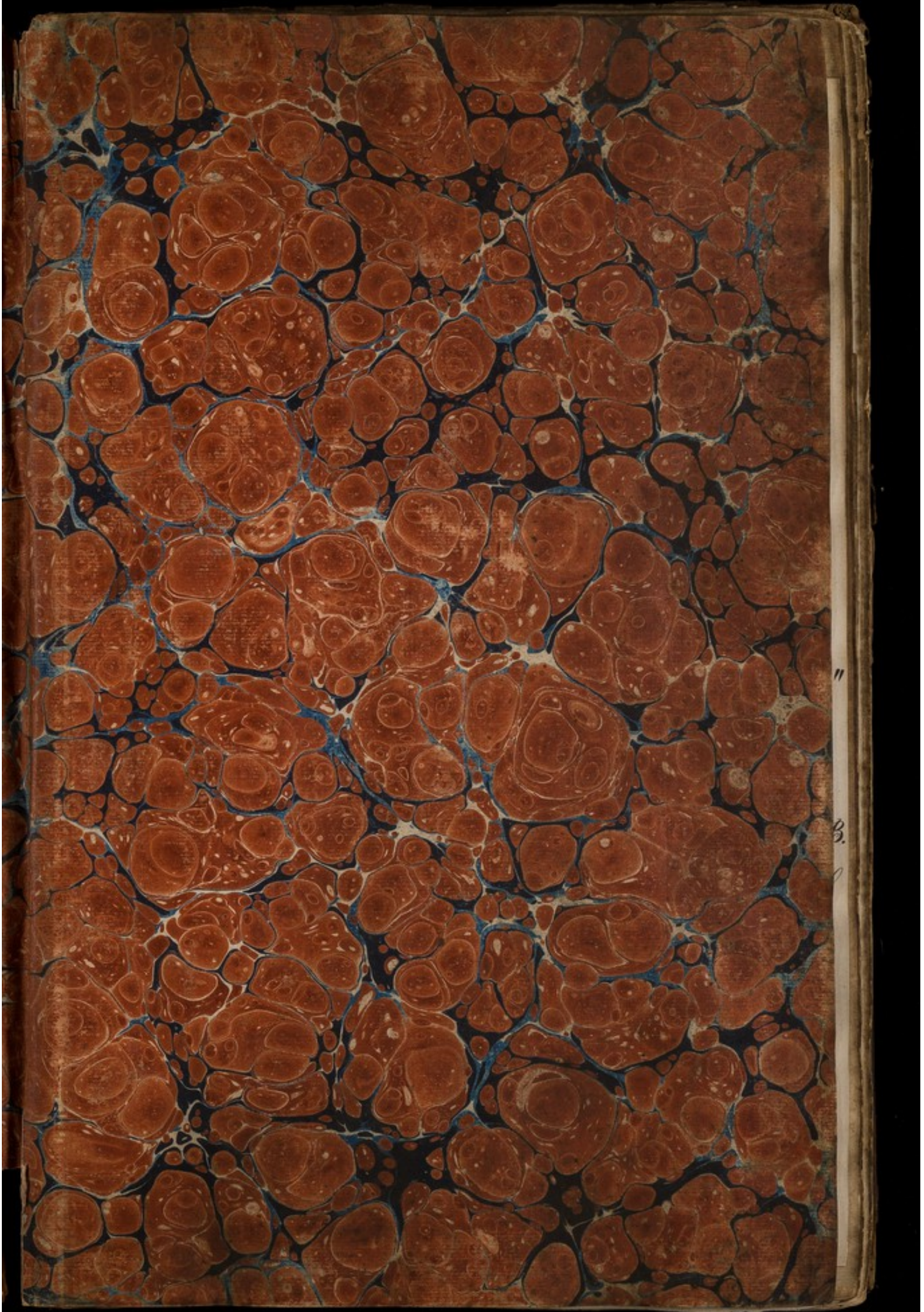

275

275

AMBULANCE APPLIANCES ..



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Illustrations of Appliances for the Transport of wounded Soldiers arranged according to "The Ambulance Transport"

by J. Longmore C.B.
Dep^t Inspector General

1869.

NAME	Troop or Company	Date of Crime	Crime	By whom Reported	Punish-ment	By whom Ordered	REMARKS

CHAPTER IV.

ON THE PROPER POSITIONS OF WOUNDED MEN DURING THE ACT OF TRANSPORTATION WITH SOME REMARKS ON THEIR REMOVAL BY BEARERS WHEN NO CONVEYANCES ARE AT HAND.

CHAP. IV.

BEFORE proceeding to consider the various kinds of conveyances which have been either proposed for use in carrying disabled soldiers, or are actually employed for that purpose, some few general remarks appear to be necessary respecting the positions most suitable for the wounded themselves during the act of removal, having due regard to their safety, comfort, and the prevention of aggravation of the injuries which they have sustained; for on the nature of these positions, it may be presumed, will depend to a certain extent the forms of the vehicles designed for their transport. It will also be useful to add in this chapter some observations on the circumstances of wounded men who do not require transportation, or who are able to make their own way for a limited distance without being carried; and lastly, to consider the manner in which hospital orderlies can most efficiently render assistance to other wounded men who are unable to march alone, but who are not so far disabled that either litters or wheeled carriages are absolutely required for their safety, or who, although requiring such conveyances, are unable from accidental circumstances to obtain them.

SECTION I.—POSITIONS OF WOUNDED MEN DURING TRANSPORTATION.

Positions of wounded men during transportation.

It is with reference to recent wounds that it is chiefly of importance in these remarks to consider the position proper for patients during transportation. It may be that the patients have only to be carried a very short distance from the place where they have received their injuries, to the place appointed as the first line of surgical assistance. Even under these circumstances the position in which a wounded soldier is carried may have an important influence on his present safety or future welfare. But the question becomes greatly more important when a recently wounded man has to be carried a long distance, such as one or two miles, for his primary treatment, and still more so, when, as not unfrequently happens, the transport occupies several days before the hospital to which the patient has to be sent for his secondary and prolonged treatment can be reached.

transport in a sitting posture.

The circumstances which would render a sitting position objectionable are those which have been already explained to necessitate removal in a recumbent posture.

The semi-recumbent position.

Transportation in a semi-recumbent position.—In this position the trunk of the patient is raised and supported at a certain angle

Patients who can be carried sitting can always be carried recumbent.

from shock, are unequal, for some time at least, to assume the upright position without risk, have been already referred to. Those of the wounded, on the other hand, who are liable to be removed without harm in a sitting posture will generally be able to find other means of removal, should there not be sufficient sitting conveyances at hand, and they can always be carried in a recumbent position if there are spare litters available. Could the necessities

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Section I.—Positions of Wounded Men during Transportation.

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CHAP. IV.

Ambulance conveyances usually constructed for patients in either a recumbent or sitting position.

Ambulance conveyances, whether they are intended to be carried by bearers, borne by animals, or are of the wheeled kind, are ordinarily constructed for carrying wounded men in one of two positions, either lying down at full length, or sitting. Experience has shown that these positions meet all the usual requirements of wounded men. Some light field hand-carriages have been designed by continental surgeons in which the patients are carried half sitting, half reclining, and which do not admit of being used for either a wholly recumbent or wholly sitting posture; but they have not yet been brought into general use; other conveyances have been invented, admitting a recumbent position, but at the same time capable, by means of mechanical contrivances, of assuming a form suited for supporting a patient in a semi-recumbent posture.

It will be convenient to consider the nature and effects of these several positions, viz., 1, the recumbent; 2, the sitting, and 3, the semi-recumbent position, separately.

The recumbent position.

Transportation in the recumbent position.—The recumbent position is undoubtedly the best position in which to place all men who have received severe wounds, and even those who appear to have been but comparatively slightly hurt, if their injuries are complicated with faintness, tendency to bleeding, shock, or any other constitutional symptoms. It is at once the most easy and the safest posture for the patient. In the recumbent posture every part of the body is equally supported, no part has to bear the weight of another part, the necessity for all muscular exertion ceases, there is perfect repose. If the balance of the circulatory system has been disturbed under faintness, from the effects of chills, or from any other cause, it is the position most favourable for its restoration. If hæmorrhage from divided vessels has been arrested by some of the ordinary natural methods through which this is accomplished, or temporarily stopped by the accumulation of coagulum, the horizontal position is the most effective for preventing disturbance to these favourable circumstances, by doing away with the need of moving the injured parts, and by lessening the weight of the column of blood in the vessels leading to them. Moreover, it is the posture in which, during the act of transport, the several parts of the body are subjected to the least amount of concussion, and in which that amount of shaking which does take place is most evenly distributed over the whole frame without shock to any one part, from the tread of the bearers or the motion of the carriage, provided the movement be judiciously effected.

Its advantages to men severely wounded.

Its advantages in case of shock, faintness, &c.

Kinds of wounds which *necessitate* a recumbent position.

Fracture of any of the bones, wounds of the articulations, of the lower extremity; severe wounds of the head, chest, or abdomen; and generally extensive injuries of the shoulder-joint, usually completely disable men from removing themselves for help. Such patients should always be transported to the rear in a horizontal posture. If the means of conveying them in this manner be not at hand on the field at the instant of need, the best plan is to carry them temporarily to a place of shelter from projectiles until the necessary conveyances can be obtained for their use. To

carry such patients to a considerable distance in a sitting position would inevitably lessen the chances of recovery, even if their condition admitted of the attempt being made.

Economy dictates that the use of recumbent conveyances should be as limited as practicable.

Essential, however, as the recumbent position is for patients labouring under certain wounds, and advantageous as it is in almost every description of recent injury, there are inconveniences connected with it when considering the subject of providing means of transportation in campaigning that cannot be overlooked. The recumbent position, as a matter of course, involves the necessity of a greater amount of space being appropriated for the accommodation of a given number of patients, and consequently causes a greater number of vehicles to be required for them than would be required if the accommodation to be provided were for the same number of patients in a sitting posture. The conveyance of patients in a recumbent position, moreover, entails ordinarily more labour on attendants, independently of the increase in number from the increased provision of conveyances than carriage in a sitting position. For these reasons, as patients with some wounds can be nearly as well transported, so far as their injuries are concerned, in the sitting as in the recumbent position, a certain amount of means of transport in a sitting posture is always provided, and it becomes only right, for the sake of economy on the one hand, and for the due protection of patients on the other, to consider and determine what cases are applicable to transport in a sitting posture.

The sitting posture.

Transportation in a sitting posture.—As a general rule, only those patients can safely be carried in a sitting posture whose wounds or injuries are of a comparatively slight nature. With the exception of wounds of the foot, wounds of the lower extremity usually cause this mode of carriage to be altogether objectionable, especially if they are complicated with injuries to some of the bones. It is for injuries in the upper part of the body that transport in a sitting posture is more particularly applicable.

Wounds for which a sitting posture of the patient is suitable.

However severe a wound of the forearm or of the hand may be, even though bones are fractured or a considerable part of the limb carried away, when no hæmorrhage is going on and when the patient is strong enough, it does not render removal in a sitting posture objectionable in any respect. The wounded extremity should be properly slung and supported by means of a handkerchief, and the patient, with such a wound, may then be removed in a sitting posture almost equally as advantageously as in the recumbent posture. In like manner uncomplicated wounds of the head, face, and upper part of the trunk, if they are unattended by any urgent constitutional symptoms, offer no features to contraindicate the removal of the soldiers suffering from them by transport in a sitting posture.

The circumstances which would render a sitting position objectionable are those which have been already explained to necessitate removal in a recumbent posture.

The semi-recumbent position.

Transportation in a semi-recumbent position.—In this position the trunk of the patient is raised and supported at a certain angle

with the lower part of the body and lower extremities; the knees are also raised, and the thighs bent and supported at an angle with the legs. This position of the lower extremities is rendered necessary when the trunk of a recumbent patient is maintained in an inclined posture for two reasons. The first is that the weight of the upper part of the body tends constantly to gravitate downwards, and to push the legs onward; the second is that an extended condition of the thighs and legs speedily becomes irksome when the body is so raised, probably to a certain extent from muscular exertion intended to resist the pressure just now mentioned. The flexed position of the legs removes the need of any such efforts. The fixed position of the pelvis and thighs as they rest against the mechanical support provided to sustain them counteracts the pressure and tendency to descent of the trunk; all feeling of need for muscular exertion is taken away, and as the lower limbs are everywhere supported, none of the irksomeness is experienced which would be felt if they were kept extended.

Kinds of wounds for which a semi-recumbent posture is particularly serviceable.

There are few recent injuries for which a wholly recumbent position will not answer, or cannot be readily made to answer, the purposes fulfilled by the semi-recumbent posture. In some cases of wounds in the region of the chest a semi-recumbent posture is very desirable. The patients are troubled with so much feeling of oppression in breathing that they not only cannot bear to remain in a wholly recumbent position, but they require the back and chest to be very considerably raised to meet their wants. At the same time such patients will be quite unable, from prostration and other causes, to remain upright or bear the jolting which almost invariably attends removal in a sitting posture. In such cases, if the lower part of the body and extremities retain a horizontal direction, as on an ordinary stretcher, and steps have been taken to raise and support by temporary expedients the back and head of the patient in a sufficiently inclined position, then the inconvenience will not unfrequently follow of the patient rolling over to one or other side, not to mention the risk which has already been mentioned of his slipping down toward the feet of the stretcher, especially if the ground be steep or much broken. A support calculated to maintain such a patient securely in a semi-recumbent posture is therefore a decided advantage.

Objections to ambulance carriages specially constructed for maintaining a semi-recumbent posture.

