Many cases of mere erosion or of slight ulceration undoubtedly pass unnoticed. The most important symptoms which indicate the existence of ulceration are two —namely, the appearance of bloody streaks in the expectoration some days after the operation and a black discoloration of the lower end of the tube.

It is on account of the danger of these pressure effects that so much stress has been laid in a previous section on the use of such a form of tube as shall in its construction provide as perfectly as possible against friction and pressure while it is worn. For the same reason efforts to dispense with the cannula should be begun very early, and whenever evidences of pressure effects are detected, its removal, if but for a short time at any one trial, should be frequently practised. In cases of the high operation the cannula may possibly sometimes be dispensed with altogether.

Granulation Vegetations. — Exuberant granulations, forming polypoid excrescences projecting into the trachea, have been noted by many observers; they may be sessile or pedunculated, single or multiple; they most frequently occupy the superior or inferior angle of the wound, at which points a small space exists not occupied by the cannula, which is early filled by granulation tissue and is constantly subject to the irritation of the tube thereafter.

Whenever vegetations are discovered protruding into the trachea from the angles of the tracheal wound, they are to be treated as exuberant granulations would be in any other locality. They are to be destroyed by the application of caustics, or if they can be torn away their bases should be cauterized. Whatever operative procedure may be necessary to make them accessible to the required applications must be done, as their presence is always a source of danger. Whenever a prolonged use of the cannula is necessary, a watch should be kept for any signs of their development and their growth repressed from the first.

Chronic Hypertrophic Subglottic Laryngitis.—A chronic thickening of the soft parts between the vocal cords and the lower border of the cricoid cartilage is an occasional sequel to laryngeal diphtheria, and by the stenosis which it causes makes necessary the prolonged retention of a tracheal cannula. Attempts to relieve the obstruction by laryngotomy and excision of the obstructing tissues have been uniformly unsuccessful.

Care of the Cannula.—A constant watch over the cannula should be had from the moment of its introduction until either it is possible to remove it altogether, or the trachea has become accustomed to its presence and the tracheal secretions are normal. The surgeon must see that the nurse is thoroughly familiar with the mechanism of the double tube and knows how to remove and replace the inner tube with the least possible disturbance to the patient. It is especially desirable that the care of the cannula be entrusted to a judicious person who will not neglect it on the one hand, nor needlessly torment the patient on the other by useless fussiness over it. The inner tube should be removed only when there is a manifest occasion for it, as shown by some interference with the free passage of air. If the toilet of the trachea has been carefully made before the tube is introduced, the amount of expectoration will often not be very great during the first twenty-four hours; but if rapid breaking down of membrane, or a copious tracheal or bronchial catarrh coincides with the introduction of the cannula and occasions profuse expectoration, the tendency to clogging of the tube will be so frequently manifest that the removal of the inner tube and its cleaning will be required at comparatively short intervals. Even in cases which are not giving much trouble, obstructive crises are likely to develop suddenly at any time, caused by clumps of inspissated mucus, or pieces of exfoliated membrane, being driven into the tube by cough, or being brought up against its lower end so as to occlude more or less completely its opening. The extreme dyspnœa caused by such an accident, if not quickly relieved, will soon end in death. If the removal of the inner tube does not relieve the symptoms, the whole tube should be removed, and the needed measures to clear out the trachea be carried on through the unobstructed wound. When the inner tube is to be removed, the shield of the outer tube should be steadied by the thumb and forefinger of one hand, while the inner tube is disengaged and withdrawn with the other hand. The withdrawn tube should then be dropped into a cup of warm water, in which it should be left for a short time in order to soften the more or less inspissated mucus within it. Then a small mass of cotton-wool or a piece of sponge should be pushed through it, so as to clear it out. A splint from a broom will always be available for the purpose of pushing the cotton or sponge through, and is to be chosen rather than a wire or hairpin; for the latter, if not very carefully used, may scratch and mar the soft metal of which the tube is made. The tube having been cleaned out, it should then be rinsed in the water and replaced. The inner tube ought not to be left out any longer than is necessary to clean it, lest, when it is replaced, it push before it a possible mass of inspissated mucus, gathered on the inside of the outer tube while the inner one has been out, which by the time the tube is down in place may become a plug sufficient entirely to occlude it.

