall be obeyed, as outlined below.

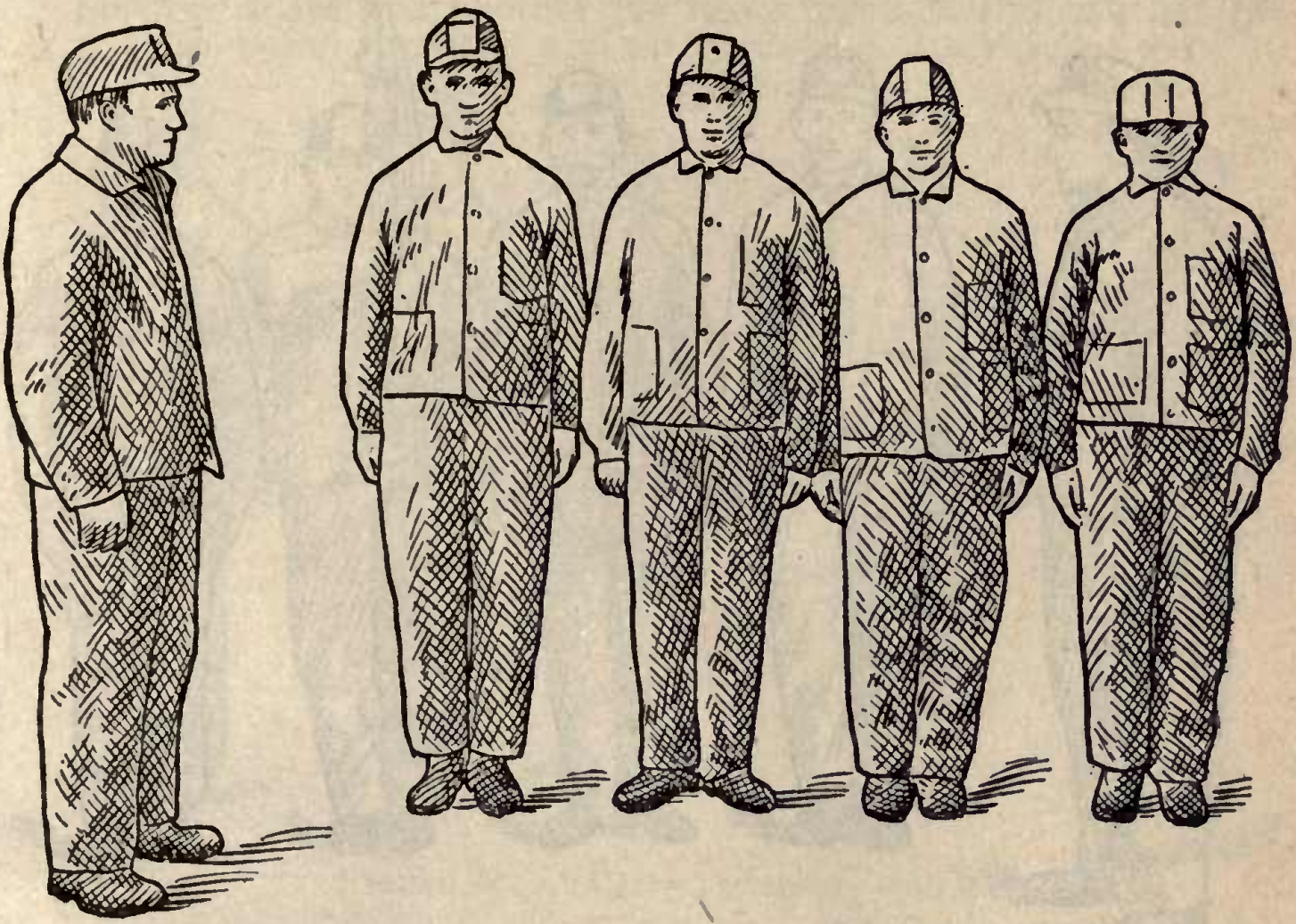

FIGURE 58.—"Fall in line—Count one, two, three, four."

The stretcher drill described below is recommended for use in first-aid contests.

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[a] See figs. 58, 59, 60, 61, 62, and 63.

The captain shall give all commands in a military manner; that is, first to give a preparatory command, so as to place each man in readiness, and follow this command after a definite interval of one or two seconds by the final command. Following this

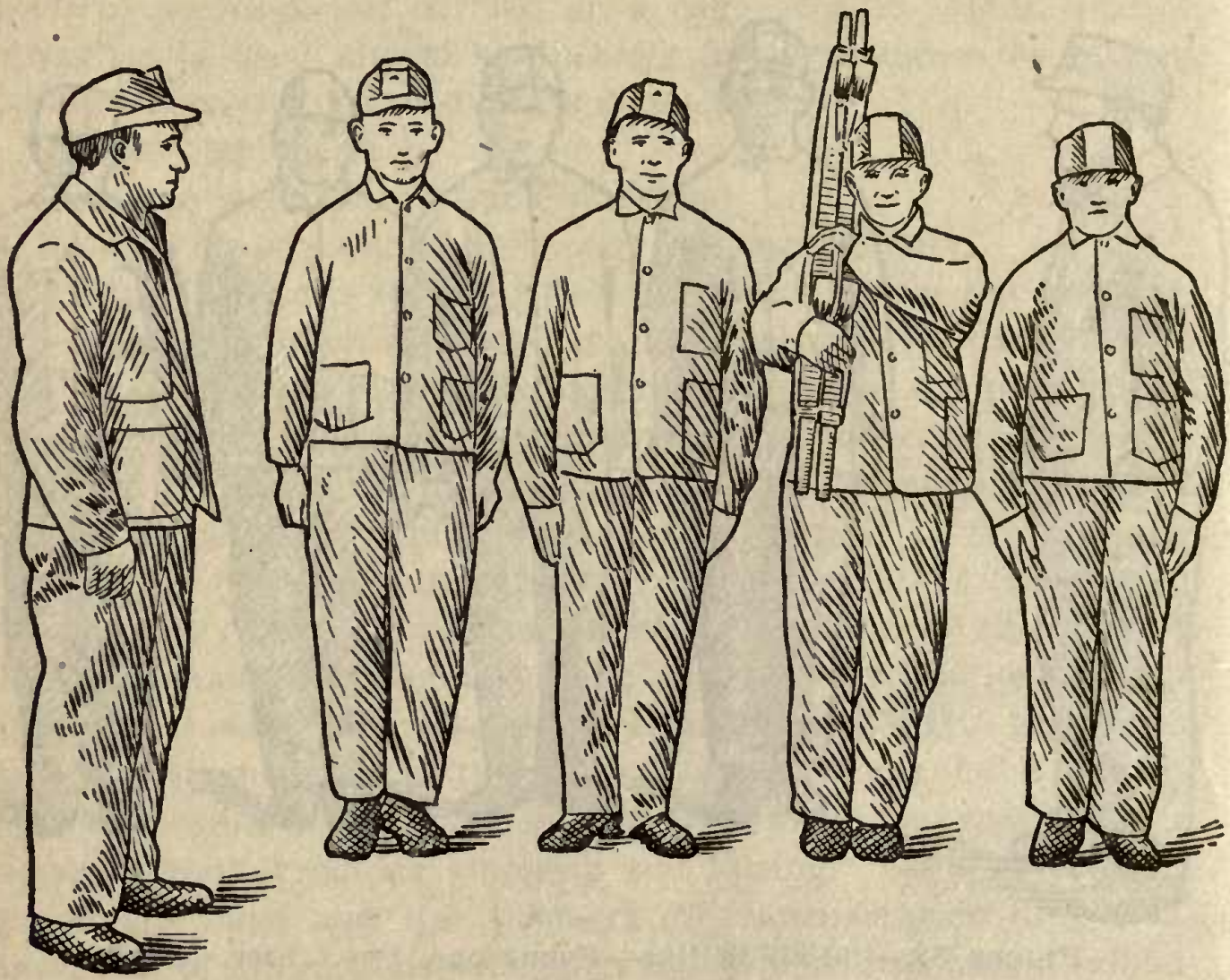

FIGURE 59.—Crew in line, No. 3 having obtained stretcher.

method, the movements can easily be made in unison, and consequently more satisfactorily and efficiently. The dash (—) in the command as given represents the interval between the preparatory and the final command.