These, however, are special cases, and even in these cases the inconveniences referred to may be materially lessened, if not prevented altogether, by care and management on the part of the bearers. For all ordinary cases of wounds it is obvious that nearly all the advantages alleged to belong, or belonging, to a semi-recumbent position can readily be given by the aid of pillows, or by the use of other substituted means of support, to a patient placed recumbent; while it seems equally obvious that it occasionally must be a source of inconvenience, whatever may be the nature of the injury, not to be able to place a patient in a wholly recumbent position in case of faintness supervening or other need.

Comparative merits of recumbent and

On the whole, then, it may be said as regards patients recently wounded, that if they be in a condition which unfits them for

walking, or for being carried in a sitting position, and if the transport be only for a short distance, conveyance in a recumbent posture will best answer their requirements, and best meet any accidents that may arise incidental to their condition. If a wound be of such a nature that the chest requires to be much raised, this can be effected by means of a knapsack, great coat, or the addition of any other temporary support properly applied, with sufficiently good results for the occasion.

semi-recumbent carriage.

Under other circumstances than those above named, special consideration is required. If the transport, for example, be for a long distance and in a wheeled vehicle, it will often be needful, or at any rate very advantageous, for support in a semi-recumbent posture to be afforded to patients; and that, too, more firm and fixed than can be obtained from temporary appliances, which are liable to be shifted under the jolting of a carriage while in motion. Here the different effects of transport in wheeled conveyances drawn by horses over rough roads as compared with hand carriage have to be taken into account, as well as the fatigue which attends a long journey, especially to enfeebled patients. But even under these circumstances, having regard to the general purposes of ambulance transport, it seems desirable that all such doubly-inclined litters, if employed, should be made capable of being lowered into a perfectly horizontal position in case of need.

SECTION II.—PRACTICAL PROVISION OF AMBULANCE CONVEYANCE, BASED ON THE NUMERICAL PROPORTION OF RECUMBENT TO SITTING TRANSPORT REQUIRED IN THE FIELD.

—The proportion of accommodation required for recumbent to that required for patients able to sit up, becomes a matter of consideration when ambulance transport has to be provided. It is not easy to define with exactness what the proportion is which the one kind of accommodation should bear to the other, for variations in the relative numbers of severely and slightly wounded take place in all engagements. From what has been already said it must be sufficiently evident that it is very important in the interest of the sick and wounded to have a *sufficient* supply of conveyances in which the recumbent position can be assumed. The difficulty of providing proper substitutes for litters for those who are dangerously or severely wounded in the head, body, or lower extremities, and the fact that many men whose injuries are of a less serious nature, or who have sustained fractures of the upper extremities, either from weakness, resulting from loss of blood, or from shock, are unequal, for some time at least, to assume the upright position without risk, have been already referred to. Those of the wounded, on the other hand, who are liable to be removed without harm in a sitting posture will generally be able to find other means of removal, should there not be sufficient sitting conveyances at hand, and they can always be carried in a recumbent position if there are spare litters available. Could the necessities

Difficulties in the way of defining the proportions of different kinds of sick-transport.

Patients who can be carried sitting can always be carried recumbent.

CHAP. IV.

of the wounded only be consulted, were it not for the unavoidable restrictions of bulk and weight, and the other strategical circumstances which limit as far as possible, in all armies, the supply of conveyances occupying so much space as those designed for carrying men in a recumbent posture, the proportion of carriage for patients in a sitting position would be probably considerably less, and the recumbent considerably greater, than it usually is.

Peculiarities in the nature and circumstances of military operations lead to variations in the relative proportions of the two kinds of transport.

We see this fact illustrated in a marked manner in the French service. In expeditions in Algeria, owing to the nature of the country and the military service, it is felt to be very important to reduce the bulk of sick conveyances as much as possible, and at the same time to have the mules available for other transport, such as stores, when no sick have to be carried. This can be done with cacolets, which fold up into a very small space and lie close to the sides of the pack saddles, but cannot so conveniently be done with mule-litters on account of their size. The latter are therefore reduced in numbers to extreme limits, being issued to columns of troops, as before explained, only in the proportion of 48 litters to 500 cacolets for every 10,000 men, or accommodation for 10 patients recumbent to 100 sitting. The proportion was very different in the French army during the Italian campaign of 1859, when the necessities referred to were felt less strongly. In that war the numbers were fixed at 15 litter mules and 30 cacolet mules for the head-quarters' ambulance, 10 litter mules and 20 cacolet mules for the ambulance of an infantry division, five litter mules and 10 cacolet mules for a cavalry division, and two litter mules and five cacolet mules for the ambulance of a reserve park of artillery.* Here the proportion of provision for recumbent patients is seen to have been one-half instead of one-tenth of the provision of carriage for patients sitting; and, judging from the evidence of professional returns, which tend to show that about one-third is the proportion of severe to slight wounds inflicted in battles. This would appear to be a much fairer average of the recumbent accommodation likely to be required than the former estimate.

Examples in the French military service.

Relative proportions of sitting and recumbent transport in the British service.

Remarks have been already made in the previous chapter on the proportion of transport to strength of troops authorized in the British service, and the Medical Regulations were then quoted to show the description of conveyance necessary for a division of 5,000 men, assuming the proportion of sick to be carried at five per cent. of the force. But no indication was there given as to the proportion of transport for recumbent to sitting patients; only a certain number of "cacolets or litters" was said to be necessary. Sir John Hall, in his recommendation on this subject, indicated what he thought to be the necessary proportion between the two kinds of transport. As already mentioned his calculation was made for a division of 10,000 men, and at the rate of five per cent. Out of the 500 sick for whom carriage was thus provided in Sir J. Hall's estimate, 50 were to be carried recumbent in the two mule-cars

Proportion recommended by Sir J. Hall.

* "Legouest, Traité de Chirurgie d'Armée," par L. Legouest, Paris, 1863, p. 968.

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CHAP. IV.

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29

X

Bearing by Hand

and four-mule waggons, 26 in the box litters of the one-mule Maltese carts, and 100 in 50 pair of mule-litters, making a total of 176 sick for whom recumbent carriage was to be provided. This made it rather more than one-third of the whole amount of sick transport, being at the rate of 35½ recumbent per cent. of accommodation. The stretchers employed for carrying the wounded recumbent for short distances from a field of action were not included in this calculation.

Proportions provided in the ambulance transport despatched to the Crimea.

The conveyances despatched to the Crimea to serve the wants of a division of the army at the recommendation of Director-General Dr. A. Smith provided accommodation for two recumbent for every three men sitting, while those despatched at the same time and also for the service of a division at the recommendation of Mr. Guthrie and Colonel Tulloh only provided accommodation for three recumbent for every 25 sitting. In the first case the recumbent accommodation was in the ratio of 66⅔ per cent., in the second in the ratio only of 12 per cent. In each case the accommodation mentioned was exclusive of the ordinary field stretchers carried by hand. The contrast between the provision made in the one arrangement for the carriage of patients in a recumbent posture with that made in the other, relatively to the amount of carriage for patients sitting, is not a little remarkable, and as the military conditions were in both instances exactly identical, serves to show how little the subject under consideration has hitherto been reduced to rule.

The settlement of the question on a fixed basis is still a desideratum. The remarks which have been already made on the descriptions of wounds which necessitate a recumbent position, and on those for which a sitting position is suitable, together with extended and more precise observations on the relative frequency of these injuries under the ordinary circumstances of modern warfare, will assist in obtaining a solution of the question, or at least in placing it on a more satisfactory basis than that on which it at present rests.

SECTION III.—CONCERNING WOUNDED WHO DO NOT ABSOLUTELY REQUIRE TO BE CARRIED TO THE FIELD HOSPITALS.

Deficiency of bearers of wounded after actions.

One of the great wants experienced in every action is the want of a sufficient number of bearers to carry off the wounded. The demand suddenly created for help is usually under such circumstances so great that it is hardly to be expected that any establishment of bearers could be regularly maintained in strength sufficient to meet it.

Duties of hospital attendants in the field as regards classes of wounded.

If there were sufficient assistants at hand no wounded man, not even those with the simplest flesh wounds, should be permitted to go to the hospital unattended. Under the movement and exertion a blood vessel may give way, and hæmorrhage occur; faintness

[illegible] wounded, across a pontoon bridge over the Rhine. The case was one of extreme urgency, for, at the time Baron

* See p. 32.

is a buckle, is nailed to the seat on the outer side of each of the long shoulder-belts just described. Each of these two shorter straps is 11 inches long.

The weight of the seat, with the belts and straps attached to it, is 3 lbs. 4 oz.

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that has passed off for a while may recur after the patient has been a short time in the upright position; with an apparently slight wound of the scalp giddiness may come on, the patient become unconscious, and fall; and so on with every wound and injury that firearms or cutting weapons are liable to produce. But the amount of help which would be required for every wounded man thus to be accompanied by an attendant, or to be carried or otherwise assisted to the rear, is much greater than is ever or than can reasonably be expected to be found; and it is the duty, therefore, of such attendants as are present on the field of action, first, to attend upon and select for transportation to the rear those patients whose wounds appear to have most urgent need of surgical attention, and next, when these have been taken to hospital, to assist in turn the less severe cases which remain on the ground.

In every action some wounded men are able to reach the hospitals without help from bearers.

Fortunately, in every action there is a certain proportion of wounded men, not only those with trifling, but some with comparatively severe wounds, who do not absolutely require transportation, recumbent or sitting, but who are able to make their own way on foot to the field hospitals without assistance from attendants.

Relative numbers of this class of wounded always uncertain.

Here again, no precise rule can be given with regard to the relative numbers of this class of wounded in any given action, nor even as to the nature of the wounds which permit the subjects of them to walk unaided to hospital. No such power can of course exist after wounds directly disabling any of those structures upon which the function of locomotion essentially depends, and very rarely after any injury that necessarily entails fatal consequences. But, with these exceptions, no general statement on this head can be made. The ability or inability to walk unsupported for help after a gunshot wound often appears to depend upon personal peculiarities, the force of character, intelligence, and moral control of the individual, as much as, or more than, upon the nature of the wound or injury which has been inflicted. One man will contrive to walk to a field hospital for assistance and exhibit comparatively little signs of distress after the loss of an arm or some other wound of similar severity; while another man, with a comparatively trivial injury, will be utterly overcome and absolutely require to be carried.

Circumstances on which the ability of wounded men to walk to hospitals sometimes depends.

Stimulus of self-preservation.

Again, if there be no means of carriage ready at hand, no prospect of speedy relief obvious, after the gravest injuries, the stimulus of self-preservation will often wonderfully assist wounded men in walking, or, if mounted soldiers, in riding, to places appointed for giving surgical aid. A man who has received a wound and who is not altogether disabled by it from moving away is first prompted to escape from the area of danger and conflict in which he is no longer of use as a combatant, in the next place he is prompted to pursue his way till he arrives at an hospital by a natural desire for relief, and not improbably also from being urged

by a pressing desire to be made aware of the real extent and consequences of the injury which he has sustained. He is alarmed as to the nature or consequences of his wound, and this alarm urges him on. Under the nervous excitement resulting from these mental emotions wounded men will often perform acts, such as walking or riding long distances, which it might well be supposed beforehand they would be physically incapable of performing. Instances have frequently been known of men with the severest wounds of the upper parts of the body, with the loss of an arm, a fracture of the skull, even with a serious wound of the brain, walking long distances to surgeons for assistance. Among the drawings by Sir Charles Bell of the wounded which he took at Brussels after the Battle of Waterloo was one of a sergeant of the King's German Legion who had had his right arm carried off close to the shoulder joint by a cannon ball.* Nothing remained of the limb but the torn stump which was left attached to the trunk and about two inches of the shattered arm bone. Yet without any dressing being applied or aid of any kind this man rode all the way from Waterloo to Brussels. On reaching the St. Elizabeth Hospital and being placed on a bed the excitement which had enabled this man to perform so long a ride in such a terrible condition immediately collapsed, he fainted and for a long time remained in an unconscious condition. This is not an exceptional, though, perhaps, considering the distance of the ride, an extreme example of the exertion which a wounded man is capable of making when stimulated by sentiments of self-preservation.

Effects of this stimulus.

Example.

It is, however, ordinarily after wounds of a mild character only, after uncomplicated flesh wounds, that men are able to get to the field hospitals for help, especially when the distance of the hospital from the scene of conflict is at all considerable. Such patients may at first be disabled by a certain amount of faintness or shock, by the severity of the pain, but, after a short time has elapsed, they will frequently find themselves able to walk to the rear with more or less activity, perhaps with the aid of a sheathed sword or a musket in their hands for support.

Patients with uncomplicated flesh wounds can generally find their own way to hospital.

It has been thought that artificial appliances specially designed for the purpose might be issued with advantage for the use of such patients. The stretchers, litters, and cacolets would be more completely at the disposal of those for whom transportation is absolutely necessary, delay would be prevented, and the services of attendants would not be required for those who, with such artificial supports, could make their own way to the hospitals. The contrivances referred to have been designed more particularly for use after wounds in the leg or thigh; for these, even if only flesh wounds, much more if one or more bones be broken, as a rule prevent the subjects of them from walking unaided for assistance.

Artificial appliances suggested for the use of such patients.

* See the large framed drawing, No. 14, in the Pathological Museum at Netley.

CHAP. IV.

Esmarch's crutches for aiding wounded men from the field to field hospitals.