The outer tube may usually be left in place, without being disturbed, for the first two days. At the end of this time, that is, at the close of the second or the beginning of the third day, it will be desirable to remove the whole apparatus for the purpose of cleaning up. By this time the wound borders will have become somewhat firm, so that the opening down to the trachea will remain patent for a while without the tube, and sufficient time can be had to clean up the wound and the parts about, as well as to cleanse the tubes and arm them with fresh tapes. When the cannula is ready to be replaced, it will generally easily slip back into the trachea along the track which it has already made for itself, the walls of which are firm enough to guide the advancing end of the tube, if it is gently pushed along with proper regard to the direction which it should take. A hitch may occur when the end of the cannula reaches the entrance into the trachea, owing to the resilient cartilages having sprung back and partly closed the opening. If the tube has been kept out some time this obstacle is more likely to arise. Usually a little gentle pressure will overcome it, but care must be taken lest the tube be thrust down in front or at the side of the trachea instead of into it. The use of a conical-pointed pilot obturator (Fig. 4743) will always prevent any difficulty of this kind, and the surgeon would do well to be provided with one. The three-bladed dilator of Laborde is also very serviceable in overcoming such a difficulty. If the cannula track has not become quite well defined and firm, the hook retractors may be used to advantage for dilating anew the tracheal wound sufficiently to permit the cannula to pass.

If the walls of the wound are still so soft at this period that they fall together at once after removing the cannula, the wound must be kept open by a dilator while the necessary cares are given to it and a fresh tube is made ready for insertion. When this first change of the cannula is to be made the patient should be placed upon a table with the same arrangement as in the original operation, otherwise the surgeon may find himself at a very great disadvantage in his efforts to give the needed attention to his patient.

The further care of the cannula will differ according to the nature of the case for which tracheotomy has been done. If the tube is to be worn permanently, or until some cause of obstruction has been removed by subsequent operation, it will be left in place, with but rare changes. If the tube is one whose size and shape are adapted to the case, the trachea soon becomes accustomed to it so that it is borne without discomfort; the superficial wound heals rapidly, and the track of the cannula becomes a fistula with well-organized walls. If the operation has been done for the relief of temporary obstruction from inflammatory or diphtheritic disease of the

larynx, it will be desirable to dispense with the cannula as soon as the obstruction shall have cleared away sufficiently to permit air again to pass through the larynx. To determine this the tube should be removed at the end of thirty-six or forty-eight hours, with great gentleness, so as to alarm the patient as little as possible, and the wound opening should be occluded with two or three folds of moist muslin placed over it, so as to test the ability of the patient to respire through the larynx. Frequently, even as early as this, it will be found that the obstruction has cleared away and that the cannula can be permanently dispensed with. If, however, respiration through the natural channels be found still impossible, the cannula must be replaced. Each day the permeability of the larynx may be again tested for a time. If by the eighth day it shall appear that easy respiration through the larynx is not yet possible, it will rarely be due to the persistence of obstructive exudate or œdematous swelling, but will be caused in the most cases either by temporary paralysis of the glottic dilators, diphtheritic in origin, or by glottic spasm of emotional origin; less frequently it will be due to persistent submucous inflammatory swelling or to inflammatory infiltration of the laryngeal muscles. More rarely yet, the inability to do without the tube will be due to the tracheal conditions already described, viz., in-turned cartilages, collapse of the trachea, or polypoid granulation excrescences. Cicatricial contractions causing stenosis of the trachea, following upon extensive destruction of its walls by ulceration or gangrene, may also oblige the patient permanently to retain the cannula. Whatever the cause, it will be well now to suspend for a time the efforts to do without the tube. A week may be allowed to pass during which the larynx is left at rest, and efforts are made to improve the general condition of the patient by iron and strychnine, and the local paresis by faradization. At the end of this time the efforts to dispense with the cannula should be renewed. All the manipulations should be made with gentleness, accompanied by manner and voice tending to reassure the patient, who has learned to rely on the cannula for breath, and who regards its removal with apprehension. As soon as any marked distress is caused by the absence of the tube it should be replaced, and further attempts deferred until another day. If after three or four trials suffocative crises continue to follow quickly after every attempt to remove the tube, these efforts should be desisted from again for some time, a week or more. In the vast majority of cases a time will finally come when the tube may permanently be dispensed with.