CAPTAIN: "Fall in." The four men fall in line, standing side by side, each with head erect, hands at sides, heels together, and eyes straight ahead. When each man stands at attention in this manner the squad makes a fine appearance, but if one man has his feet apart and another his heels together and one has his

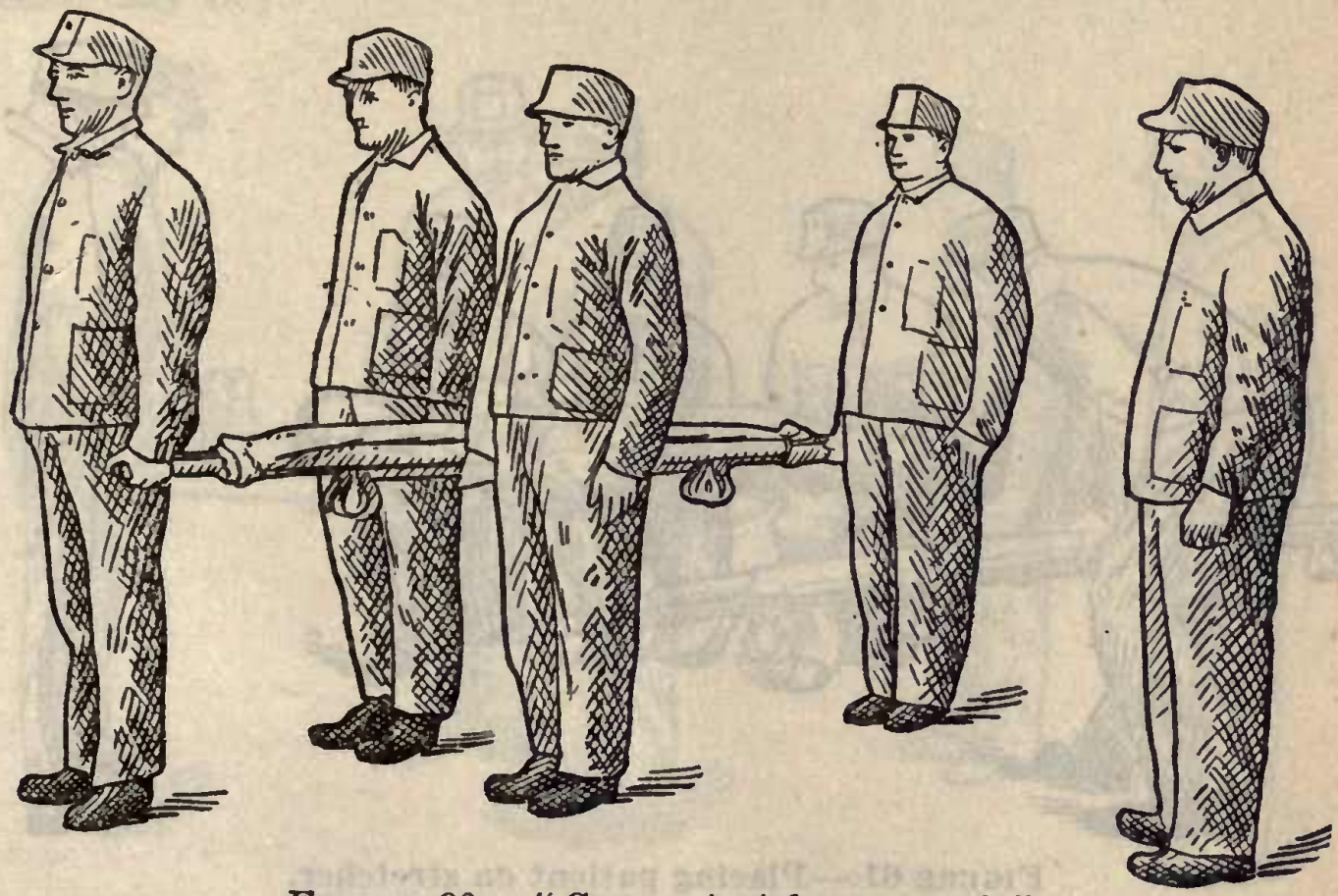

FIGURE 60.—"Carry stretcher—march."

hand behind his back and another keeps his hands at his sides the squad does not make a good impression on either judges or spectators.

CAPTAIN: "Count off." The man at the right of the squad (looking toward patient) calls, "One," and the remainder of the squad follow in order, counting, "Two," "Three," "Four."

CAPTAIN: "Procure stretcher—march." At the command "March," No. 3 steps forward and proceeds to the stretcher by the shortest route, picks it up and places it over his right shoulder as shown in figure 59 and returns to his place in line.

CAPTAIN: "Carry stretcher—march." At the command "March," No. 3 tilts the stretcher on his shoulder and holding

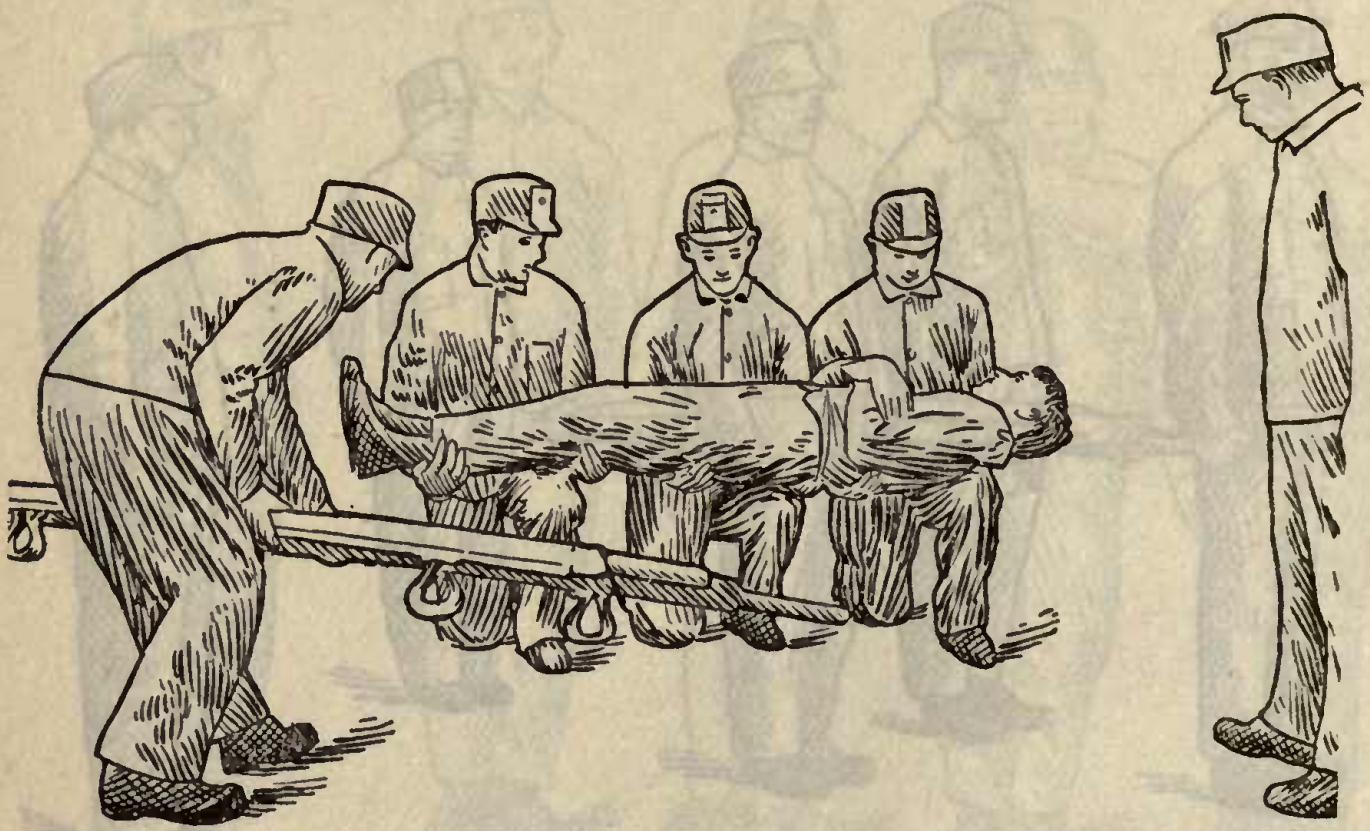

FIGURE 61.—Placing patient on stretcher.

one end allows the other end of the stretcher to fall slowly forward. At the same time No. 2 takes two long paces to the front and as the stretcher drops forward he catches the handles at the free end with his left hand. No. 1 steps to the middle of the right-hand side of the stretcher while No. 4 steps to the middle of the left-hand side.