Dr. Esmarch, a German surgeon, has proposed the use of various kinds of crutches to assist men wounded in the lower extremities in walking to the field hospitals without attendance.* Dr. Esmarch's crutches are jointed so as to be capable of adjustment for the use of persons of different heights. Attached to them are various appliances to fit them not only for bearing the weight of the body, but also to afford local support to particular parts of the limbs which have been injured. Thus, if the foot or leg have been much injured, there is a projecting ledge to the crutch, on which the knee can rest, so that the leg and foot are kept from the ground during the progression; for other cases there is an iron plate at the bottom of the crutch to support the foot. Again, if necessary, movement in a leg or thigh may be prevented by securing the limb to one of the crutches by means of certain straps attached to them. The crutches are fitted with cross pieces at the lower ends to prevent them from slipping, or sinking in soft ground. Such assistance could of course only avail when the arms and hands are uninjured. It is scarcely probable that such appliances, which generally require no little care in adjustment, will ever be supplied for use in the field. Even if they were made part of the surgical equipment of ambulances, from the rapid and varied movements of field evolutions, they would seldom be at hand when wanted by a wounded soldier to withdraw himself from the midst of the melée; and that would, of course, be the only place where they would be much required.

Their practical utility questioned.

IV.

SECTION ~~III.~~—ASSISTANCE TO WOUNDED MEN BY TRAINED ATTENDANTS WHEN NO STRETCHERS OR REGULAR CONVEYANCES ARE AVAILABLE.

The proper modes of proceeding for lifting and transporting wounded men on stretchers, and other regular field conveyances, will be considered elsewhere; but it may be advantageous to notice here some of the methods by which bearers can best give help to wounded when the stretchers are occupied or are not available for use on some other account. Some special contrivances have been designed for economizing the labour, and lessening the fatigue of bearers under such circumstances, and these also may be worthy of description.

There are various methods by which the transport of a wounded man, who is too weak to walk alone to the rear for surgical assistance, may be effected by trained attendants when no litter or conveyance is disengaged, or near at hand, for use. Transport of this kind should only, however, be attempted when the wounds are not grave in their nature, and when the distance for transportation is not very great. And in any case suited to transport of this kind, in order that the patient may receive the full amount of benefit such

Such help should be systematically conducted.

* Specimens of these crutches may be seen among the articles of surgical field equipment (No. 831) in the Museum of Military Surgery at Netley.

assistance is capable of affording, it must be given systematically according to the site and nature of the injury.

It will be useful, therefore, to give a few hints on the best and readiest means by which attendants may assist wounded men according to the site or nature of the wounds which they have sustained. It will be convenient to mention first some methods of affording help when only *one attendant* may be at hand.

Assistance when only one bearer is available.

With patients wounded in the head or upper part of the trunk.

If the wound be in the head, neck, or upper part of the trunk, the patient should partly support himself by his musket in one hand used as a walking stick, while his other arm and hand lean upon the upper part of the back and distant shoulder of the attendant who walks by his side. At the same time the attendant should place his near arm across the back of the wounded man, reaching round and partly encircling ~~the chest~~ his body with ~~his~~ forearm and hand, so as to assist in supporting and keeping erect the upper part of the patient's trunk. The attendant should carry the wounded man's knapsack in his disengaged hand.

With patients wounded in an upper or lower extremity.

The same relative position of the patient and attendant will answer when the wound has been inflicted in any part of either an upper or lower extremity, after proper temporary protection has been applied to the injured limb. If the wound be in the lower extremity the patient will be enabled by such assistance to walk without throwing the weight of the body upon the foot of the injured side, or may hop along with less exertion and fatigue. If it be in the upper extremity the patient will not be able to avail himself of any support which requires to be held in the hand; but the injured arm should be slung in a handkerchief so arranged as to fully support it. In all other respects the assistance will be best given in the way already described.

Caution necessary in descending a declivity with such patients.

Should the patient have to descend a declivity the attendant should take especial care to hold him up as he walks down the slope, not only by encircling the back and chest, but also at the same time by supporting the patient's arms under the arm-pits. This is necessary in order to guard against the accident of the patient suddenly slipping or falling forward from an accession of weakness.

Carriage of a patient pick-a-pack fashion, or "en cheval."

If the upper extremities be uninjured as well as the thighs, and the attendant be strong enough, he may take up the patient on his back and so carry him to the hospital. In this case the patient places both arms round the neck of the attendant, while the attendant supports with his own arms on either side the corresponding thigh of the man he is carrying. It is evident that the bearer cannot with this arrangement carry a knapsack, neither can the wounded man's musket be taken on unless it is capable of being slung. It was in this manner that the distinguished surgeon Baron Percy, the same who designed and organized the French Companies of "Brancardiers,"* carried an officer, who had been dangerously wounded, across a pontoon bridge over the Rhine. The case was one of extreme urgency, for, at the time Baron

Example of Baron Percy.

* See p. 32.

CHAP. IV.

Percy carried the disabled officer over, twelve Austrian guns were directed against the bridge, and it was being broken up under their fire. This pick-a-pack fashion was a common mode of carrying off wounded soldiers from all fields of battle until stretchers were regularly supplied in sufficient numbers for the necessities of warfare.

Fischer's apparatus for carrying a wounded man, "en cheval."

It has recently been suggested that this mode of carriage might be systematized and advantageously introduced for general use. With the view of carrying this suggestion into practical effect, Messrs. Fischer and Co., the well-known manufacturers of surgical appliances and ambulance conveyances at Heidelberg, invented a special apparatus, a shoulder-litter (Schulterbahre mit Rücksitz) for carrying a wounded man in a sitting posture on the back of a bearer. By means of this appliance, it was asserted, a bearer could easily carry a man on his back for a long distance without being over-fatigued, and without the necessity of the wounded man holding himself on. The following is an account of the apparatus as it was obtained from the inventors, and also of the results of the trials made with it by myself at Netley, for the purpose of ascertaining its practical merits*:—

Fig. I.—Fischer's Apparatus for carrying a wounded man *en cheval* on a bearer's back.

Fig. II.—Supporting Belt used with the same.

A. Sitting Board, 1 foot by 6 inches shaped to fit into the bearer's back

B. Cross straps

* This description, with the accompanying illustrations, was originally published in the Army Medical Reports, vol. vi., p. 479.

Fig. III.—Illustration to show the Mode of using the Apparatus.

The apparatus consists of two parts, viz., (*a*), a seat for the patient, and (*b*), a detached supporting belt. (See Drawings, Nos. 1 and 2.)

The following is a description of these two parts:—

The patient's seat. (*a*).—This is made of a piece of beech wood, smooth on the surfaces, hollowed out and padded on its inner edge to adapt it to the loin of the bearer, and generally rounded on its outer edge. Its greatest dimension across from side to side is 22 inches, its breadth 6 inches, its thickness three-quarters of an inch. Two shoulder-belts made of canvas girthing, 3 inches in width, are nailed to the lower surface of the seat. Each of these two belts is 22 inches long, and terminates at its full extremity in a leather strap, 1 foot in length, with punched holes for the reception of the tongue of a buckle. These belts are padded and covered with soft leather at the parts where they rest on the shoulders of the bearers. A narrower and shorter strap, ending in a buckle, is nailed to the seat on the outer side of each of the long shoulder-belts just described. Each of these two shorter straps is 11 inches long.

The weight of the seat, with the belts and straps attached to it, is 3 lbs. 4 oz.

CHAP. IV.

Fischer's apparatus for carrying a wounded man en cheval.

The detached supporting belt. (*b*).—This is simply a canvas band, 3 inches wide, also made of girthing, strongly secured at each end to a handle of a form convenient for grasping, ~~and~~ is 4 feet in length. Its weight is 11 oz.

The following is the method of using this form of conveyance according to explanations given by the inventors, Messrs. Fischer:—

The board is placed so as to rest on the small of the back of the bearer. The shoulder-belts are adjusted in the manner of a pair of braces, forming a cross behind the bearer's back, passing over his shoulders to be secured to the adjoining short straps by the buckles, and leaving the chest free. On taking up a patient, the bearer is to kneel down on one leg, keeping the other leg stretched out. One or two men then lift and place the patient in a riding position on the board. The loose supporting belt is adjusted under the patient's arms, and its handles are given over to the bearer. This belt serves to secure the patient in his position while the bearer is rising from his knee, and also during the transport. On arriving at his destination the bearer is to go down on his knee again, and the patient taken off in the same manner as that by which he was assisted upon the seat at starting. (See Drawing, No. 3.)

Results of trials of the apparatus.

The following points were noted in the experiments made with this appliance:—

1. It is not practicable for the bearer upon whose back the appliance is placed to help in putting a disabled patient upon it. Even in case of the bearer being a strong man, and the patient neither heavy nor so disabled as to be prevented from taking his place upon the appliance himself, still the bearer is then only able to rise from the kneeling posture with very great exertion, and with a considerable risk of losing his balance, and thus of injuring both himself and the patient. But if the patient, once placed upon the bearer's back, be a heavy man, and the bearer only of average strength, then the latter is not able to rise without assistance from the kneeling position at all. The addition of a strong stick for the support of the bearer is almost indispensable.

2. When the bearer is in the erect position, no wounded man could get upon the appliance. This could only be accomplished by a man in possession of the full use of all his limbs, and even then only with considerable exertion.

3. Two bearers are required to place the patient upon the appliance, the apparatus thus employing three men before the bearer can start with the patient on his back.

4. When the patient has once mounted the seat the bearer finds the use of the appliance convenient. He could march farther with a patient sitting on the seat, than with one placed on his back without it. After a short time, however, a good deal of pressure upon the shoulders is experienced by the bearer. But if the patient is not faint, or has the use of one or both of his arms, then the bearer can temporarily release the strain on his shoulders by placing his hands under the patient's thighs, and supporting his weight in the ordinary way of carrying a person

en cheval, while the patient assists in securing his own position by embracing the bearer's chest with one or both of his arms. On the other hand, if the patient is faint, or so wounded as to be unable to grasp the bearer, then the latter must continue to employ his hands in holding the patient on his back by the canvas strap designed for that purpose.

5. If the bearer happen to slip he is liable to fall back upon the patient in consequence of the position and weight of the latter. A strong staff in the bearer's hand is almost essential to enable him in such an emergency to preserve his balance. It is extremely difficult for the patient to disengage himself, in case of a fall in any direction, on account of the width of the board and its ends projecting beyond the patient's thighs. He would have to make a circular horitontal sweep with both thighs simultaneously in order to get clear of the board. At the same time the width of the board from end to end could not well be reduced without impeding the security and convenience of the patient when once he is placed upon it. This is one of the difficulties which applies with equal force to the case of a patient trying to get on the board unassisted.

6. In dismounting, even in placing a patient on a bed from off the appliance, no little difficulty is met with unless the assistance of two other bearers can be procured. To place a patient safely on the ground from off the appliance without additional help is almost impracticable.

7. The appliance could be adapted to be *worn* with the knapsack, without, and in lieu of, the ammunition pouch; but as soon as the appliance would have to be *used* for the conveyance of a patient the knapsack would have to be taken off and left behind.

On considering the various practical points enumerated above, all of which were observed during the experiments made at Netley with this contrivance, the conclusion was arrived at that the necessity of the additional aid required for its use neutralized its alleged advantage as regards economy of labour; and that the other objections adverted to above precluded it from being suitable for general use in the British military service.

It is advantageous for military surgeons to be acquainted with all the various resources of this nature which from time to time are brought into notice; for on the one hand, the knowledge may sometimes be turned to useful account, and on the other hand it is useful to be aware of the practical objections to their employment when, as will often happen, their adoption is advocated by interested persons, or by others who have not sufficiently studied their qualities. It is questionable whether it would be desirable under any circumstances, even if the results of the experiments had proved more satisfactory than they have been described to have been, for the Government to make provision of any such kind of special apparatus. At the best it must ever be but a very imperfect substitute for apparatus of more regular forms.

A few methods of assisting a wounded man may next be mentioned, when *two attendants* are available, and no stretcher or

CHAP. IV.

substitute for a litter to be constructed.

regular litter is at hand. A convenient substitute for a litter capable of being carried by two men is so easily improvised by means of a couple of muskets and one or two great-coats, that it would be profitless to make efforts to assist a weak or disabled man by any other means; unless these articles are not forthcoming, or the place to which the patient is to be removed happens to be very close at hand. Should the necessity arise for doing so, however, the support of a patient may be accomplished by the two bearers in several ways.

Carriage by the two bearers only.

First Method. Two-handed conveyance, patient sitting.

1. He may be carried in a sitting position by the two bearers joining two of their hands beneath his thighs, while their arms which are not thus occupied are passed round his loin, in the manner shown in the illustration.


Fig. IV.—Two Bearers carrying a wounded Man between them.

In this instance the fingers of the left hand of one of the bearers are interlaced with the fingers of the right hand of the other bearer, and a seat so formed. The patient, if he be able, helps to support himself by clasping the bearers with one or both arms.

Objections to this mode of carriage.

This mode of conveyance is very trying to the bearers, and could not be endured for any long distance. The defect of the procedure, compared with others, consists in the strain which results from nearly the entire weight of the patient being thrown on two of the arms and chiefly on the interlaced fingers of the two bearers, and only a comparatively limited number of muscles being called into action to meet it; while by other plans the weight may be thrown and distributed more evenly over the whole of three or four arms of the two bearers, at the same time that the arms are so arranged as to give each other mutual support, and all the muscles *acting upon* the upper extremities, as well as those directly *belonging to* the extremities themselves, assist in sustaining them under the burden which they are required to bear.

Second Method. Two-handed transport for patient semi-recumbent.