Emotional laryngeal spasm is a condition which has frequently to be encountered in the effort to remove the cannula in nervous, excitable children. It may coexist with and thus aggravate the difficulties caused by other conditions, or may be the sole trouble.

This emotional condition is to be overcome by tact, patience, and time. Many artifices have been resorted to for conquering the nervous fear upon which the spasm depends. Gradual shortening of the cannula, even down to the point of a mere button resting upon the closed external wound, and gradual narrowing of the cannula until it is no longer a pervious tube, have each been resorted to successfully. The confidence of the patient in his ability to breathe without the tube must be awakened; how to do this must be left largely to the ingenuity of the attendants and the inspiration of the occasion.

Lewis S. Pilcher.

TRAGACANTH.—(*Tragacantha*, U. S., Br., P. G.; *Gomme adragante*, Cod. Med.) A gummy exudation from *Astragalus gummifer* L., and from other species of *Astragalus* (fam. *Leguminosæ*). The species yielding this gum are straggling, spiny shrubs of southwestern Asia, some of them extending into southeastern Europe. The gum is a product of the mucilaginous degeneration of the cell walls of the pith. At certain seasons it is subjected to a great pressure within the stem, by which it is forced out, in the manner indicated in the accompanying illustration, through any opening reaching to the surface. Many such openings occur from natural causes, while others are made for the purpose by the gum collectors. The form of the exudate varies somewhat with that of the opening, so that cylindraceous ("vermicelli"), ribbon-like ("flake"), tear forms, etc., occur. Most of the flake form is obtained from artificial incisions. The gum is gathered promiscuously by the collectors, and is carefully assorted by professional pickers after being

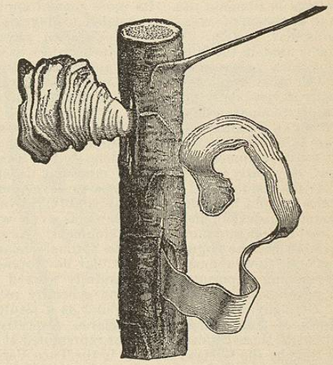

Fig. 4746.—Gum Escaping from Incisions in a Branch of a Tragacanth Shrub. (Baillon.)

marketed. There are numerous commercial grades, primarily designated by number, and depending upon the purity, solubility, and whiteness of the article.

Description.—In narrow or broad bands, more or less curved or contorted, marked by parallel lines or ridges, white or faintly yellowish, translucent, horn-like, tough, and rendered more easily pulverizable by a heat of 50° C. (122° F.).

On treating tragacanth with water, it swells and gradually forms a gelatinous mass, which is tinged blue by iodine T.S., and the fluid portion of which is precipitated on the addition of alcohol, but is not colored blue by iodine T.S.

Tragacanth consists of from one-third to one-half its weight of *bassorin* ($C_6H_{10}O_5$), an insoluble gum common to a number of commercial products (bassora gum, simaruba gum, cherry-tree gum, etc.) and of extended occurrence in the vegetable kingdom. It is capable of absorbing a good many times its weight of water, when it becomes transparent, soft, and jelly-like, but will not dissolve clearly when more water is added. Bassorin can be seen reasonably pure by putting a piece of tragacanth in a tumblerful of water and letting it remain, say, twenty-four hours until the soluble gum is dissolved out. About half of tragacanth consists also of a *soluble gum*, of the arabin series. Water, mineral substances, and impurities constitute the remainder. Tragacanth has no medicinal, and very little nutritive value. It is very largely used in the arts for sizing, mucilage, etc., and has considerable employment in pharmacy, where it is used as a basis of emulsions, for the suspension in liquid of powders and insoluble substances in "mixtures;" as a body for troches, etc. It appears in the following official preparations: *Trochisci Acidi Tannici*, *Trochisci Ipecacuanhæ*, *Trochisci Potassii Chloratis*, *Trochisci Santonici*, *Trochisci Zingiberis*, all of them belonging to the United States Pharmacopœia. There is a Mucilage of Tragacanth (*Mucilago Tragacanthæ*, U. S. P.) consisting of six parts of tragacanth, eighteen of glycerin, and enough water to make a hundred; this, diluted with about as much more water, will emulsionize cod-liver or