CAPTAIN: "To patient, forward—march." After reaching the patient, Nos. 2 and 3 open the stretcher and fix the braces, Nos. 1 and 4 take their places beside the patient, No. 1 on the patient's right, and No. 4 on the patient's left side.

CAPTAIN: "Post to patient's right side" (or left side, as the case may be).

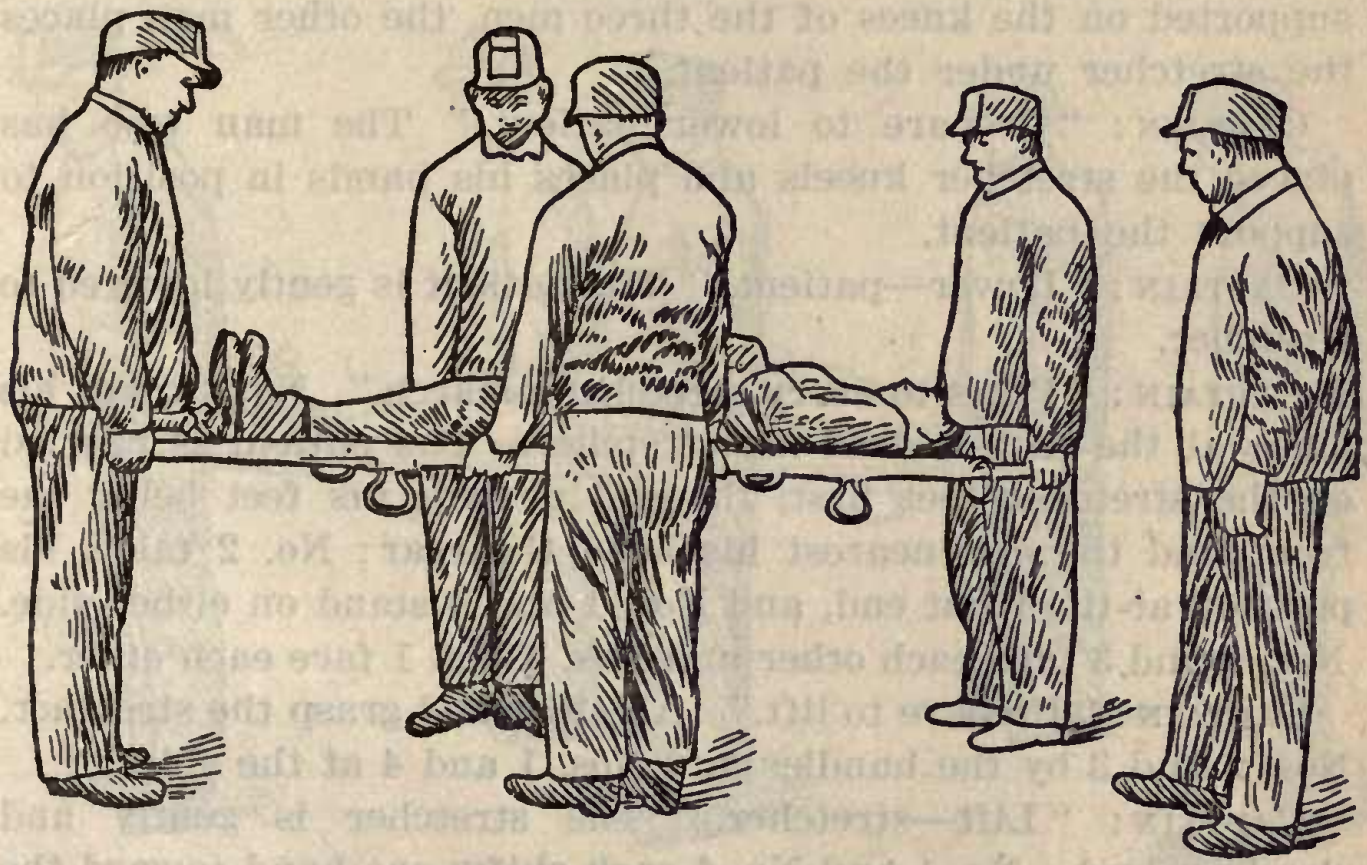

FIGURE 62.—Lifting patient.

CAPTAIN: "Prepare to lift patient." Each of the four men kneel, No. 2 opposite the patient's knees, No. 3 opposite the patient's shoulders, and Nos. 1 and 4 opposite the patient's hips on their respective sides. Nos. 2 and 3 kneel on the uninjured side of the patient, thus having three men on this side, unless the nature of the patient's injuries makes it desirable to have

three men on the injured side. Each of the three men kneels on the knees nearest the patient's feet. No. 3 places his hands under the patient's neck and shoulders, No. 2 places his hands under the patient's knees and thighs, while Nos. 1 and 4 place their hands under the patient's pelvis and the small of his back.

CAPTAIN: "Lift—patient." The patient is slowly raised and supported on the knees of the three men, the other man places the stretcher under the patient.

CAPTAIN: "Prepare to lower patient." The man who has placed the stretcher kneels and places his hands in position to support the patient.

CAPTAIN: "Lower—patient." The patient is gently lowered to stretcher.

CAPTAIN: "Posts to carry stretcher—march." No. 3 takes his place at the rear end of the stretcher. The patient is carried on the stretcher feet first, the end nearest his feet being the front and the end nearest his head the rear; No. 2 takes his position at the front end, and Nos. 1 and 4 stand on either side. Nos. 2 and 3 face each other and Nos. 4 and 1 face each other.

CAPTAIN: "Prepare to lift." All stoop and grasp the stretcher, Nos. 2 and 3 by the handles and Nos. 1 and 4 at the sides.

CAPTAIN: "Lift—stretcher." The stretcher is gently and slowly raised. No. 1 and No. 4 each shifts one hand toward the front of the stretcher and supports this end while No. 2 turns to the marching position. If the patient is suffering from severe bleeding of the head, and must be carried up a steep grade on a stretcher, his head should be carried first with No. 3 bearer leading.

CAPTAIN: "Forward—march." Nos. 1, 2, and 4 each steps off with his left foot while No. 3 steps off with his right foot. This procedure prevents the stretcher from swaying.

In marching, when necessary to turn:

CAPTAIN: "Squad right—march," or, "Squad left—march," as the case may be.