2. A better plan of joining two hands for the support of a patient is shown in the following drawing. The advanced right and left hands of the two bearers are closely locked together, and the wrists brought into contact, not merely the fingers interlaced, so that a firm junction of both hands is established. At the same time the other hands of the two bearers are made to rest upon and in a certain degree to grasp each other's shoulders on the same sides respectively. When a patient is carried according to this method, the weight of the patient falls chiefly upon the two arms behind him, but to some extent also upon the chests of the two bearers; while that portion of the weight which falls upon the arms in front does not bear upon the fingers and hands so much as in the former case, but is distributed over the forearms and

shoulders. The patient is not carried in a sitting position, but lying back. It is therefore well adapted for removing a patient who is so weak as absolutely to require complete support at the back to prevent him from falling, or is quite helpless, or one who is disabled in both upper extremities. It is not so easy for two bearers to assume the relative positions just described when they have to pick up a patient lying upon the ground as it is to take the former one; but the art can be acquired by a little training and practice, and the labour is fully repaid by the advantages to both patient and bearers. If the bearers are untrained it will be better, if it can be done, for them to stand in the position shown in the drawing, while two other bearers lift and place in their arms the man who has to be carried away. A disabled man of moderate weight may be carried to a considerable distance without extraordinary fatigue to the bearers in the way described.

Comparison between this and the former method.

Fig. V.—Two-handed Support by two Bearers for carrying a Patient in a semi-recumbent position.

Third Method. Four-handed seat by two bearers with *crossed arms.*

3. If a wounded man be able to sit upright, and is able to assist in holding himself up by his own arms, the bearers may then employ all their hands and arms in forming a seat for him. This is sometimes done by the bearers crossing their arms and then grasping each other's hands. A space is thus left between the bearers' hands and forearms, upon which the patient may be supported for a time with tolerable security. The objection to this method of supporting a wounded man is the pain that is caused after a time to the bearers at the points where their arms are crossed one upon the other. The weight of the patient acts constantly upon these particular parts, for when once he is "settled" in his place, the relative position of the bearers' arms cannot be shifted, at least not without the patient is laid down upon the ground while the change is being effected. The portions of the arms which lean upon each other are also those where the bones of the forearm are not provided with much muscular covering, so that the painful effects of the continued pressure are very speedily, and soon painfully felt.

Objection to this mode of conveyance.

Fourth Method. Four-handed seat with uncrossed arms.

4. A better way of effecting the removal of a wounded man, if he is to be transported on all four arms of the bearers, is represented

in the following drawings. The mode of forming a seat is known among schoolboys under the name of the "sedan chair," and it is remarkable how well the weight of a person sitting is borne when the hands and arms of the bearers are so placed; for, with each arm engaged in composing the support, the muscles that are

Fig. VI.—Four-handed Seat formed by two Bearers, the arms being uncrossed.

ordinarily employed in effecting its various movements now all act in concert to enable it to resist the strain which is cast upon it. The arrangement, moreover, forms a very easy seat for the person carried, and a very secure one also if he is in a state to give himself the necessary additional support by placing his arms over the shoulders of the bearers. As seen in drawing No. 6, the backs of the bearers' hands are turned uppermost, while the palms rest upon the adjoining arms.

Each forearm near its middle is grasped by a hand, and each in turn holds in its grasp the next arm, which is placed at right angles to it. They thus mutually support each other and are mutually supported. Simple as the manner of placing the arms to form this seat is to those who are acquainted with it, no little difficulty and hesitation are often exhibited by men who are ignorant of it, much to the amusement of the lookers-on. If the following directions be followed the object will be at once effected:—No. 1 bearer stands on the left side; No. 2 on the right. No. 1 bearer grasps with his right hand the left arm of No. 2 bearer; No. 2 bearer grasps with his left hand his own right arm; No. 2 bearer then

Carriage by two Bearers.

Fig. VII.—Position of the Bearers when forming the four-handed Seat with uncrossed arms.

Fig. VIII.—The Bearers marching with Pati
Front View.

Fig. IX.—The Bearers marching with a Patient. Back View.

Patie

NAME	Troop or Company	Date of Crime	C

Wounded who can walk unaided to Hospitals.

passed off for a while may recur after the patient has

CHAP. IV.

Fifth Method. Three-handed seat and back support.

grasps with his right hand the left arm of No. 1 bearer; No. 1 bearer grasps with his left hand his own right arm; this being done the connexion is complete. Or No. 1 and No. 2 bearers may be directed each severally to grasp his own arm, and when thus ready to take the grasp of each others' arms.

5. The usual condition in which a patient is found, however, who has to be carried away by bearers, is neither one of such extreme helplessness as that for which the second method of carriage has been described as the most appropriate, nor one of such power of self-control as that for which the mode of carriage last described has been named to be appropriate. The patient is usually weak, but at the same time able to help himself to a limited extent. For a patient in such a condition the mode of carriage next described is well fitted, and in all respects is the most easy for the bearers. It first attracted my notice in the course of some experimental trials on the subject with men of the Army Hospital Corps at Netley.

Arrangement of this method of carriage.

As shown in the illustrative drawings, Figs. X. and XI., this conveyance consists of a three-handed seat and single-arm back support. The three-handed seat is formed in the same way as the four-handed seat last described, so far as the positions of the three hands and the mutual support given to them are concerned. A

Figs. X. and XI.—Three-handed Seat and back Support.

Fig. X.—The Bearers with the three-handed Seat and back Support formed.

Fig. XI.—Three-handed Seat and back Support. Bearers marching with a Patient.

Bearing by Hand

	Punish-ment	By whom Ordered	REMARKS

triangular instead of a quadrangular seat is formed for the patient. The hand which is left disengaged is then made to rest on the adjoining shoulder of the other bearer, so that the arm forms a back, as it were, to the chair. The superior advantages of this, as compared with the last method, are the following:—

CHAP. IV.

Its advantages over the four-handed seat.

The patient has not only a sufficiently firm seat, but also a certain amount of support and protection against falling behind.

The bearers not only carry the weight with comparative ease, owing to the manner in which it is disposed, but they have less difficulty in marching with the patient, because they are enabled to face more to the front. When all four arms are connected, the bearers unavoidably front each other, as shown in drawings, Figs. VII. and VIII.; and in moving along a very restrained and difficult mode of progression results. The three-handed position allows the bearers to turn their bodies more to the front, and their progression, being proportionably less irksome and fatiguing, can consequently be maintained for a longer distance if the need for it exist. It is altogether the most generally applicable to the cases in the field which conveyance by bearers may be required for, and is therefore the one which ought to be the most taught and practised in the training of the men who are likely to be engaged in such duties.

Carriage of wounded on muskets, or other convenient articles, held between two bearers.

Instead of either of the plans just described, a temporary substitute for a seat is occasionally formed by some article of convenient size and length, which has happened to be at hand, being held horizontally between the two bearers, and thus converted into a means of support. One or two muskets may be employed in this way. A great coat or blanket is rolled round the musket, or round two muskets placed side by side, and secured by a couple of straps or handkerchiefs. The patient sits on this support, and places his two arms, if neither be wounded, over the shoulders of the bearers between whom he is carried. If any belts or other articles can be got to answer the purpose of shoulder straps, the muskets can be carried with greater facility and less fatigue by the bearers, while their hands can be from time to time employed in giving additional support to the wounded man whom they are transporting. This is a rough, though ready, mode of carriage, and excepting when used for very short distances, as before named, its adoption is not an advisable proceeding, for the same articles can be turned to a more serviceable account by other arrangements. It is also obvious that the devices for transporting men just described can only be applied to such patients as are able to maintain an upright position. The mode of forming musket litters and other temporary expedients in substitution of regular conveyances for effecting the removal of wounded men to whom a *recumbent* position is a matter of necessity, or who have to be transported to comparatively long distances, will be described in the chapters on hand-litters.

The surgical treatment of field injuries not discussed in this work.

No reference has been made in the preceding observations, nor will be hereafter made, unless incidentally, to the necessity for first removing the knapsack and accoutrements, and setting free


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CHAP. IV.

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Instead of either of the plans just described, a temporary substitute for a seat is occasionally formed by some article of convenient size and length, which has happened to be at hand, being held horizontally between the two bearers, and thus converted into a means of support. One or two muskets may be employed in this way. A great coat or blanket is rolled round the musket, or round two muskets placed side by side, and secured by a couple of straps or handkerchiefs. The patient sits on this support, and places his two arms, if neither be wounded, over the shoulders of the bearers between whom he is carried. If any belts or other articles can be got to answer the purpose of shoulder straps, the muskets can be carried with greater facility and less fatigue by the bearers, while their hands can be from time to time employed in giving additional support to the wounded man whom they are transporting. This is a rough, though ready, mode of carriage, and excepting when used for very short distances, as before named, its adoption is not an advisable proceeding, for the same articles can be turned to a more serviceable account by other arrangements. It is also obvious that the devices for transporting men just described can only be applied to such patients as are able to maintain an upright position. The mode of forming musket litters and other temporary expedients in substitution of regular conveyances for effecting the removal of wounded men to whom a *recumbent* position is a matter of necessity, or who have to be transported to comparatively long distances, will be described in the chapters on hand-litters.

The surgical treatment of field injuries not discussed in this work.

No reference has been made in the preceding observations, nor will be hereafter made, unless incidentally, to the necessity for first removing the knapsack and accoutrements, and setting free

the chests of patients; to the particular supports to be given to fractured limbs; or to various necessary dressings and means of local protection which have to be applied to wounds preliminary to the transportation of wounded soldiers from a field of action to the rear. These are subjects which belong to the study of field surgery in general, and of the proper treatment of special injuries. The modes of effecting the transportation itself of the wounded men, irrespective of the surgical treatment of their injuries, are alone intended to be discussed in this work. This, however, includes rules for *safely conducting* the transport, and these will be noticed hereafter in succession as each class of conveyance is described.

Conveyances

Borne by Men.

Punish-ment	By whom Ordered	REMARKS

CHAPTER V.

Sick-Transport ~~AMBULANCE~~ CONVEYANCES.

General Classification.

Chap. V. Classification of conveyances for the carriage of sick and wounded men.

The conveyances which have been, or are still, employed in the transportation of sick and wounded men on land, and those which have been designed for the same purpose but not brought into general use, are very numerous, and exhibit great variety in design and construction. All of them, however, to whatever country they may belong, whatever particular climate they may have been adapted to, whatever special objects they may have been intended to accomplish, will be found to be included in one or other of the following five classes, viz.:—

Five classes of conveyances.

Class 1. Conveyances borne by men.
Class 2. Conveyances wheeled by men.
Class 3. Conveyances borne by animals.
Class 4. Conveyances drawn by animals.
Class 5. Conveyances moved by steam power on railways.

Some of these classes naturally become again divided into certain orders, having marked and distinctive features. The five classes above enumerated and their subdivisions will now successively be considered.

CLASS I.—CONVEYANCES BORNE BY MEN.

Subdivisions of the first-class of conveyances.

The class of ambulance conveyances borne by men, or, as they are sometimes called, "hand-litters,"* will be first treated upon; and, as they are very numerous, it will be convenient, in order to facilitate their description, to subdivide them into four sections or orders, each of which will be found to be distinguished by certain special features. These subdivisions are (A.) Hammocks; (B.) Stretchers; (C.) Dhoolies; and (D.) Swinging litters.

General principles of the first-class of conveyances.

One general principle as regards the mode of carriage prevails in all the conveyances of this class. The patient is supported either upon a netting or canvas cloth, or in a cot or framed bed of more substantial construction; he usually has the opportunity of lying down on the litter at full length, in a few special kinds only, having to adopt any other posture; and, while thus reclining, he is borne between two or four men, who are called the

* Litter, or litière, from the Latin *lectica*, a sort of couch with a bed in it in which the wealthier Romans were carried by servants called lectícarii, litter-bearers. In the older English writers the term "litter" appears to have been chiefly applied to certain conveyances borne or drawn by horses, according as they were placed on shafts or upon wheels.

to follow page 29 Chap. 5.

Drawn by Sgt-Sergt J. J. Supple.

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CHAP. V.

"bearers."* One of the bearers, if only two are employed, sustains the front of the conveyance, while the other sustains the hinder part; if four are employed, two bear the conveyance in front, and two behind.

Construction and mode of carriage of the first class of conveyances.

The conveyance is sometimes carried by its own two extremities, or by appliances attached to them, sometimes suspended from a single pole, on the *shoulders* of the bearers; sometimes, though in like manner carried on the shoulders, it is borne between two poles, or the suspension is effected by a framework, part of which is made to project for the purpose of affording the necessary means of support. Sometimes the conveyance is arranged to be placed between two side-poles, the supporting bottom being either left slack, or expanded and tightened by means of moveable cross-pieces or by being connected with a permanently fixed frame-work, and the extremities of the poles are held in the *hands* of the bearers, with or without the additional support of straps passing round their necks or otherwise attached to their persons. The height from the ground at which the patient is carried is determined partly by the construction of the conveyance, partly by the manner in which it is borne. The risk of falling off the litter during the transport is obviated in some forms by the bed or sacking bottom upon which he is placed dipping below the level of the framework; in others, in which the support is firm and level, by the framework being raised above it; occasionally a strap, or two straps, are passed across the body of the patient so as to guard against the possible occurrence of this accident. In all cases the comfort of the patient during his transport depends on the manner of movement adopted by the bearers. When the conveyance itself is suitable, and the bearers are skilled in their work, this mode of conveyance becomes the most easy that can be devised for the carriage of an invalid through a hilly country or over uneven ground; perhaps it is also over made roads.

Uses of this class of conveyances.

In European armies conveyances borne by men are generally only employed under circumstances in which the distances to be traversed are very short, and in situations where other modes of

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Distinction between the terms "stretchers" and "bearers."