castor oil sufficiently well; the usual strength is to make the emulsion one-half oil. It may be flavored with peppermint, almond, or other fragrant substance. For desk purposes, as an adhesive mucilage, tragacanth, softened with thymol water and kept from evaporation, will not decompose or sour in the least, even after years.

W. P. Bolles.

TRAINING, PHYSICAL.—The word *training* has two applications in common use. Its more general application is to a system of exercises intended to develop the neuromuscular system. In this application physical training is used in the literature of the subject as synonymous with "*physical education*" and "*physical culture.*" The other application of the word *training* is to a specially devised daily programme of exercise and diet preparatory to an athletic contest.

I. Physical Training.—Physical training in its general sense is an educational system supposed by many to signify the development of muscle alone, but it became apparent very early in the study of muscular development: (1) that there could be no extensive development of muscles without brain development; and (2) conversely no extensive development of the brain as a rule without at least a moderate muscular development. As soon as educators became cognizant of the intimate relation between brain development and muscular development, the far-reaching importance of a carefully worked out system of physical education became generally recognized. Germany, Sweden, and England as a result of the efforts of Jahn, Ling, and Maclaren, respectively worked out in those countries systems represented at the present time by the German method in the Turn Verein, the Swedish gymnastics, and the English modification of the German system.

Somewhat later, Dr. Dio Lewis started a movement in this country through his lectures and writings on hygiene, muscular exercise, and gymnastics. The general interest aroused led to the gradual development of a system which embodies some of the better features of the European systems, while introducing many features which are particularly adapted to the conditions that exist in America.

The system of physical training, now used in this country, may be classified under the heads: (1) Developmental or educational; (2) corrective or therapeutic; (3) recreative or hygienic.

1. *Developmental* or *educational* physical training is a progressive series of physical exercises designed to cultivate in the growing child or the youth muscular strength and the ability to command the muscles singly or in groups to act gracefully and accurately. Both grace and accuracy depend upon co-ordination. Such a series of exercises is adapted not only to the development of the normal child, but also of the child whose mental and physical development has been retarded or arrested.

2. *Corrective* or *therapeutic* physical training consists of a series of specially devised exercises prescribed by a physician to correct special pathological conditions.

3. *Recreative* or *hygienic* physical training consists of a series of calisthenics, gymnastic floor games, field sports, and athletics intended to maintain the physical vigor, to divert the mind from its regular channel, and to increase the power of resistance to disease.

II. Athletic Training.—1. *Definition.*—To produce in an individual by a definite régime a condition of strength, agility, skill, and courage; with ability to endure pain, to maintain self-control, to resist or quickly to recover from fatigue.

2. *The régime* of training consists in a course of carefully arranged exercises or tests which gradually bring the muscular strength and agility to their highest point of perfection. The exercises are of a threefold character: (*a*) General exercises to increase general strength, and particularly the strength of heart and capacity of lungs, as upon a vigorous circulation and an ample respiration depends much of the success of the athlete in these contests. (*b*) Daily practice in the event or particular exercise in which the athlete is to contest. The object of this part of his training is to give him skill and courage in that particular exercise or sport. (*c*) A carefully arranged system of diet, baths, and general hygiene, the object of which is to keep his system in the best possible hygienic condition.

Winfield S. Hall.

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TRANCE. See *Consciousness, Disorders of.*

TRANSFUSION.—Under this title are included the various processes of introducing into the veins of a patient the blood of another person or of an animal. The term is often used more broadly to include also the procedures already described under the titles *Hypodermoclysis* and *Intravenous Injections.*

The possibility of transfusing blood was known to the ancients and was occasionally practised during the Middle Ages. A famous instance is that of Pope Innocent VII., mentioned by Savonarola. The pope was bled and his blood injected into two young men. They were bled in turn and their blood was introduced into the veins of the pope. All three died.