On reaching the ambulance the command is given:

CAPTAIN: "Squad—halt." At the command "Halt" each man takes an additional step forward and then brings the foot

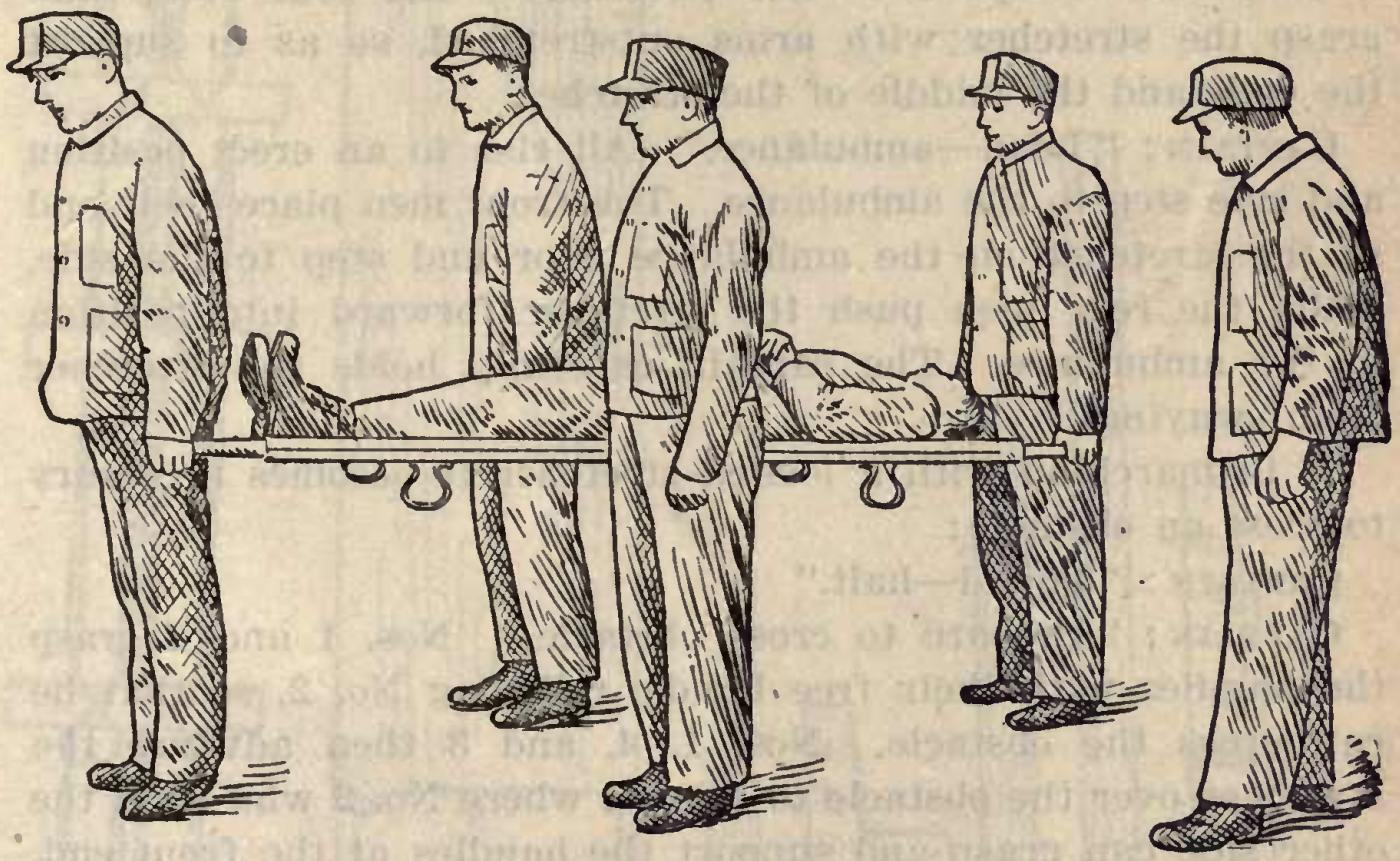

FIGURE 63.—Prepared to carry patient.

in the rear up to a heel-to-heel position with the foot that is forward.

CAPTAIN: "Lower—stretcher."

CAPTAIN: "Take posts to load ambulance." The captain opens the ambulance door and takes his place in the ambulance.

Patient is loaded head first.

No. 3 steps to the right side of the stretcher, opposite the patient's head; No. 2 to the left side of the stretcher, opposite the patient's feet; No. 1 moves toward the patient's feet on his side and No. 4 toward the patient's head on his side, so that Nos. 1 and 2 face each other, and Nos. 3 and 4 also face each other.

CAPTAIN: "Prepare to lift stretcher." All four stoop and grasp the stretcher with arms outstretched, so as to support the ends and the middle of the stretcher.

CAPTAIN: "Load—ambulance." All rise to an erect position and side step to the ambulance. The front men place their end of the stretcher on the ambulance floor and step to the side, while the rear men push the stretcher forward into position in the ambulance. The captain carefully holds the stretcher from swaying.

If in marching with a loaded stretcher it becomes necessary to cross an obstacle:

CAPTAIN: "Squad—halt."

CAPTAIN: "Prepare to cross obstacle." Nos. 1 and 4 grasp the handles with their free hands, relieving No. 2, so that he can cross the obstacle. Nos. 1, 4, and 3 then advance the stretcher over the obstacle to a point where No. 2 who is on the other side can grasp and support the handles at the front end. Nos. 1 and 4 then cross the obstacle and again obtain side holds on the stretcher, relieving No. 3 and carrying the stretcher forward with the assistance of No. 2. No. 3 then crosses the obstacle and takes his normal position.

Owing to restricted passages and numerous obstructions, it is sometimes impossible to carry a patient on a stretcher within

a mine according to the directions outlined above hence the following method has been adopted:

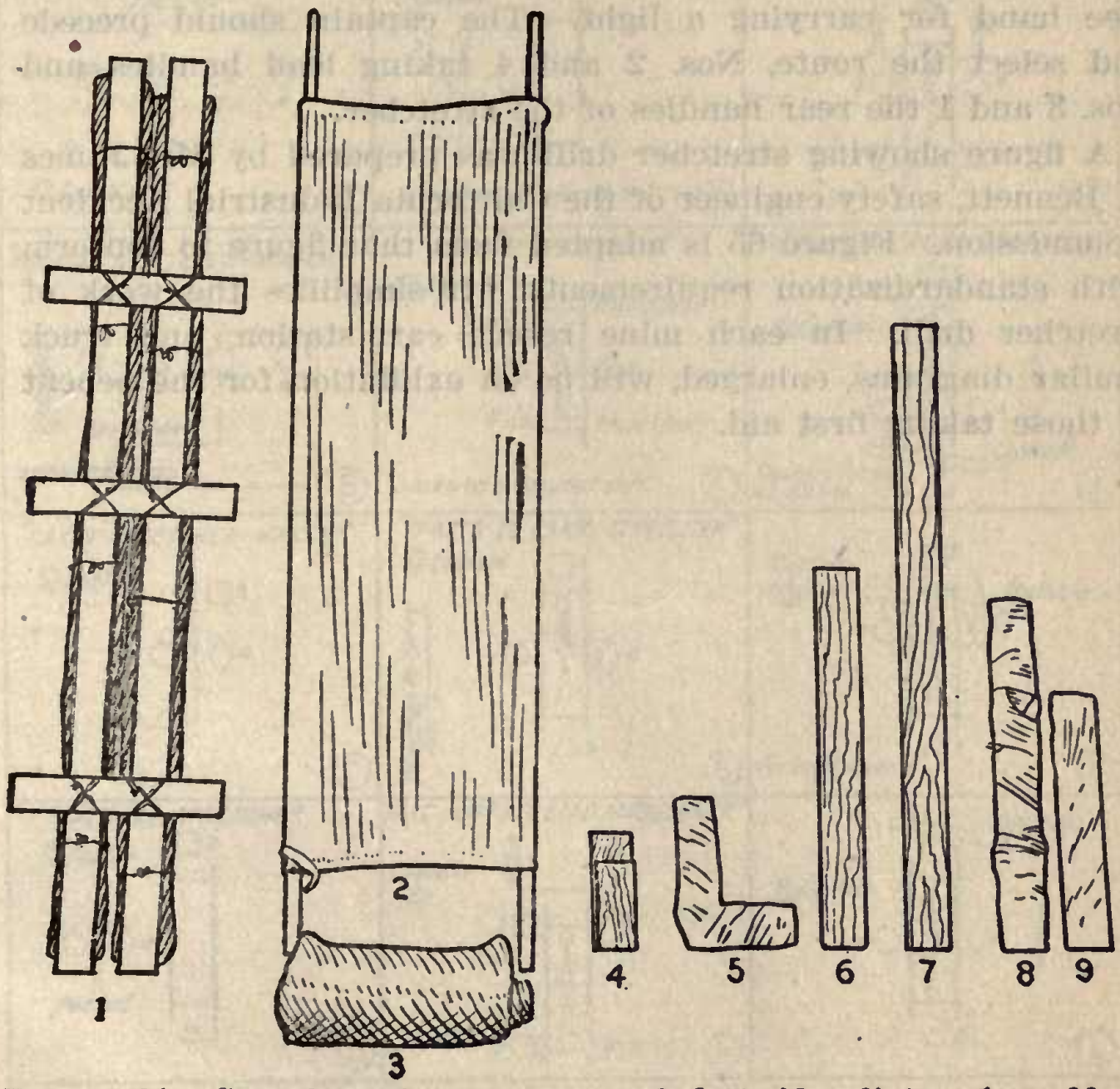

FIGURE 64.—Stretcher of army type and first-aid splints. 1, padded broken-back splint, back view; 2, stretcher; 3, blanket; 4, forearm splint; 5, padded elbow splint; 6, 7, splints for upper leg; 8, 9, splints for lower leg.

To transport the injured on a stretcher of the Army type (fig. 64) in a mine the rescuers should be in a position to see where

they step. For carrying a patient underground the four rescuers should each take hold of a handle of the stretcher and use the free hand for carrying a light. The captain should precede and select the route, Nos. 2 and 4 taking lead handles and Nos. 3 and 1 the rear handles of the stretcher.

A figure showing stretcher drill was prepared by Mr. James C. Bennett, safety engineer of the California Industrial Accident Commission. Figure 65 is adapted from that figure to conform with standardization requirements. It simplifies the work of stretcher drill. In each mine rescue car, station, and truck similar diagrams, enlarged, will be on exhibition for the benefit of those taking first aid.

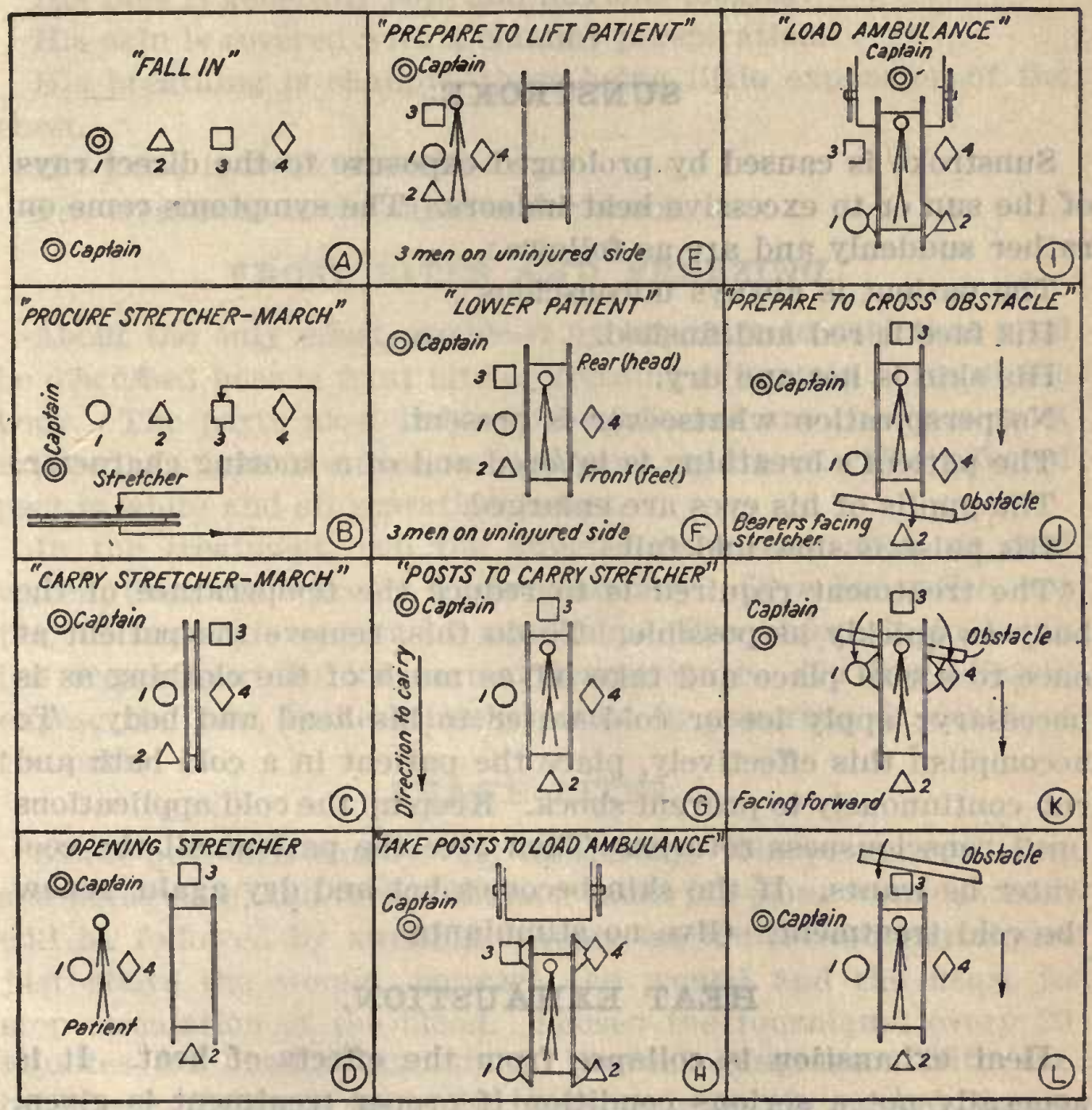

FIGURE 65.—Diagram of stretcher drill.

SUNSTROKE.

Sunstroke is caused by prolonged exposure to the direct rays of the sun or to excessive heat indoors. The symptoms come on rather suddenly and are as follows:

The patient is always unconscious.

His face is red and flushed.

His skin is hot and dry.

No perspiration whatsoever is present.

The patient's breathing is labored and of a snoring character.

The pupils of his eyes are enlarged.

His pulse is slow and full.

The treatment required is to reduce the temperature of the body as quickly as possible. To do this, remove the patient at once to a cool place and take off as much of the clothing as is necessary; apply ice or cold water to his head and body. To accomplish this effectively, place the patient in a cold bath and rub continuously to prevent shock. Keep up the cold applications until consciousness returns. Then give the patient all the cool water he wants. If the skin becomes hot and dry again, renew the cold treatment. Give no stimulants.

HEAT EXHAUSTION.

Heat exhaustion is collapse from the effects of heat. It is generally not a serious condition if proper treatment is given. The symptoms, which are directly opposite to those of sunstroke, are as follows:

The patient is never unconscious.

His face is generally pale and anxious looking.

His skin is covered with a clammy perspiration.

His breathing is shallow, there being little expansion of the chest.

His pulse is weak and fast.

The treatment is the same as for shock.

FROST BITES AND FREEZING.

About the only effect produced by exposure to cold that need be discussed here is frost bite or freezing of certain parts of the body. The parts most liable to be affected are the ones most exposed, such as the nose, ears, fingers, and toes. The affected part is white and all sensation is lost.

In the treatment, rub the affected part with snow or cold water; then use warmer water gradually. Give hot coffee, hot tea, or aromatic spirits of ammonia. The object is to bring the frozen part to its normal temperature. To immediately expose the part to heat might result in gangrene or death of the part.

SNAKE BITES.