* The terms *stretchers* and *bearers* are not unfrequently used synonymously in published works, and misapprehension and confusion have occasionally arisen in consequence. In page 21 of the pamphlet entitled "Personnel and Matériel of the "Medical Department of the Army of 30,000 Men ordered to Turkey," among the means for the conveyance of wounded are mentioned "*bearers or stretchers* . . . 780." Similar indiscriminate use of the two terms occurs every now and then, even in official documents. In circular No. 856, 31st March 1864, page 3, it is remarked "two at "least of the *stretchers* shall be conveyed in the ambulance waggon." In the descriptive plate G. to the same circular the drawings representing the very articles of equipment referred to are designated "*bearer* open for use" and "*bearer* packed "for transport." This has probably arisen from the fact of the patient being practically borne by the stretcher just as both the stretcher and patient upon it are borne by the men who carry the conveyance. But it is evidently more explicit, and therefore more convenient, to maintain in English phraseology the same distinction which is made in other countries between the passive conveyance and the agents by whom it is carried. Just as the dhooly and dhooly-bearers are spoken of in India, as brancards and porteurs de brancards in France, so stretchers and stretcher-bearers should be distinguished in the military language of this country. Moreover, "stretcher" is the name by which soldiers generally speak of this conveyance, not bearer, and it seems, therefore, in every way better to adopt the same signification exclusively in English phraseology.

Sometimes indiscriminately used.

Probable source of this error.

want of discrimination

conveyance are not practicable. In the East, as will be explained when describing the dhooly, they form one of the ordinary means of conveying the sick and wounded for all distances. This difference of feature in the two modes, habitually adopted in the East and in Europe, of employing these conveyances leads to a great difference as regards the economy of their use for military purposes. In the one case, where they are only employed for short distances, if the bearers are well trained and active, two men bearing one stretcher will carry a considerable number of wounded in succession to the ambulance, and when not thus employed will be available for other duties; in the other case, when the conveyances are employed for all distances, not only must a certain number of men be entirely devoted to the duty of bearers, but they must be accompanied, in addition, with a proportion of reliefs. A large body of bearers is thus brought together, who of necessity must continually weigh upon the commissariat resources of the country through which they are passing, and in other ways increase the impedimenta of the army to which they are attached. Other points of interest to the army surgeon on this subject will be noticed in the course of the description which follows of the special qualities of each kind of conveyance.

Their different uses in European and in Eastern armies.

A.—HAMMOCKS.*

This section contains the simplest forms of conveyances borne by men; they may in some instances be said to be devoid of any distinct form of construction, nothing more than a simple piece of cloth being occasionally used, hammock fashion, for a litter. Whatever may be the material of which they are composed, it is used in a more or less loose and pliable condition—not stretched out—and, therefore, yields to the weight of the patient, and assumes whatever form the position of his body may give to it. The soldier's blanket, when used as a conveyance for a wounded man without the addition of a pole or side supports, the broad officer's or serjeant's sash, as formerly made, offer examples of the hammock in its primitive state. The sailor's hammock, Indian hammock, Turner's hammock, severally suspended from a single over-head pole, exhibit a step in advance of construction. The so-called "stretchers," as formerly used without traverses, and the looped blanket, are examples of the same kind of conveyances; but they show a still further advance in construction, inasmuch as they are adapted for carriage by side-poles, and are thus sustained with less difficulty by the bearers. A still more perfect form of this kind of conveyance, so far as the transport of a wounded man is concerned, is the New Zealand litter. Remarks on each of these kinds of conveyance follow.

Hammocks, the simplest forms of the conveyances borne by men.

Various forms of hammocks.

* The word "hammock" is generally supposed to have been brought into use in Europe from the American Indians by whom it is applied to the kind of hanging bed suspended between trees, which is in ordinary use among them. In support of this origin some dictionaries quote Columbus, who in the narrative of his first voyage, speaks of Indians in canoes coming to the ship to barter their cotton and "hamacas, "or nets in which they sleep." Dr Johnson, however, derives it from hamaca, a Saxon word.

CHAP. V.

The soldier's blanket used as a hammock.

The Soldier's Blanket as a mode of conveyance.—In an urgent case, one where there is much laceration, or much prostration, and where, therefore, a position as nearly horizontal as possible of the patient is necessary, when haste too is important for the removal of the wounded man to the place of surgical aid, or on an occasion where, if not carried away, a wounded man must be left behind to be exposed to greater risks and evils, and always provided *no better means of transport are at hand*, a blanket, great-coat, or any cloth of sufficient size, may be used with advantage for the conveyance. The blankets which soldiers carried with them into the trenches before Sebastopol were sometimes thus employed after a sortie of the ~~evening~~, or on any occasion on which the killed and wounded surpassed the average of ordinary days, and when, therefore, a sufficiency of regular stretchers could not be immediately obtained. In using it the blanket must be spread fully out upon the ground, the patient laid gently upon it in a suitable direction, and four men laying hold of the four corners of the blanket then raise it together, and march with it, as nearly as practicable, in the same manner as if they were bearing a stretcher. The great-coat may be employed in a similar way.

Fig. XII.—Conveying a wounded soldier in his blanket from the trenches before Sebastopol to the "ambulance de la tranchée." From a drawing by M. Durand-Brager.

It is scarcely possible for a less number than four bearers to convey a wounded man away by these means; should the attempt be made by two bearers, each bearer sustaining two corners of the blanket, the inconvenience of the position as regards the bearers in front, the constant drag of the weight on one part of the body, the shoulders, of each bearer without any intermission, the liability of the knees of the bearer marching behind to strike against the back of the patient, will be found to be serious impediments to progress. The officer's silk sash, as formerly made, did not present the same objections to being borne by two men. At the same time that the netting of which it was composed became

Officer's sash as a hammock.

readily stretched out laterally to a sufficient width to hold the person being carried, it was long enough for one end to be passed over the shoulder of the foremost bearer and to be held in front of him. The weight was therefore more evenly distributed over his whole body, and his position for marching rendered in all respects more easy. The woollen scarf worn round the waist of each of the privates employed in Larrey's ambulance volante was adapted to be used in a similar manner, and was made broad and strong for the purpose.

The woollen scarf worn by the privates of Larrey's ambulance volante.

In whatever way, however, such conveyances without poles are carried, they should be regarded in no other light than as expedients only admissible in the unavoidable absence of better means of support. They have nothing to recommend them beyond being less bad than no means of support at all. They are no less irksome and unsuited to the patients than they are burdensome to the bearers. After injuries in which fractures of bones have been produced, more especially of the long bones of the lower extremities, they should never be employed with the view of saving time, of getting a patient more speedily to the ambulance or place of surgical aid; for, without the greatest care as regards provisional support to the broken bones, the mischief done to wounded limbs will be immensely aggravated by this mode of carriage, partly owing to the doubled up position of the patient's body, partly to the pressure upon him of the sides of the blanket, which are drawn unavoidably together by the pull and efforts of the bearers, and, in great part also, owing to the disturbance resulting from the unrestrained movements of the conveyance as it becomes alternately shortened and lengthened under the impulse of the transport. The safety of a patient with a gun-shot fracture of the thigh or leg will be better provided for by his removal being delayed until a stretcher can be procured for his conveyance, even though many hours may have to elapse before one can be obtained.

Objections to these conveyances.

Specially unsuited for the carriage of men with fractured bones.

Hammocks without poles should only be used for short distances, unless under circumstances of extreme risk in other ways. Bearers become more quickly fatigued with them than with any other kind of carriage. The form of the human body causes a heavy weight to be most easily carried, and to be sustained for longest distances, when the pressure resulting from it is directed upon and distributed evenly over the arch which is formed by the pelvis and lower extremities. The weight may be carried on the head, and conveyed in the upright position down the vertebral column to the pelvis; or it may be thrown directly upon it, the body being bent for the purpose, according to the custom of the porters of Constantinople, who are remarkable for the heavy burdens which they carry upon the upper part of the sacral region, or, as it were, upon the keystone of the arch just described. The carriage of a weight upon the shoulder is an imperfect application of this principle, but the element of imperfection which exists in it is counteracted to a certain extent by a proportionate inclination of the body, so as to distribute the weight from the shoulder in as nearly vertical a direction as possible along the vertebral column. In proportion

Hammocks should never be employed for conveyance of wounded men to long distances.

Manner in which weights are most easily sustained by bearers.

Manner in which Turkish porters carry very heavy loads.

as this is effected, the burden, whatever it is, is more easily borne. But when two men have to carry the weight of a man in a hammock without the aid of poles, the mode of sustention for which the human frame is adapted, as named above, is completely departed from, and, as a consequence, fatigue quickly ensues. The weight is applied to the upper part of the body on one side, at a considerable angle to the end, as it were, of a long lever, the action of which is to exert a constant tendency to pull the bearer over, and this can only be overcome by continued muscular effort of a severe kind. In estimating the amount of fatigue produced, this effort must be taken into account as well as the mere weight to be carried. Moreover, the bearers cannot rest from their labour by laying the hammock on the ground without the risk of detriment resulting to the wounded man whom they are carrying, for it is destitute of any sort of protection suitable for such a position. These several conditions are sufficient to show the impropriety of making an attempt to carry a patient to any lengthened distance in such a conveyance as a sash, blanket, or other such contrivance, unless under circumstances of extreme necessity.

Hammocks suspended from poles.

Hammocks suspended from a single Pole.—A hammock of regular construction has at each end several small lines, which are either looped together at their extremities, or terminate in rings, so that by these means it can be readily secured and suspended between two solid supports, by means of hooks, screws, or any convenient fastenings. Such are the hammocks used on board ship, the grass hammocks made by the natives of South America, and others. In the sailor's hammock the lines, or *clues* as they are called, meet at each ~~each~~ end in an iron ring, or *grummet*. When it is in use on board ship, a mattrass and pillow are placed in it for a bed, and the whole is then hoisted up into its place between the deck beams by means of laniards. It will be at once seen that such hammocks can be readily adjusted so as to be suspended from a single long pole; the points of suspension being established by either the loops or rings, or secured by the laniards. By a little management again they can also be arranged to be carried between two poles, one pole being secured to either side.

Sailor's hammocks.

The "looped blanket."

In the same way two poles are sometimes adapted to a soldier's blanket to convert it into a somewhat similar kind of conveyance. The blanket does not admit of being suspended from a single pole for ambulance purposes, for it is not sufficiently long, but if a loop be sewn at each corner, and the blanket be then doubled over so that the two loops at each end are brought together, a pole, or even a musket, can be passed through the four loops on one side, and another passed within the doubling of the blanket on the other side, and in this way we get the conveyance which was formerly commonly known as the "looped blanket." If the loops have not been previously added to the blanket, a small slit may be made in each corner as an impromptu measure instead of the loop, and the blanket can thus be used for the same purpose if the material be sufficiently strong and resisting. Such conveyances correspond in their nature with the hand litters which were formerly used without cross-pieces or traverses. They are an important step in

advance, as regards efficiency, beyond the sash, blanket, or hammock used without poles. CHAP. V.

Rationale of the advantages resulting from the suspension of conveyances of the ham-

The advantages arising from the suspension of the hammock from a pole will be at once understood on recollection of the disadvantages which have been just described to result from its absence. The bearers, carrying the pole on their shoulders and steadying it in position by their hands, support the weight with less difficulty, and can sustain it for considerable distances. The carriage is more easy for the patient, because the distance between the two points of suspension remains unaltered during the transit. The irregular movements from head to foot of the hammock, caused by the distance between the two bearers in marching occasionally varying, as well as from the frequent alterations of direction in the "pull" of the conveyance as the bearers seek to relieve themselves from the effects of the strain upon their arms, are in a great degree avoided by the hammock being suspended from a fixed and comparatively rigid support. After the battle of the Alma a large number of wounded officers and soldiers were conveyed in hammocks, suspended in the manner described, from the field of action to the shore, a distance of about two miles, for removal to the [illegible] to convey them to Scutari. The inconve- Disadvantages

Use of hammocks after the action at the Alma.

Himalayan "dandie."

There is a kind of native hammock litter used in the Himalaya range of mountains known by the name of "dandie." It has always been issued as an article of field equipment in India, for the conveyance of sick and wounded, when troops have been engaged in hill expeditions; and it is now ordered to be used as an adjunct to dhoolies when troops take the field in the plains. As there are six bearers to every dhooly on the march, it is calculated that, while four of the bearers are carrying a wounded man away in the dhooly from a field of action, the remaining two bearers, or reliefs, can be well employed in carrying another but less severely wounded man away in a dandie.

Its construction.

The dandie consists of a large piece of strong cloth secured by bands at its four corners to four rings fixed in a long pole. The pole is about 10 feet in length, and the rings are placed in pairs, nearly opposite to each other, at about two feet from either end of the pole. Sometimes a dandie is suspended from two iron stanchions, as shown in Fig. No. XV. The dandie is carried on the shoulders of two men; but four men usually accompany it, two acting as reliefs and carrying it in turn. It has this peculiarity that it does not admit of the person conveyed in it lying down, or occupying the conveyance in the direction of its length; he must sit crosswise in the middle of it, resting his feet on a loose rope slung beneath the hammock part, and steadying himself whenever necessary by grasping the pole with his hands. The sides of the dandie are therefore kept apart principally by the back and thighs of the person who is being carried upon it. Occasionally, as when it is used for the carriage of European ladies, a sort of basket-work chair is placed in the dandie to form a seat for the occupant. The person carried still sits cross-wise.

Peculiarity of the position of the person carried on it.

CHAP. V.

concerned, as an application, ~~for purposes~~ of temporary ~~expediency~~, of articles designed for other purposes under ordinary circumstances; just as the sailor's hammock, or soldier's great coat or blanket, may be used in the same way on occasion. When so employed, they are detached from the tent to which they belong together with their poles, and are carried in the special manner shown in the accompanying illustration. The pole is not borne as usual on the shoulders, but on one side of the bearers. Each bearer is provided with a shoulder belt, which crosses the right shoulder, while its two ends are made to meet near the waist on the opposite side; to these ends a ring is connected sufficiently large to receive the end of the pole. The weight of the conveyance is partly borne from the right shoulder, partly sustained by the left hip, and at the will of the bearer by the left arm also; the right hand and arm of the bearer, and, if not employed for helping to hold up the hammock, the left arm and hand also, are left free for use. The weight of the hammock with all its fittings is stated to be usually only seven lbs. A specimen in the Army Medical Museum on being weighed gave as the result:—hammock, $3\frac{3}{4}$ lbs. pole, $4\frac{1}{4}$ lbs., together, therefore, 8 lbs.