After the discovery of the circulation by Harvey in the early part of the seventeenth century a number of experiments on animals and on man were done with the object of treating various diseases by the transfusion of blood. Attempts were made to cure leprosy, insanity, and other diseases in this way, as well as to combat hemorrhage and shock and to rejuvenate the aged. The names of Libavius, Lower, and Denis are prominent in this connection. They had more or less success. In consequence of the death of one of Denis' patients, treated for insanity by the introduction of lamb's blood, the operation was forbidden in France. It was revived in the early part of the last century. It then steadily gained ground as its value became obvious. Only quite recently has it been displaced by the safer, simpler, and equally efficacious method of saline infusions.

The blood of animals and of man has been employed. Many of the early operators used the blood of lambs. The introduction of the blood of an animal of one species into the veins of an animal of a different species is, however, a dangerous procedure, as the blood of one animal destroys the corpuscles of another. Moreover, in man marked toxic symptoms are produced. Even with small doses dyspnœa, sensations of heat and distention, especially in the face and head, backache and headache may come on during the administration. Increased peristalsis with abdominal pain, vomiting and catharsis may occur. In the course of an hour chills and fever are almost always observed. Subsequently hæmoglobinuria, albuminuria, and urticaria are sometimes present.

Defibrinated human blood has also been used. This is objectionable because the process is somewhat complicated and time-consuming, and it is difficult to keep the blood aseptic. A more important objection arises from the fact that the fibrin ferment is formed in the process of defibrination, and is present in the blood injected. There is good reason to fear that intravascular clotting might result.

The immediate transfer of blood from donor to patient without intermediate manipulation is probably the best method. Even this, however, is not free from the dangers of air emboli and of clot formation in the tubes. It is possible, too, that serious diseases might be transmitted. Another objection is the difficulty of securing a donor. These objections are not, however, insurmountable, and the operation has been developed to such a point of safety and convenience that, had not safer and simpler, but almost equally efficient means been devised for accomplishing the same end, there can be no doubt that the operation would be of great value to-day.

Operative Procedures.—These have varied greatly, but in the present status of the operation a detailed description is not necessary. For further details the reader is referred to the excellent article by Dr. Howe in the first edition of this Handbook. For direct transfusion the apparatus of Aveling is perhaps the best. This consists of a rubber tube eighteen inches long, with a small bulb in the middle and a cannula and stopcock at each end. The instrument is boiled, filled with warm, sterile decinormal salt solution (sodium chloride, six-tenths of one per cent.), and every care taken to expel all the air from it. It is kept, while the patient is being prepared, in a basin of the same solution. The arm of the patient is rendered surgically clean, and the most prominent vein near the bend of the elbow is exposed by a short incision and slight dissection. The vessel is opened and one of the cannulæ inserted. The assistant in the mean time has inserted in exactly the same manner the other cannula in a vein of the donor. The latter should be in good health, of strong mental equanimity, and preferably not an anxious relative of the patient. As in phlebotomy the veins may be made more prominent by applying about the arm above the elbow a bandage tight enough to obstruct the venous outflow without stopping the pulse. During the transfusion the bandage should of course be removed from the patient, but may with advantage be left upon the donor.

The cannula in the donor should point toward the fingers, that in the patient toward the shoulder. They

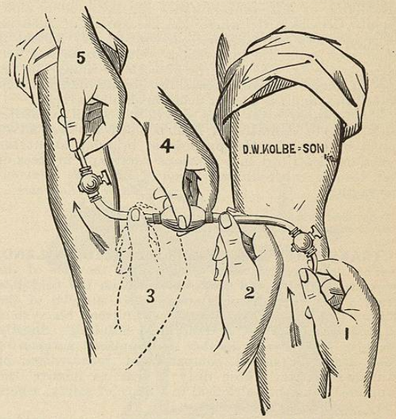

Fig. 4747.—Aveling's Transfusion Apparatus. 1, 5, Hands of the assistant holding the cannulæ in position; 4, hand of the operator compressing the bulb; 2, 3, hand of the operator compressing alternately the afferent and efferent tubes.