Snake bites are usually very dangerous. The patient will feel a stinging pain, and there will be a small pin-point wound, which will be followed by swelling. Apply an improvised tourniquet just above the wound, between the wound and the heart to stop circulation of the blood. Loosen the tourniquet every 20 minutes for one-half minute to prevent gangrene. With the tip of a knife blade open the holes made by the snake's fangs, cutting lengthwise of the limb. Let blood run from the cut, at the same time rubbing the wound with the fingers to dislodge any of the poison that remains. Suck the wound. There

is no danger in doing so provided you do not swallow the blood and you have no wound in or about the mouth. Wash wound with whiskey rather than give it to the sufferer. Rub into the wound some baking soda or permanganate of potash moistened with water. If a hypodermic needle is available, use it to inject a saturated solution of permanganate of potash into the flesh around the wound.

COUNTERIRRITANTS.

Counterirritants act by causing a dilation of the vessels of the skin and reflexly by contracting the deeper vessels. The mustard poultice or mustard plaster and the turpentine stupe are the most commonly used. They are employed to relieve deep-seated pain and inflammation.

MUSTARD POULTICE.

Take 1 part of powdered mustard to 3 or 4 parts of flour and stir well into 10 parts of cold water. The resulting mixture may be spread between two pieces of muslin, warmed by holding near a fire, and applied to the skin.

MUSTARD PLASTER.

A mustard plaster may also be made by taking one part of mustard and four parts of ordinary flour, and adding sufficient water to form a paste. This is spread between two pieces of muslin, a piece of stiff paper being placed behind the plaster to give it added firmness. The action of the plaster should be watched and it should be removed after the skin has become reddened.

TURPENTINE STUPE.

A turpentine stupe, or healing application, may be made by stirring one tablespoonful of turpentine into a pint of boiling water. A piece of flannel is then dipped into the hot solution and wrung out by being twisted in a towel, and is then applied to the part while hot. The stupe is left in place until it produces a redness of the skin, but not long enough to cause blistering. Never attempt to warm the turpentine over a fire. Moreover, the boiling water should be removed from the fire before the turpentine is added.

MATERIAL FOR ADVANCED FIRST-AID STUDENTS.

DIGESTIVE SYSTEM.

The digestive system or alimentary apparatus may be considered as consisting primarily of a long tube composed of the mouth, pharynx (throat), esophagus (tube leading to stomach), stomach, and intestines or bowels, with the salivary glands, liver, and pancreas as accessory organs. This tube or alimentary canal is about 30 feet long, of varying diameter, and extends from the mouth to the anus. Its purpose or function is, first, to separate the nutritious material from the food and to expel the residue from the body, and, second, to convert the nutritious matter into such a form that it can be easily absorbed into the blood and be utilized by the tissues. To understand how this is accomplished, some knowledge of the separate parts forming this complicated apparatus is necessary.

MOUTH.

Strictly speaking, the mouth is only a cavity when the lips and jaws are open; at other times the whole cavity is filled by the tongue. For the sake of convenience, however, the mouth will be called an oval cavity forming the commencement of the alimentary canal; bounded in front by the lips, laterally by the cheeks, behind by the soft palate and the opening of the pharynx, above by the hard palate, and below by the floor of the mouth and the tongue. Suspended from the posterior border of the hard palate and narrowing the opening between the

mouth and the pharynx is a movable fold of mucous membrane, the soft palate; hanging down from the center is a small projection, the uvula; extending from the uvula downward and forward on either side are two folds of tissue or muscles known as the pillars of the soft palate. Between these two pillars are the tonsils. Separated from the cavity of the mouth by the soft palate is the pharynx or throat.

TONGUE.

The tongue lies in the floor of the mouth, and is composed of muscular fibers in which are embedded nerves and blood vessels. Its base is attached to adjacent structures by numerous muscles, its tip and sides being free. Extending from the under surface of the tongue to the floor of the mouth is a fold of mucous membrane called the frenum. The upper surface of the tongue is covered with a mucous membrane which is raised into numerous projections and gives to the tongue its rough appearance; beneath the mucous membrane lie the so-called taste buds.

TEETH.

Extending around inside the lips and cheeks in the form of an arch are the two rows of teeth, 32 in all, consisting of 2 incisors, 1 canine, 2 bicuspids, and 3 molars, in each half of each jaw. The teeth have as a special function the grinding of food, and are necessarily made up of a very strong, dense substance called dentin, which is covered with enamel, the hardest substance in the body. The interior of the tooth is known as the pulp cavity and contains blood vessels and nerves. Each tooth consists of three parts—the fang, or root, which lies embedded in the jaw, the crown, or that part projecting beyond the

gums, and the neck, or that part covered by the gums, lying between the root and the crown. Particles of food, if allowed to collect between the teeth, undergo fermentation and produce an acid that eats away the enamel, so that unless the teeth are kept properly cleaned decay is apt to follow.

The interior of the mouth is lined with mucous membrane, which contains numerous glands, the buccal glands, and has openings upon its surface for the ducts of the salivary glands. These consist of three pairs of glands—parotid (near the ear), submaxillary (under the jaw), and sublingual (under the tongue). The secretion from these glands, mixed with that from the many small glands in the mucous membrane of the mouth, forms the saliva or "spit." It is an alkaline fluid containing as its active principle a substance called ptyalin (ferment from saliva), which has the property of changing insoluble starches into a soluble sugar, maltose.

ESOPHAGUS.

The tube or gullet known as the esophagus extends downward from the lower part of the throat in front of the spinal column to the stomach. It is a canal about 10 inches long and serves to convey food from the mouth to the stomach.

STOMACH.

The stomach is an inverted, pear-shaped, baglike dilated part of the alimentary canal lying between the esophagus and the bowels. The greater part of it lies on the left side of the abdomen below the large muscles of respiration and beneath the anterior wall of the abdomen. The larger dilated end, lying to the left, is called the cardiac extremity; the smaller end, lying

to the right, is called the pyloric extremity or gateway to the bowels; and the part between the two is known as the body. As the stomach is easily distended, its capacity is subject to wide variations. Its average capacity, however, may be said to be about 2½ pints. When it is moderately distended its greatest diameter is 10 to 12 inches. When empty it collapses.

SMALL INTESTINE.

The small intestine or bowel is that part of the alimentary canal extending from the stomach above to the larger intestine. It is about 22 feet long and in diameter varies from 1 to 2 inches. The small intestine is divided into three parts: The duodenum, the first part, is 10 or 12 inches long and about 2 inches in diameter; the jujenum, the upper two-fifths of the small intestine, is 8 or 9 feet long and about 1½ inches in diameter; the ileum, or the lower half of the intestines, is 12 to 13 feet long and about 1¼ inches in diameter.

LARGE INTESTINE.

The large intestine is that part of the alimentary canal lying between the small intestine and the anus. It is 5 to 6 feet long and 2½ inches in diameter at its widest point. It begins on the right side as a dilated pouch 2½ to 3 inches long, termed the cecum, or blind pouch, from the lower back part of which extends a rudimentary bowel, usually curled, known as the vermiform appendix. The opening of the bowel is guarded by a double valvelike fold of tissue. From the blind pouch the large intestine or bowel passes up the right side of the abdomen, or belly, as the ascending colon. Upon reaching the liver it makes a sharp turn and passes across the abdomen as the transverse

colon. On the left side of the body it passes down as the descending colon and terminates or ends in the rectum, which opens externally as the anus.

LIVER.

The liver is a dark reddish-brown gland occupying the right side and part of the left side of the abdomen, lying below the larger breathing muscle and above the stomach and the intestines. It is the largest organ in the body, weighing 50 to 60 ounces and measuring 8½ to 9½ inches in its transverse diameter, 4¾ to 7¼ inches anteroposteriorly, and 6¼ inches in its greatest diameter vertically.

GALL BLADDER.

The gall bladder is a pear-shaped receptacle for the bile, and is 3 to 4 inches long with a capacity of 8 to 12 teaspoonfuls. It has a duct leading from its smaller end, which is joined by a duct from the liver, and the two form a larger duct which empties into the duodenum or small bowel.

PANCREAS.