How suspended when used for carrying patients.

Position of the pole from which a Turner's hammock is suspended during transport.

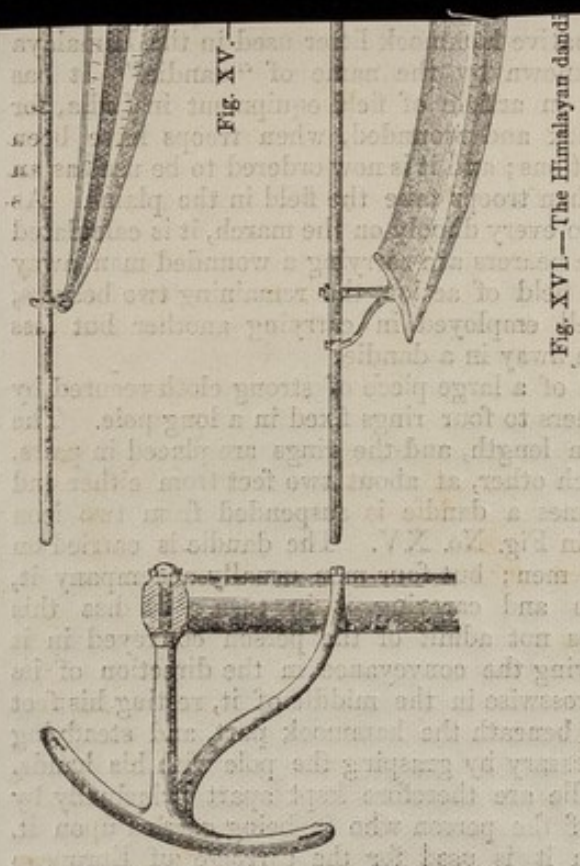

Fig. XV.—

Fig. XVI.—The Himalayan dandi

Fig. XVII.—One of the pole-stanchions used in suspending the Himalayan dandie on Dr. McCosh's plan.

ing for protection from the sun or rain to be thrown over the person lying in it. Dr. Mc Cosh mentions that he used it arranged as described on many occasions in travelling with very favourable results, and expresses his belief that from its lightness and portability it would in its improved form ~~prove~~ a valuable addition to the usual mode of transport in the field in India, especially during an action.

The ~~following~~ drawings ~~of dandies~~ are copied from sketches given me by Dr. McCosh.

Bareilly "dandie."

There is a dandie, known as the *Bareilly dandie*, which differs greatly, both in appearance and construction, from the dandies which have just been described. It consists in the middle of an oval frame of wood, prolonged at the two opposite ends of the oval into two single straight poles. The whole frame really consists of two pieces of wood placed side by side; but they are so closely applied to each other at the two ends, where they are intended to rest on the shoulders of the bearers, that the junction of the two pieces in each of these situations practically unites them into a single pole. Just before the two sides are thus joined together, two short cross-pieces or traverses are firmly fixed within the frame, where they evidently answer the purpose of keeping the sides of the oval part of the dandie from approaching towards each other. Surgeon-Major Dr. Francis, of the Bengal Army, informs me that he has occasionally seen the Bareilly dandie made with the two side pieces of wood completely separated throughout their whole length, so that two side-poles are formed as in an ordinary stretcher. The ends of these side-poles rest on the two shoulders of the bearers when the dandie is carried; they are never carried by hand like stretchers. In the ordinary Bareilly dandie, of which a drawing is annexed, the pole is single, and is firmly connected with the rest of the frame. It is in this respect that it principally differs from the other hill conveyances, known by the name of *jhampans;* for, in these latter, the short poles which rest on the shoulders of the bearers have a certain amount of mobility, from being held by pliable supports between the side-poles (see page).

202/

The seat, or support, in the Bareilly dandie, is contained in the space within the arched sides of the oval frame. It is formed of a light open kind of basket work, and is divided into four parts, of which the uppermost makes a rest for the back of the person carried, the lowermost acts as a support for his feet. The horizontal part on which the person sits is held suspended by four straps, two on each side; these straps are buckled round the arched sides of the oval frame. The foot-piece of the seat is held up by being fastened to the traverse at the corresponding end of the dandie. The back-piece, which tapers in form toward its upper part, is sufficiently high to rest against the traverse at the other end of the oval space.

A person sitting in a Bareilly dandie is well protected against falling, whatever may be the inclination or irregularity of the ground over which the bearers have to pass, by the oval frame within which the seat is slung. He is at the same time carried at such an elevation, and in such a position, rather semi-reclining than completely sitting, that there is no likelihood of any part of his person being brought into collision with inequalities of surface, or scattered boulders of rock, over or between which the bearers may have to pass. Lastly, the conveyance is so narrow that it can be readily carried over a narrow ledge or along any mountain path, however contracted in width, along which the bearers themselves can pass. There is no provision made, as in jhampans, to facilitate lowering or raising either end of the conveyance, for the

CHAP. V.

purpose of keeping the sitter level when ascending or descending steeply inclined paths; this can only be effected in the Bareilly dandie by the bearers themselves altering their relative heights, one bearer stooping more or less according to circumstances, when such a necessity arises.

The illustration is taken from Spec. No. 1245 in the Military Surgery Museum sent from India by Surgeon Franklyn, 7th Dragoons.

Fig. XVIII.—The Bareilly Dandie.

Dr. Landa's "Mandil de socorro," or "Apron of succour." Its construction.

Landa's Apron.—Closely allied to the hammock order of conveyance is the "Mandil de socorro," or apron of succour, of Dr. Landa, a distinguished army surgeon of the Spanish service.* It is made of stout canvas and is carried by and upon a bearer much in the same way as a pioneer's leather apron. The main part is oblong in shape, about two feet broad, and a little more than three and a half feet long. It terminates at the upper end in two triangular bands, about a yard in length, which cross over the shoulders and are buckled together upon the back of the bearer. The lower end, which reaches down to the middle of the bearers' legs, is fitted with a stitched fold or loop, intended to receive within it a strong rounded piece of wood or staff, one yard in length. This staff is carried under ordinary circumstances attached to the knapsack of the bearer. When placed in the fold its two ends project on either side and form two handles. If a second bearer, turning his back upon the first bearer, now lay hold of these handles, the apron is raised in an inclined direction. It then constitutes a litter upon which a wounded man can be carried, with his head and shoulders resting upon the chest of the first bearer, and his two legs passed between the arms and the body of the second bearer.

Shoulder-straps can be employed for supporting the handles at the front of the apron; in this case the hands and arms of the second bearer are left free.

* For a full account of this mode of conveyance, with remarks on its application on field service, *see* a pamphlet entitled "Nouveau Système pour l'Enlèvement des "Blessés dans la Ligne de Bataille. Par le Dr. Don N. Landa y Alvarez, de Carvello, "Méd.-Major du Reg. de Castille, Commandeur de l'Ordre d'Isabelle la Catholique, "Chev. de l'Aigle Rouge de Prusse, &c., &c." Pamplona, 1865.

Fig. XIX.—Manner of wearing the "Mandil de socorro." The staff is inserted in its hem.

Fig. XX.—Manner of using the "Mandil de socorro."

Directions for raising from the ground and carrying away a wounded man in the "Mandil de socorro."

The following is the mode of bringing the apron into use, according to the directions of Dr. Landa :—

When a wounded man falls, the bearer of the apron hands the shoulder straps, if they are provided, to his neighbour who is to assist him in the transport, and the two together make the following movements :—

1. The first bearer passes the staff along the fold of his apron and places himself with one knee on the ground and his body inclined forward near the head of the wounded man; he then passes the apron under the body of the patient until the staff is under the hollow of his knees.

2. The second bearer places himself in front between the legs of the patient, with his back to the first bearer, and stoops down with his thighs and legs brought as closely together as possible. With his hands stretched behind, he then takes each end of the staff, or causes its two handles to pass into the rings of the shoulder straps.

3. The first bearer holds with each hand the sides of the apron, taking hold of it about midway of its length, and then, at a signal given by him, the two raise themselves up together with the wounded man, and, at a further signal, march off to the ambulance.

CHAP. V.

The advantages claimed by Dr. Landa for this kind of conveyance are the following :—

It is of the simplest construction, so that it is not liable to derangement. It is very light, not weighing more than 500 grammes without the staff. It does not require to be specially carried to the place where it is required for use, as framed stretchers do. It does not distress the bearer that carries it, nor does it prevent him from carrying his knapsack or accoutrements, or hinder him from carrying a rifle and using it up to the moment of his placing a wounded man upon it. It is complete in itself, not requiring a second bearer specially provided with any appliance; any one can lay hold of the lower end of the apron and complete the means necessary for making the apron an effective litter. They are cheap, costing only about three francs each, thus effecting an economy of about 95 per cent. by comparison with the price of ordinary stretchers, and enabling them to be supplied with profusion for use on fields of action. The transport by means of the mandil is easy for a wounded man; involves him in little fatigue; obviates all risk of his falling off, since he is held up or supported by the hands of the first bearer, while his legs are between the body and the arms of the second bearer; and it supplies what to him is a matter of first necessity, a ready means of withdrawing him from the scene of conflict to the ambulance. No kind of wound is liable to be aggravated by the sole fact of the transport, excepting certain fractures of bones of the lower extremity; but even ~~these injuries~~ of this mischief can be avoided by employing proper splints and bandages for the purpose. The bearers with the apron are more disengaged than bearers with a stretcher; they can move away with great speed; and they can pass along the narrowest paths, since they present a front of only a single man. When not required for use the lower end of the apron can be rolled up and secured to the waist of the bearer; his movements are then quite unfettered by its presence upon his person. Such are the advantages claimed by Dr. Landa for this contrivance.

Advantages claimed for the mandil de socorro as a conveyance for wounded from a field of action.

These alleged advantages considered.

There can be no doubt that some of the advantages attributed by Dr. Landa to this system of carrying off wounded men really belong to it. Its simplicity, lightness, cheapness of cost, and the fact of its allowing the bearer to carry his knapsack, arms, and accoutrements, and to do all the ordinary duties of a combatant soldier when not engaged in his duties as a bearer, are qualities which cannot be disputed. But the alleged ease to the wounded man carried, and the ease to those who have to carry him, are attributes essentially important to those concerned, and the possession of these by no means appears to be so well established. On the contrary, judging from personal observation of the experiments made with these aprons at the trials which were instituted during the International Exhibition of 1867 at Paris, it was in these essential particulars that they were so defective as to cause them to be held by most of those who assisted at the trials to be unsuited to the purposes for which they were designed. The person carried was "huddled up" in a very restrained and oppressive posture, while the bearers had great

Experimental trials of Landa's aprons at Paris.

Their results.

difficulty in making progress with their charge. The "drag" of the apron upon the shoulders of the first bearer was very severe. What the carriage might be with more practised bearers it is difficult to say, but certainly the experiments at Paris quite warranted the conclusion, which was come to by all who observed them, that these aprons were unsuitable for the general purposes of transport of sick and wounded. They hardly appeared to be so effective as some of the modes of carrying off wounded by two men unaided by any artificial appliance. It must be admitted, however, that the observations would have been more satisfactory had the trials been conducted by men thoroughly trained and habituated to the employment of these articles.

Italian modification of Landa's "mandil de socorro."

An Italian modification of Landa's apron (tablier porte-malade, modèle Landa, modifié par le Comité de Milan) was exhibited at the Universal Exposition at Paris. Its general construction, form, and arrangement for use, closely resembled Landa's apron just described; and the same objections were found with it, when subjected to trial, as those with Landa's apron itself.

Canvas seats, borne by two bearers.

Trag-sitze.—Some simple conveyances, known under the name of "bearing-seats" (trag-sitz), are commonly used in Bavaria and other parts of Germany. They are occasionally supplied as supplementary to other conveyances of a less portable kind, Neudörfer's and Perigoff's two-wheeled litters, for example. These are really stretchers without side poles, designed for the removal of wounded men in a sitting position by two bearers. Though very different in appearance, they closely approximate in nature to the "mandil de socorro" just described, in which the body of one bearer acts as a traverse to one end of the apron, while the wooden traverse in the hands of the second bearer stretches the other.

The bearing seat consists of a piece of stout canvas doubled over at the two ends, the whole being 22 inches long by 14 in breadth. It is stretched out cross-wise at each end by a round piece of wood secured within its folds. Each of these pieces of wood is left exposed at the middle, so that it may be grasped by the hand of a bearer. Thus a seat is formed on which a patient may be placed and conveyed by two bearers, each using one hand to carry the seat, while the other is left free to support the patient's back, or otherwise to assist him during the transport.

If the patient be weak, or wounded in the arms or upper part of the body, each bearer, in addition to holding the bearing seat by one hand, will have to support the back of the patient by his other arm. To accomplish this it is necessary that the arms by which the bearers carry the seat shall cross their front respectively, while their arms nearest the patient are left disengaged and ready to act as supports behind him.

If the patient, however, be sufficiently strong not to require support to his back, or is wounded in either of his lower extremities, then the bearers grasp the seat with their hands nearest to it, while the patient, to keep himself securely in position, folds his arms round the backs of the bearers on either side.

CHAP. V.

In either of these ways a couple of bearers can carry a man of average weight from one given spot to another for a distance of a few hundred yards very conveniently, and without much fatigue.