need not, as a rule, be tied in. The operator now pinches the tube between the bulb and the donor (*2*, Fig. 4747), and with his other hand opens both stopcocks. He then compresses the bulb, thus driving its contents into the patient's arm. Keeping the bulb compressed, he removes the first hand and pinches the tube on the patient's side of the bulb (*3*, Fig. 4747). Now, the pressure on the bulb itself being released, the apparatus fills with blood from the donor, which, on repeating the process, is forced into the patient's vein. Five to ten ounces of blood should be transfused. The quantity can be calculated from the capacity of the bulb, ordinarily two drachms.

It is said that the bulb is unnecessary as, by properly bandaging the arm of the donor, his intravenous blood pressure may be made sufficient to bring about the transfer.

For the use of defibrinated blood various methods were devised. The simplest way is as follows: The donor is bled into a clean vessel. The blood is then whipped with glass rods till the fibrin is all removed. It is then strained through muslin and kept warm until needed by setting the container in warm water. An ordinary glass funnel with a rubber tube ending in a cannula and guarded by a stopcock may be used for the injection. Syringes of various sorts have been used both with whole and with defibrinated blood. Full aseptic precautions should of course be observed and every care taken to exclude air bubbles.

Peritoneal transfusion, the injection of blood into the peritoneal cavity, is of no practical value and should not be used. *Autotransfusion* consists of increasing the supply of blood to the essential organs at the expense of the limbs. It is accomplished by the application of tight rubber bandages to the legs, beginning at the toes and going upward. It is of undoubted value for temporary use in emergencies where large amounts of blood have

been lost, until the volume of the circulation can be made up in other ways. A somewhat similar procedure has been recently advocated for the purpose of maintaining the blood pressure in cases in which the vaso-motor centre has been exhausted by shock—the pressure being applied to the abdomen and extremities by inflating a pneumatic rubber suit.[1]

The principal indication for transfusion is severe hemorrhage. It may be said that in most cases the introduction of salt solution under the skin will be sufficient. Occasionally, where the absorption of such an injection does not take place or where every instant of time is of value, the intravenous route is to be selected. Rarely, if ever, will there be enough advantage in the use of blood to overbalance its greater dangers and difficulties, and the greater delay in administering it.

The repeated intravenous injection of small quantities (5–25 c.c.) of defibrinated lamb's blood has been advocated by Bier[2] for the purpose of bringing about the reactions described in a previous paragraph in cases of old, chronic tuberculosis. Some of his cases were encouraging. *Ralph C. Larrabee.*

[1] Crile: Boston Med. and Surg. Journ.., March 5th, 1903.
[2] Bier: Münch. med. Wochenschr., 1901, Bd. xlviii., S. 569.

TRANSPORTATION OF THE DISABLED ON LAND.—The first systematized methods for the care of the wounded in battle and their removal from the field date from 1792, when Baron Larrey, chief surgeon of the French army under Napoleon I., established his system of *ambulances volantes*, or flying field hospitals. Shortly after, in 1800, Percy, another distinguished surgeon of that army, organized companies of *brancardiers*, or stretcher-bearers, whose duty it was to remove the wounded from the battlefield to a place of safety, where they could receive proper care.

Since that period increasing attention has been paid to this subject, until at the present day more or less elaborate systems of military hospitals, and means for transporting the sick and wounded to these hospitals are maintained by all civilized armies.

It should be explained in this connection that in foreign armies by the term "ambulance" is understood the entire movable field hospital, including medical and surgical supplies, the means of transportation, the animals and harness, and the personnel of the hospital officers and men of the sanitary force. In our army the term is restricted to the *ambulance wagon*, in which the sick and wounded are carried. The term ambulance corps in the United States Army comprehends the ambulance wagons, litters and other appliances for transporting the disabled; the baggage and subsistence wagons; the harness and animals, as well as the officers and men who are charged with their control and management. In this article the terms will be used in the same sense in which they are understood in the United States.