The pancreas is a narrow, elongated gland 6 inches long, 2 inches broad, and 1 inch thick, and weighing 2 or 3 ounces. It extends transversely across the abdomen, the greater part of it lying on the left side behind the stomach and bowels. From its interior leads a duct which opens into the small bowel with the bile duct.

PROCESS OF DIGESTION.

The material taken into the body as food, although containing the necessary elements of nutrition, is often in an insoluble

form and of a composition far different from the tissues it is to build up or repair. Thus all foods have to be digested or changed into such form that they can be easily absorbed and at the same time furnish the necessary nourishment for the tissues. When the food is taken into the mouth it is thoroughly ground and chopped by the teeth. At this time the salivary glands begin to secrete a large quantity of saliva which moistens the mouth and the food and thoroughly mixes with the latter. The food thus becomes converted into a semisolid mass, and all parts of it are exposed to the action of the saliva, while the insoluble starchy constituents commence to be converted into a more soluble sugar, maltose. The bolus, as the food now thoroughly masticated and mixed with saliva is called, passes back into the pharynx, but is prevented from getting into the nose by the soft palate; it is pushed farther back by the tongue and, passing over the larynx which is closed by the epiglottis (a thin plate over the tube leading to the lungs) is then grasped by the muscular walls of the pharynx (a sac behind the mouth) and pushed on into the esophagus or tube leading to the stomach. This tube then begins to contract, from above downward, and propels the bolus along into the stomach.

As soon as the stomach receives the food an abundant secretion of gastric juice is poured out by the gastric glands and the stomach commences to contract. The food is thus churned and thoroughly mixed with the acid gastric juice until it resembles a thick pea soup, and is now known as chyme. The gastric juice through its acidity soon prevents any further digestion of the starches, which commenced in the mouth, but it acts on the proteids (the albuminoid constituents of an organism), changing them into more soluble substances, the peptones (albu-

minoids produced by the action of pepsin). Most of the chyme passes out into the duodenum or small bowel, then through the pylorus or gate, but a small part of it—some of the soluble sugars, water, and peptones—is probably absorbed directly by the blood vessels of the stomach wall.

As the chyme passes into the small bowel the bile and the pancreatic juice are poured out and mix with the acid chyme, converting it into an alkaline substance (one that combines with an acid to form a neutral salt), the chyle. The secretions from the liver and the pancreas, with those from the intestinal glands themselves, act on any proteids that remain undigested, converting them into more soluble substances. At the same time the conversion of starch into sugar, which is interrupted while the food is in the stomach, is continued. Finally fats and oils are emulsified or broken into minute drops, in which form they are more readily absorbed. As the chyle is forced along the intestines by their contraction, the products of digestion are absorbed by the villi (minute vascular projections from the mucous membrane of the bowels). Water, salts, proteids, and sugar are taken up from the villi by the blood vessels, and fats by the lacteals; the latter empty into the thoracic duct. This duct begins as a small sack situated upon the second lumbar vertebra. From the sack it extends as a small tube about the size of a goose quill up through the thoracic cavity and enters into the vein that collects the blood from the upper extremity on the left side.

When the digested matter with the undigested residue reaches the large intestine it is a fluid, but during its passage through the large intestine the fluids, as well as any dissolved substances which may have escaped absorption in the small intestine are

absorbed. The contents of this part of the bowels are thus gradually converted into a solid mass, and by the time the material reaches the rectum it is dark in color, has a characteristic odor, and is known as feces.

To sum up the process of digestion, the carbohydrates only are digested while the food is passing to the stomach; in the stomach the ptyalin (ferment of saliva) swallowed with the food continues to digest the starches for a time, and the proteids are also digested here, and a small quantity of water, soluble proteids, and carbohydrates are probably absorbed; in the small intestine carbohydrates, proteids, and fats are all digested and absorbed; and in the larger intestine a further absorption of those substances and of the fluid occurs.

EXCRETORY SYSTEM.

The lungs remove from the body a large quantity of carbonic acid and a small quantity of water, part of the fluid exhaled probably coming from the moisture of the nostrils.

SKIN.

The secretion in the skin, the sweat or perspiration, is a colorless fluid, with a salty taste and a peculiar odor, in which are excreted water, certain salts, carbonic acid, and urea. The amount of carbonic acid given off by the skin is less than 0.01 part of the amount given off by the lungs, and only small quantities of urea are normally eliminated by this route.

There is always a little perspiration being excreted, though we may not be conscious of it; the average amount in 24 hours is about 2 pounds; there may, however, be only a few ounces. The

perspiration may be so scant that it immediately evaporates, leaving no visible residue upon the skin. If, on account of an increase in the quantity of fluid perspired, or on account of the temperature, the perspiration does not evaporate, it remains in drops on the skin. Any condition causing blood to circulate freely through the skin will cause an individual to perspire more freely. After eating, after violent exercise, or in hot weather a large amount of perspiration is excreted.

On the other hand, early in the morning and in very cold weather, when the skin is less active, little perspiration is lost. The amount excreted also depends on the quantity of fluids a person takes.

The function of the sweat glands is to regulate the temperature of the body. Under the influence of high temperature of the atmosphere the sweat glands are stimulated. They pour out an increased amount of fluid, which rapidly evaporates and thus cools off the surface of the body. For this reason a dry atmosphere of high temperature can be borne more readily than an atmosphere of even lower temperature laden with moisture. In the first instance, evaporation of moisture readily occurs; in the latter, evaporation is interfered with and the body rapidly becomes overheated.

KIDNEYS.

Carbonic acid, salts, urea, and water are discharged in the form of urine from the kidneys into the tubes leading from the kidneys to the bladder. Urine is excreted continuously by the kidneys, and trickles drop by drop into the bladder until a sufficient quantity has accumulated to distend that organ and cause an uneasy sensation to be felt by the individual, when it

is discharged by contraction of the bladder. In a normal person about 42 ounces is excreted daily, but the amount varies in different individuals, depending upon the quantity of fluid swallowed, upon the food, upon the external temperature, and upon the amount one perspires.

As eliminators of water the kidneys may be considered as accessories of the skin, the amount of water they excrete depending upon that excreted by the skin; that is, the less the amount lost through the skin the more will be excreted by the kidneys. The amount of solids excreted, however, has little to do with perspiration, being dependent entirely on the waste going on in the body.

MEDICATION.

Although the Bureau of Mines does not advocate any surgical or medical interference by first-aid men, nevertheless miners in their homes are frequently called on to carry out instructions given by physicians, and often the miner and his family will be obliged to take the initiative until the doctor arrives. By knowing what to do and doing it, often a life may be saved.

The administration of drugs, outside of those agents employed as stimulants, is not often required in emergencies, yet a knowledge of this subject may at times prove of the greatest value in the absence of a physician or a nurse.

Medication by mouth is the method most frequently employed, and is applicable when rapid effect from the drug is not of prime importance; absorption of a drug from the stomach takes 20 to 30 minutes before the effects of the drug are felt. If rapid action is desired, drugs are injected by means of a hypodermic syringe into the tissues beneath the skin, from which absorption takes

place within four or five minutes; but this is a method that should be employed only by a physician or nurse. A third method of administering drugs and stimulants is by the rectum.

MEDICATION BY MOUTH.

When drugs are administered by the mouth, they are prescribed in the form of solutions, pills, or powders. It should be remembered that a drug is absorbed more rapidly when given in solution and on an empty stomach, whereas pills and powders are absorbed with comparative slowness as they have first to be dissolved in the fluids of the stomach before absorption is possible. Likewise, stimulants given hot are more effective, as heat in itself is somewhat of a stimulant.

The quantity of a drug administered at a given time will, of course, vary according to the particular drug used and the purpose for which it is prescribed, drops, teaspoonfuls, dessertspoonfuls, and tablespoonfuls being the doses employed. Roughly, 1 drop means a minim, a teaspoonful equals 60 drops or 1 dram, a dessertspoonful equals 2 drams, and 4 drams is a half ounce. When minims, drams, etc., are prescribed, and if great accuracy in dosage is required, as with more powerful remedies, the doses should be measured by means of a medicine dropper for minims, and by a medicine glass for drams. The glass or dropper used should always be perfectly clean, and should be carefully washed both before and after use. When any drug is administered, great care should be taken to insure that the correct drug is given. To make doubly sure, the label should be carefully read before the drug is measured out and again before it is given to the patient.