Altogether, the employment of this simple contrivance furnishes a method of conveying patients for comparatively short distances much preferable, for ease and convenience, to carrying them on crossed arms or in any of the other positions bearers have to adopt when no conveyances for the purpose are forthcoming; and it may be worth considering whether some of these bearing seats might not be used with advantage in the field as supplementary to the regulation stretchers, and principally for bringing off the field such men as do not require to be carried in a recumbent position. The small space these bearing seats occupy, their lightness and handiness, would enable them to be taken into the field by bearers with very little inconvenience.

The weight of the bearing seat in the Military Surgery Museum at Netley is 19 ounces. Some trials made with this bearing seat are referred to in the description of Pirogoff's litter on page 220.

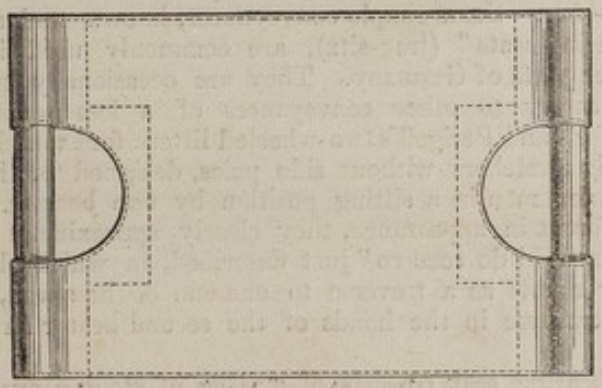

Fig. XXI.—The "Trag-sitz," or Bearing Seat.

Short canvas litter, borne by four bearers.

Canvas Body Litter.—This is a short litter, 3 feet in length and 1½ in width, with handles ~~at the~~ sides, answering the same purpose for recumbent patients as the canvas seat just described answers for patients sitting. By its means a wounded man can be carried and deposited in a recumbent position upon the floor of a railway wagon, or upon any bed that it may be desired to place him upon, and the litter can then be taken away without further disturbance to the patient. When a patient is carried upon an ordinary stretcher and the stretcher is deposited upon the floor of a wagon or other flat surface, the stretcher can only be taken away from beneath the patient by first lifting the patient off it. This proceeding entails no little disturbance and pain. But as the canvas litter under description does not extend below the patient's hips, and as the bearers are at the sides instead of being at the two ends of the litter, and close together, there is no difficulty in withdrawing the litter upwards from behind the patient while in the act of placing him upon the floor. While the patient is being carried upon this litter his back and upper part of his body are alone

Conveyances

CHAP. V.

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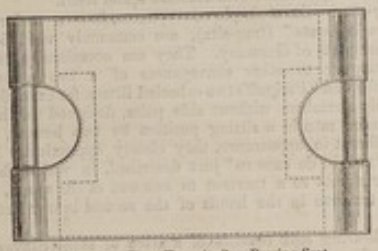

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Borne by Men.

NAME	Troop or Company	Date of Crime	Crime	By whom Reported	Punish-ment	By whom Ordered	REMARKS

to follow page 29
Bruch 5.

Bareilly Dandie.

Drawn by Asst-Surgeon J. J. Supple.

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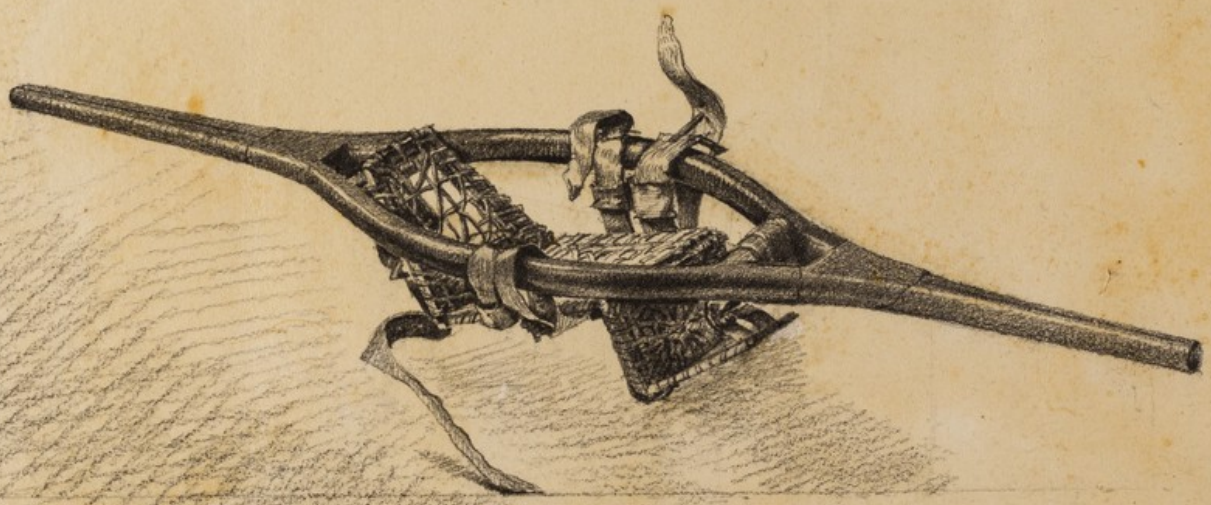
Chap. 5.



Bareilly Dandie.

Drawn by Asst-Surgn J. J. Supple.

Conveyances

NAME	Troop or Company	Date of Crime	Crime	By whom Reported	Punish-ment	By whom Ordered	REMARKS

Borne by Men.

Punishment	By whom Ordered	REMARKS

supported by it; his lower extremities are supported by the two bearers who are nearest to them. These two bearers, at the same time, each hold in one of their hands the lower of the two litter handles on their respective sides; the other two bearers, near the head of the patient, give their whole support to the upper two handles. *The contrivance is of very doubtful utility.*

CHAP. V.

New Zealand litter.—The native litter of New Zealand, or "Amoo," is a netted hammock stretched out to a certain extent by side poles and short cross pieces near their ends, but still pliable and bellying downwards like the other conveyances of this section. It is intermediate in its nature between the ordinary hammock and the stretcher. It is quite peculiar in the manner in which it is carried, no other conveyance being carried precisely in the same fashion.

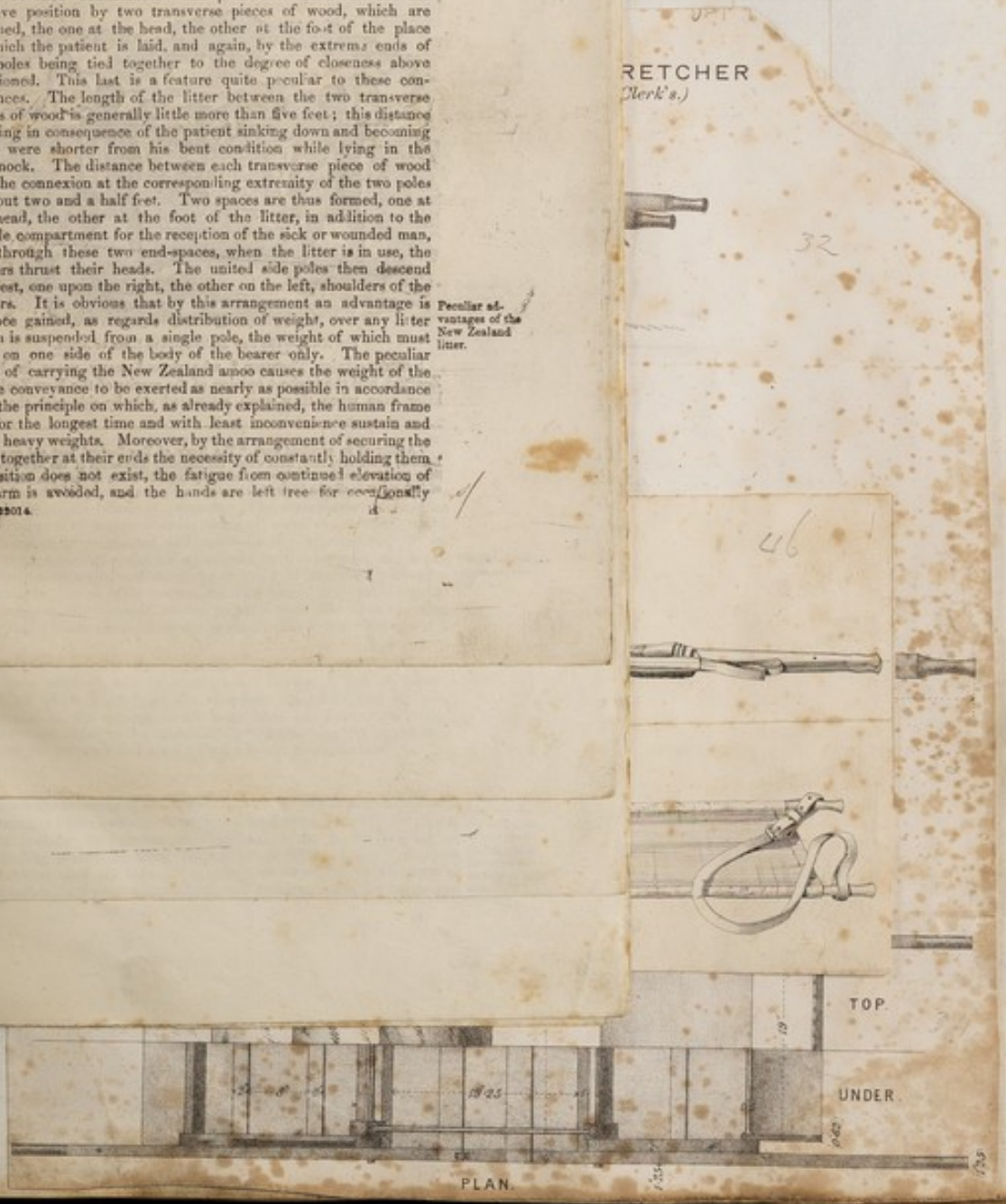
New Zealand native litter or "Amoo."

Peculiar manner in which it is carried.

The network of this litter is made of cord or strips of the common flax, which is very abundant in the country, and hangs loosely downwards. It is supported at the sides by two slight poles, about eleven feet long, placed very nearly parallel with each other. The poles are kept about a foot and a half apart from each other midway of their length, but from that point they gradually approach each other, until they are only about four or five inches apart at their extremities. The poles are maintained in this relative position by two transverse pieces of wood, which are fastened, the one at the head, the other at the foot of the place in which the patient is laid, and again, by the extreme ends of the poles being tied together to the degree of closeness above mentioned. This last is a feature quite peculiar to these conveyances. The length of the litter between the two transverse pieces of wood is generally little more than five feet; this distance sufficing in consequence of the patient sinking down and becoming as it were shorter from his bent condition while lying in the hammock. The distance between each transverse piece of wood and the connexion at the corresponding extremity of the two poles is about two and a half feet. Two spaces are thus formed, one at the head, the other at the foot of the litter, in addition to the middle compartment for the reception of the sick or wounded man, and through these two end-spaces, when the litter is in use, the bearers thrust their heads. The united side poles then descend and rest, one upon the right, the other on the left, shoulders of the bearers. It is obvious that by this arrangement an advantage is at once gained, as regards distribution of weight, over any litter which is suspended from a single pole, the weight of which must press on one side of the body of the bearer only. The peculiar mode of carrying the New Zealand amoo causes the weight of the whole conveyance to be exerted as nearly as possible in accordance with the principle on which, as already explained, the human frame can for the longest time and with least inconvenience sustain and carry heavy weights. Moreover, by the arrangement of securing the poles together at their ends the necessity of constantly holding them in position does not exist, the fatigue from continued elevation of the arm is avoided, and the hands are left free for occasionally

Its construction.

Peculiar advantages of the New Zealand litter.



Convevances

NAME	Troop or Company	Date of Crime	Crime	By whom ordered	REMARKS

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Its construction.

Peculiar advantages of the New Zealand litter.


J. Huppelu
1867

CHAP. V.

raising the litter and temporarily taking the pressure off the shoulder or for any other purpose. Another advantage of the amoo is that it can be made in a very short time in the bush, or near any place where fighting is likely to take place. The poles are made from branches of trees of convenient size; the native flax, which is very strong and grows to a height of several feet, is torn into strips; and these form all the materials necessary for its construction. Extempore litters were constantly made in this way of the green flax by the natives during the recent campaigns in New Zealand.

The natives have generally two bearers, and one or more reliefs according to distance and the kind of country to be passed over, for each litter: but they can be made to be carried by four bearers by merely increasing the length of the poles. When only two bearers at a time are employed, the bearers in waiting can relieve them without halting. The fresh bearers, keeping pace with the movement of the bearers about to be relieved, insert their heads between the poles either before or behind the other bearers who then slip away. Cords are sometimes passed between the poles above the patient to prevent the chance of the patient being thrown out by any sudden jerk during the transport.

Fig. XXII.—The New Zealand Native Litter or Amoo.