In our service the means of transportation, which usually accompany a moving command, are its ambulances

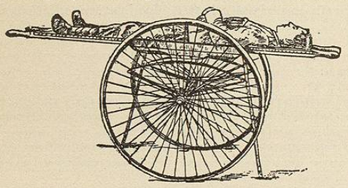

FIG. 4748.—British Wheeled Litter, Loaded.

and hand litters. At times, owing to the character of the country in which the troops are operating, as in regions without roads, the ambulances cannot be employed; in such cases other means must be resorted to. When, owing to excessive casualties or other exigencies, sufficient ambulances are not available, army wagons, wagons or carts of the country, saddle, pack, and draught animals may supplement the ambulances. When rail or water transportation is available and practicable, railroad trains and boats are employed, especially when large numbers of sick and wounded are to be removed to a considerable distance, as in the service of evacuation. It is a military principle that the operating force should not be embarrassed by the care of its sick and wounded any longer than necessary; this enables the field hospitals, which always accompany the moving army, to travel light, makes room for the wounded from an impending engagement, and diminishes the danger of infecting the well by those already diseased. Besides, base and general hospitals being more or less permanent institutions, are better supplied with the necessities and comforts for the care of the sick than would be possible in a hospital which accompanies a moving force.

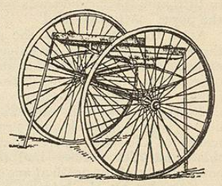

FIG. 4749.—British Wheeled Litter, without Litter.

Ordinarily patients from the battlefield will have to be carried on litters to the dressing station, from which point they are again carried by litters to the ambulance stations; here they are loaded into the ambulances for removal to the field hospitals. Other specially devised means that are used for the transportation of the disabled in the military service are the wheeled litter, cacolet, single or double-horse (or mule) litter, and the travois.

The hand litter has already been described in this work in the article on *Army Hospital Corps* by Major Bushnell, and will not be considered here.

The Wheeled Litter.—The wheeled litter is simply a litter mounted upon wheels, usually two in number, designed to be propelled by a single bearer. Numerous different patterns of such appliances have been devised, varying in design with the character of the service required of them. In some forms the bed for supporting the patient is removable, permitting of its use as a hand litter; in others, it is fixed permanently to the carriage; some are made to fold into a compact bundle to permit of ready packing or shipment; in another form, the litter is mounted between two bicycles, which are joined to the litter frame and to each other by interlocking bars; tricycles arranged "fore and aft" with reference to the litter have also been adapted to form the carriage. The simplest and most practical form consists of two light wheels and an axle, supporting a frame for the litter with a device for holding it in the horizontal position when at rest without the bearer's help. This device consists of two hinged bars of proper length fastened to each end of the frame or carriage, which are swung up and secured by suitable fastenings when the litter is in motion. Usually litters of this class are covered with a removable hood and are mounted upon springs. An excellent type was used by the British military surgeons in the recent war in South Africa, and is shown in Figs. 4748 and 4749. The wheels have steel spokes and rims, rubber tires, and ball bearings; the bed is made to take the British regulation litter, and is mounted upon elliptical springs; the litter is securely held in place upon the bed by means of two buttons with tightening screws. The great object of this carriage is said by its designer, Major McCormack, R.A.M.C., to have been "to obtain mobility, strength, and lightness combined with efficiency and a ready and easy means of transport for sick and wounded, no matter where a patient has to be transported from." Nevertheless, wheeled litters have but a limited range of usefulness. They were extensively tried during our Civil War for the purpose of removing the wounded from the battlefield, but did not meet with favor from our surgeons; they proved to be practically

useless over the rough ground upon which battles were fought. In moving patients from one part of a hospital to another, and in villages and towns where ambulance systems do not exist, their utility is undoubted; but in the military service their sphere of usefulness will be largely confined to work in and about hospitals, and in loading and unloading trains; they will here prove economical of men and comfortable to patients.