RECTAL MEDICATION.

When the stomach is unable to retain anything or if the patient is in such a condition that he can not take medicine by mouth, the drug may be introduced into the rectum by means of an enema, meaning a rectal injection of liquid medicine or food; or in a suppository, meaning a rectal injection of a solid. It should be remembered, however, in giving drugs in this way, that although the absorptive power of the bowel is great, drugs are taken into the circulation slowly—in about three-quarters of an hour—and if a rapid effect is desired this method should not be employed. As a rule, unless the drug is powerful, the dose is twice the quantity given by the mouth.

Enemata, or injections of fluids into the bowels, are of several kinds, and have a variety of uses. The doctor, when necessary, will advise the kind of enema needed. Those given to produce an evacuation of the bowels are known as purgative enemata; another class, spoken of as nutritive enemata, are employed to administer food or drugs by the rectum; again, in the treatment of shock or hemorrhage, large quantities of salt solutions are frequently injected into the bowels, and these are known as saline enemata.

The simplest apparatus for administering an enema consists of an ordinary fountain syringe and hard-rubber tip. found in nearly all households.

To give the enema, a sheet folded several times, or a single piece of rubber sheeting, should be placed under the patient as a protection for the bed. The patient is then turned on his left side with his knees drawn up. The fountain syringe should be filled with the solution to be injected and the air should be

expelled from the tubing by allowing some of the solution to escape; the nozzle should be well lubricated with olive oil or vaseline and should be gently inserted into the rectum a distance of about 2 to 3 inches while the patient strains slightly. The syringe should then be raised 2 or 3 feet above the patient and its contents allowed to enter the bowel. The patient is apt to complain of fullness and pain in the rectum, as the fluid distends it, but if the flow is temporarily stopped, this feeling soon passes off. When the desired quantity has been introduced, the flow is shut off by pinching the tube and gently withdrawing the nozzle from the rectum.

When an enema is given for the purpose of producing an evacuation of the bowels, the patient should, if possible, hold the enema for 5 or 10 minutes before using the bedpan. If an enema—as, for instance, a nutritive or a saline enema—is to be retained, the patient should lie quietly on his back for about half an hour and should avoid making any straining efforts.

PUBLICATIONS OF ESPECIAL INTEREST TO MINERS.

A limited supply of the following publications of the Bureau of Mines is temporarily available for free distribution. Requests for all publications can not be granted, and to insure equitable distribution applicants are requested to limit their selection to publications that may be of especial interest to them. Requests for publications should be addressed to the Director, Bureau of Mines.

Bulletin 17. A primer on explosives for coal miners, by C. E. Munroe and Clarence Hall. 1911. 61 pp., 10 pls., 12 figs.

Bulletin 62. National mine rescue and first-aid conference, Pittsburgh, Pa., September 23–26, 1912, by H. M. Wilson. 1913. 74 pp.

Bulletin 80. A primer on explosives for metal miners and quarrymen, by C. E. Munroe and Clarence Hall. 1915. 125 pp., 51 pls., 17 figs.

Bulletin 87. Houses for mining towns, by J. H. White. 1914. 64 pp., 8 pls., 9 figs.

Technical Paper 33. Sanitation at mining villages in the Birmingham district, Ala., by D. E. Woodbridge. 1913. 27 pp., 1 pl., 9 figs.

Technical Paper 59. Fires in Lake Superior iron mines, by Edwin Higgins. 1913. 34 pp., 2 pls.

Technical Paper 62. Relative effects of carbon monoxide on small animals, by G. A. Burrell, F. M. Seibert, and I. W. Robertson. 1914. 23 pp.

Technical Paper 67. Mine signboards, by Edwin Higgins and Edward Steidle. 1913. 15 pp., 1 pl., 4 figs.

Technical Paper 97. Saving fuel in heating a house, by L. P. Breckenridge and S. B. Flagg. 1915. 35 pp., 3 figs.

Technical Paper 111. Safety in stone quarrying, by Oliver Bowles. 1915. 48 pp., 5 pls., 4 figs.

Technical Paper 116. Miners' wash and change houses, by J. P. White. 1915. 27 pp., 3 pls., 3 figs.

Miners' Circular 5. Electrical accidents in mines, their causes and prevention, by H. H. Clark, W. D. Roberts, L. C. Ilsey, and H. F. Randolph. 1911. 10 pp., 3 pls.

Miners' Circular 7. Use and misuse of explosives in coal mining, by J. J. Rutledge, with a preface by J. A. Holmes. 1913. 52 pp., 8 figs.

Miners' Circular 9. Accidents from falls of roof and coal, by G. S. Rice. 1912. 16 pp.

Miners' Circular 10. Mine fires and how to fight them, by J. W. Paul. 1912. 14 pp.

Miners' Circular 11. Accidents from mine cars and locomotives, by L. M. Jones. 1912. 16 pp.

Miners' Circular 12. Use and care of miners' safety lamps, by J. W. Paul. 1913. 16 pp., 4 figs.

Miners' Circular 13. Safety in tunneling, by D. W. Brunton and J. A. Davis. 1913. 19 pp.

Miners' Circular 14. Gases found in coal mines, by G. A. Burrell and F. M. Seibert. 1913. 23 pp.

Miners' Circular 16. Hints on coal-mine ventilation, by J. J. Rutledge. 1914. 22 pp.

Miners' Circular 17. Accidents from falls of rock or ore, by Edwin Higgins. 1914. 15 pp., 8 figs.

Miners' Circular 18. Notes on miners' carbide lamps, by J. W. Paul. 1915. 11 pp.

Miners' Circular 19. The prevention of accidents from explosives in metal mining, by Edwin Higgins. 1914. 16 pp., 11 figs.

Miners' Circular 20. How a miner can avoid some dangerous diseases, by A. J. Lanza and Joseph H. White. 1916. 26 pp., 4 figs.

Miners' Circular 21. What a miner can do to prevent explosions of gas and of coal dust, by G. S. Rice. 1915. 24 pp.

Miners' Circular 23. Elementary first aid for the miner, by W. A. Lynott and Daniel Harrington. 1916. 24 pp., 19 figs.

PUBLICATIONS THAT MAY BE OBTAINED ONLY THROUGH THE SUPERINTENDENT OF DOCUMENTS.

The editions for free distribution of the following Bureau of Mines publications are exhausted, but copies may be obtained by purchase from the Superintendent of Documents, Government Printing Office, Washington, D. C., or can be consulted at public libraries. Prepayment of the price is required and should be made in cash (exact amount) or by postal or express money order payable to the Superintendent of Documents.

The Superintendent of Documents is an official of the Government Printing Office and is not connected with the Bureau of Mines.

Bulletin 44. First national mine-safety demonstration, Pittsburgh, Pa., October 30 and 31, 1911, by H. M. Wilson and A. H. Fay, with a chapter on the explosion at the experimental mine, by G. S. Rice. 1912. 75 pp., 8 pls., 4 figs. 15 cents.

Technical Paper 24. Mine fires, a preliminary study, by G. S. Rice. 1912. 51 pp., 1 fig. 5 cents.

Technical Paper 29. Training with mine rescue breathing apparatus, by J. W. Paul. 1912. 16 pp.

Technical Paper 56. Notes on the prevention of gas and dust explosions in coal mines, by G. S. Rice. 1913. 24 pp. 5 cents.

Miners' Circular 4. The use and care of mine rescue breathing apparatus, by J. W. Paul. 1911. 24 pp., 5 figs. 5 cents.

Miners' Circular 15. Rules for mine rescue and first-aid field contests, by J. W. Paul. 1913. 12 pp. 5 cents.

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