Horse-litters.—One form of horse-litter is the *cacolet*, which consists of a pack saddle, from each side of which

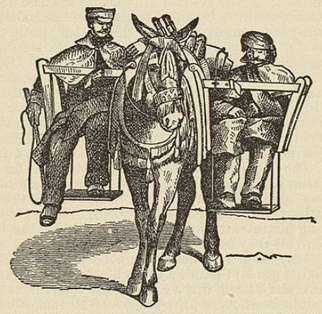

FIG. 4750.—British Crimean Cacolet. (After Weir.)

is suspended a seat or chair; in this seat the patient is carried in the sitting posture. This form of litter was extensively used by the English in the Crimean war, and by the French in Algeria and Mexico, apparently with satisfactory results. In our service trials were made during the Civil War with this form of litter, but the consensus of opinion of our medical officers, who had experience in its use, was decidedly against this method of transportation for sick and wounded. No doubt this unfavorable opinion was largely due to inability to secure properly trained animals, and perhaps also to the fact that other more satisfactory means were available.

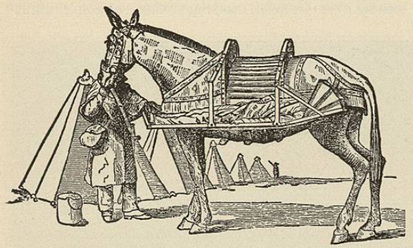

FIG. 4751.—British Crimean Mule Litter. (After Weir.)

Its sphere of utility should properly be confined to work over country that is inadmissible to wheeled transportation. Its successful employment requires strong, docile and well-trained animals, and a comparatively open country; it cannot be employed on a narrow trail running through a heavily wooded region. Fig. 4750 represents the cacolet used by the British in the Crimea.

During the same war the British also made successful use of a mule-litter in which a litter is slung horizontally from each side of a pack-saddle. Like the cacolet, this form of litter has not been favorably considered by our medical officers, and the same objections hold good with reference to it. An additional objection is its weight, which, with its pack-saddle and bedding, is placed at one hundred and sixty-seven pounds; this, added to the weight of two patients, makes a formidable load for the average-sized horse or mule. Fig. 4751 illustrates the arrangement and general appearance of this kind of horse-litter.

In another form of horse-litter a single patient is carried in the recumbent or semirecumbent position upon the back of the animal, either upon a specially devised saddle and litter, or upon an improvised arrangement made by securing the ordinary hand-litter to a pack or riding saddle. An example of the former is the McElderry single mule-litter (Figs. 4752 and 4753), devised by the late Major Henry McElderry, Surgeon, U.S.A., with a view to its employment in operations against the Modoc Indians in the lava beds of California. In this, the frame is hinged, allowing its adjustment at different angles; the hinges also permit it to be folded compactly

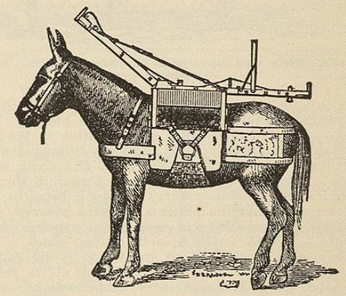

FIG. 4752.—McElderry's Single Mule-litter.

together for facility in its transportation. The saddle to which it is attached when in use is that known as the Mexican *aparejo*, now universally used in pack-trains. Some of the advantages claimed for it by its inventor are that "it is especially adapted for use in broken and mountainous country; long narrow and winding defiles, abounding in sudden and abrupt angles; and in places and under circumstances generally where no other kind of litter could be employed. A wounded man can be transported on this litter with entire safety on the back of any steady pack-mule or horse, taken indiscriminately out of the pack-train; the animal not requiring any special training before he will pack it, otherwise than that already received in the pack-train."

In the improvised form two stout wooden traverses are strongly lashed to the pommel of a riding or pack-sad-

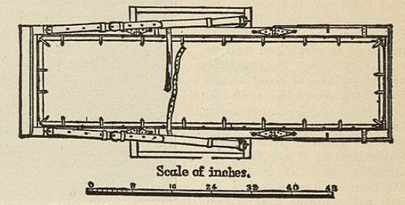

FIG. 4753.—Plan of McElderry's Single Mule Litter.

dle, preferably a pack-saddle; upon the outer ends of these traverses two wooden poles or bars are fastened in a longitudinal direction and parallel to each other, forming a framework upon which the litter rests and to which it is securely bound by ropes or other lashings.