Surgeon-Major Thomson,* who passed many years in New Zealand, had the highest opinion of the merits of the New Zealand litter, even when they were estimated side by side with those of

* Author of an excellent work, "The Story of New Zealand, past and present," London, J. Murray, 1859, from which the foregoing illustration of the New Zealand litter is copied, and an officer whose untimely death in China in 1860 was the source of deep regret to all who knew him.

the Indian dhooley or Staff-Surgeon Millingen's stretcher. Dr. Thomson, comparing it with these conveyances, in a letter to my friend, Professor Tufnell, of Dublin, thus remarked :—

"The New Zealand litter possesses several advantages over Staff-Surgeon Millingen's litter. The weight of the former rests on the shoulders in place of the hands of the bearers, which renders it much more easily carried, as I found on making a trial. I am convinced that four men, two bearers and a relief, will convey a man on a New Zealand litter over twelve miles of bad road with less trouble and fatigue than they could carry him half the distance on Dr. Millingen's litter. The New Zealand litter has other advantages; the bearers can be changed without any trouble or stoppage on the march, and with very little inconvenience to the sick person; it is a litter which can be made and had on many occasions where no other could be got; and while most other litters are only useful for short distances, the New Zealand litter is alike applicable whether the distance be long or short. It may be said that the New Zealand is less comfortable for the conveyance of the sick than Dr. Millingen's, but if the bearers keep the step and are careful I see no great difference, indeed, I have seen sick men conveyed in the luxurious Indian dhooley over a comparatively smooth road complain more of the shaking of the dhooley than the sick and wounded French sailors did of the New Zealand litter."

The justice of these conclusions can be best considered after a description of the other litters has been given.

B.—STRETCHERS.

SECTION I.—GENERAL DESCRIPTION OF STRETCHERS.

Derivation of the name "stretchers."

Stretchers appear to derive their name from the fact of the sustaining canvas being *stretched* within a frame, so that the whole constitutes a tolerably firm support when a patient is carried upon it. The strong, and almost unyielding nature of the litter or means of carriage which is thus afforded by the "stretcher" forms the chief distinction between it and any of the more or less loose and impressible conveyances described in the preceding section. Stretchers closely resemble in their nature the temporary wooden supports for wounded persons, such as hurdles, ladders, doors taken off their hinges, and the other expedients of a like kind which are employed in cases of emergency in civil life; the chief difference being that they are just sufficiently yielding not to require the soft materials upon them, which are necessary in these harder kinds, to moderate the effects of pressure. The stretching of the canvas is produced by means of cross pieces of metal or of wood, which are sometimes separated and made to slip over the ends of the poles by means of eyelet holes designed for this purpose, and sometimes are severally secured to one or other of the side poles by a moveable joint or other mechanical contrivance, so as to be capable of being readily fastened to the opposite side pole when required for use. These cross-pieces are generally called the *traverses* of a

Comparison with conveyances of the hammock-kind.

The stretching apparatus or *traverses*.

CHAP. V.

stretcher; in some works they are spoken of as "the stretching apparatus," in others as the "stretchers" themselves.*

General plan of packing stretchers.

By the traverses being detached altogether, or so fixed as to be capable of being laid parallel with the poles at the option of the bearers, the stretcher is rendered more portable. When not in use the traverses are usually stowed away within the canvas, or they are folded up alongside of the side poles, round one of which the canvas is rolled until it is brought into contact with the other pole and the whole is then secured together into one long narrow package. Occasionally, however, the traverses are solidly united to the two side poles so as together to form a strong frame, within which the canvas is enclosed. Of course, such stretchers are not capable of being rolled up, though occasionally they are divided and hinged in the centre and thus made capable of doubling over with a view to rendering them more portable. These stretchers are usually spoken of as "framed stretchers." The side poles of stretchers are used parallel with each other, not curved, as in the New Zealand litter last described.

Framed stretchers.

Carriage of stretchers.

All field stretchers are made suitable for being carried by the hands of bearers, including those which have ~~special~~ arrangements for adapting them to be carried in carts or waggons; hence, they are not unfrequently designated "hand litters." This designation is however equally applicable to other kinds of conveyances for sick and wounded carried by the hands of bearers.

specially/(–) / has no value, / for it is/

Stretchers only suited for European bearers.

It is the mode in which they are carried which limits the use of stretchers to Europeans and their allied races. Such conveyances would be quite unserviceable if placed in the hands of Eastern bearers, for they never support heavy burdens by the strength of their arms. They are never seen in India. The stretchers which were sent with the troops engaged in the last war in China in 1860 had to be provided with poles and bamboo supports, "the Chinese being incompetent for any other mode of "carriage than that by means of a pole borne on the shoulder."† The forms of the ordinary hand conveyances for the sick in India, which will be described hereafter, have been in a great degree determined by the prevailing habit in the East of supporting

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See/

* Chisholm's work on Military Surgery, 3rd edit. See also Millingen's Army Surgeon's Manual. The French expression for a stretcher is "*brancard*," this term being derived from the two poles, or, as it were, shafts, like the shafts of a cart, "les branches," between which the supporting canvas is held. Baron Percy, who first employed the name "brancardiers" for carriers of stretchers, mentions that the word "brancard" was formerly written *branchard*.[1] The poles of the stretcher are sometimes also designated the arms, "les bras," a word evidently of the same derivation as "branche." The horse-litters spoken of in one of the succeeding chapters are named in French "des litières à brancards pour des chevaux." In this term the *poles* are spoken of as the "brancards;" so that "brancard," the ordinary name now employed for the whole conveyance in France, appears to have been adopted in accordance with the same figure of speech which has produced the English appellation "stretcher," in which a part of the appliance has equally come to be employed to signify the whole.

† Army Medical Reports for 1860, p. 379.

[1] Art. "Despotats," (*milites despotati*,) in the "Dict. des Sciences Médicales," by Baron Percy.

burdens *upon* the shoulders instead of sustaining them *from* the shoulders and carrying them in the hands.

Various forms of stretchers.

Stretchers of a great variety of forms have been employed at different times in armies, and even in our own military service; and still greater has been the number of those which have been proposed for use, and for which special advantages and merits have been claimed and advocated by their respective inventors.

It has always been the rule in the civilized armies of modern times to employ at least two distinct classes of stretchers under the circumstances of campaigning. The stretchers of the first class have been those intended for use on the field of action itself, and between it and the ambulances or moving field hospitals, and these may rightly be designated "primary" or "ambulance stretchers"; the second class comprehends those designed for use within the hospital transport vehicles, and at the fixed hospitals, these being distinguished as "secondary" or "hospital stretchers." No single form of stretcher has hitherto been devised capable of answering the requirements of the field and at the same time those of the hospital vehicles and fixed hospitals. A stretcher of the first category—an ambulance stretcher, must be of the very simplest construction, must be complete in itself, and it must be light and capable of assuming a contracted form, so that one man may easily run while carrying it. Readiness for use whenever and wherever required is the first consideration in a stretcher of this class, its fitness as a means of support for *particular* wounds and injuries being subordinate and secondary to its general fitness for *all kinds* of wounds and injuries. A stretcher of the second category may be more complex in construction, more capable of adaptation to the necessities of particular wounds and injuries, fit to be placed on the floor of a hospital wagon or ordinary country cart without springs, suitable for use as a hospital bedstead in the absence of regular bedsteads, or answering other hospital purposes; but yet, while fulfilling these *desiderata*, it must not be too heavy to be easily carried with a patient upon it by two men, or so fragile or complicated as to be liable to be broken or become disarranged, or to be repaired with difficulty when out of order.

Primary stretchers.

Secondary stretchers.

The two classes of stretchers, the primary stretchers, more or less simple, the secondary stretchers, more or less complicated, will be found copiously illustrated in the different forms of stretchers which will now be described. The examples selected for description are those which have appeared specially worthy of notice, either from peculiarity of design, particular construction, or some other features of interest, or because they form part of the authorized transport equipment of some existing armies. Under each kind of stretcher described, the value of the special quality aimed at in its contrivance will be glanced at, and how far the object has been attained will be considered. Lastly, a list of those qualities which a study of the stretchers described, and a consideration of the defects which have been experienced in their employment, show to be essential for forming a good stretcher, both of the primary and secondary kind, will be enumerated.

CHAP. V.

SECTION II.—STRETCHERS INTENDED TO BE EMPLOYED AS PRIMARY ARTICLES OF FIELD EQUIPMENT FOR USE ON THE FIELD OF ACTION.

Staff-Surgeon Millingen's stretcher.

Staff-Surgeon Millingen's Stretcher.—The faulty construction of the so-called stretcher used in the British army during the Peninsular War, which has previously been alluded to,* led Dr. Millingen, a surgeon of very great experience in field service, to advocate the use of the form of stretcher which had been devised by the French surgeon, Baron Percy. This stretcher, although called Baron Percy's by Dr. Millingen,† has ever since the publication of Dr. Millingen's work, entitled the "Medical Officer's Manual," been known in this country by the name of "Millingen's stretcher." The faults of the Peninsular stretcher were the same as those which have been described to be common to all conveyances of the hammock kind. Dr. Millingen wished to obviate these faults by having two arched cross-pieces of such a size and form, and so substantially made, either of elm or oak, that when the poles of the stretcher were passed through certain openings at the sides of these cross-pieces, the whole would form a secure and substantial couch or litter for a patient. The openings through which the poles were intended to be passed were placed about nine inches above the bottoms of the cross-pieces, by which means, when the stretcher was laid down by the bearers, the cross-pieces acted as feet, and the canvas on which the patient was lying was prevented by them from coming into contact with the ground. The stretcher would thus answer the purpose of a camp hospital bed if necessary. According to Percy's arrangement‡ an increased depth was given to the holes in the traverses by small perforated pieces of wood being nailed to them on their inner aspect. This prolongation of the pole openings was said to have the advantage of giving to the whole apparatus, when it was put together, a greater degree of support and firmness without adding to the thickness of the traverses generally, and especially of preventing it from moving unsteadily when the patient was being placed upon it.

Dr. Millingen's plan for obviating the faults of the Peninsular stretcher.

Dr. Millingen's stretcher good for surgical purposes.

The *surgical necessities* of a field stretcher seem to have been well provided for in this stretcher; but it appears to have been found objectionable in other respects, so that it has never been brought into general use either in the French or in our own army. It required a special equipment of the men who were to use it. This equipment will be referred to hereafter.§ Other objections were probably its weight, the liability to loss of some of its parts, or the risk of all the parts not being at hand together when wanted, on account of its being composed of several pieces, and these pieces being divided between two bearers.

Practical objections to Millingen's plan.

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* See page 34.

† Army Medical Officer's Manual, 1819, p. 22. Sketches of this stretcher are given on page 138. A model of it may be seen in the Museum of Mil. Surgery at Netley, Spec. No. 1204.

‡ For a more detailed description of Baron Percy's stretcher see "Dictionnaire des "Sciences Médicales," Paris, 1814, Art. "Despotats," par Percy; and also Millingen's "Army Surgeon's Manual," Lond., 1819, p. 22.

§ See page 136.

For similar reasons, especially the risk of such conveyances being rendered useless from the absence of some of their parts, two forms of stretchers, which were sent to the army of the East in the early part of the Crimean campaign, were objected to by the Inspector-General of hospitals in the field. These stretchers were designated "*Clerk's stretchers*," and "*Smith's stretchers*" from the names of their inventors, Capt. Clerk and Dr. Smith. Both forms answered the double purpose of a stretcher for conveyance, and, by being provided with means for keeping the patient off the ground when laid down, of acting as a camp bedstead. An ample supply of each of these hand conveyances was sent out to the Crimea for trial. On the 20th December 1854, at which time they were used principally as bedsteads for the sick in the hospital tents, from there being no other bedsteads then in the field, and from the stretchers originally brought with the army sufficing for the number of sick and wounded requiring conveyance from the trenches, the principal medical officer reported of them from the camp before Sebastopol as follows:—"The camp bedsteads lately sent out, both Smith's "and Clerk's, are comfortable and good when stationary; but, in "the carelessness and confusion of shipments, and in the move-"ments of stores on service in the field, detached portions are "apt to be mislaid or lost, and thus to render the whole "inefficient."

Clerk's and Smith's stretchers.

Objections to stretchers consisting of several detached portions.

The stretcher which was used at the beginning of the campaign in the Crimea was nearly identical with the *regulation stretcher* in present use. While the campaign was in progress not only the two forms just referred to, but several others were sent out for trial, and were successively abandoned; while other forms were examined by committees of experienced officers in London, and being found unsuited for the objects proposed were also rejected.

The exigencies of military service limit the construction of field appliances to extreme simplicity, and, at the same time, demand for them much strength. Inventors seldom sufficiently comply with the requirements in these respects; but, too often, on the contrary, from designing in the study, and contriving in the workshop, mechanical adjustments calculated to answer a variety of adaptations, render the whole machine when completed unserviceable for the main purpose intended to be fulfilled. They lose sight of the fact that the men who will afterwards have to use their contrivances on service are, for the most part, not drawn from the class of society which includes skilled mechanics and artificers, but from that of ordinary labourers: and that, consequently, with comparatively few exceptions they are apt to be rough, devoid of neatness and manual dexterity, and, too often, especially under excitement, careless. They do not take into account the violence to which stores of all kinds are subjected in being put into and stowed in the holds of ships, during gales at sea, in transfer to lighters, in disembarkations, in being piled on landing places, in being carried in all kinds of land transport vehicles over all kinds of ground, in exposure to all sorts of weather, in frequent unpackings and packings amid the bustle and

Simplicity and solidity essential qualities for all military hand-conveyances.

Mistakes made by inventors.

The class of men by whom stretchers are used on field service.

Risks and exposure to which field-stores are subjected during their transit under the circumstances of warfare.

excitement of a campaign. Let inventors remember the violent usage which ordinary baggage receives in a long journey along comparatively smooth roads when there are many changes in the conveyances, notwithstanding that the packages transported are specially adapted for movement and made to withstand shocks, notwithstanding that the conveyances are expressly built for the reception of such articles, and notwithstanding too that throughout the journey they are moved by porters under the supervision of guards whose daily business it is to handle such packages and to protect them against injury in the transit. They may then imagine what would be the fate of their packages were they subjected to such continued removals with scarcely any similar preparation or precautions. But though the effects in such a case might be fairly guessed at, still, without being familiar with the actual transit of army stores under the circumstances of warfare, it would be difficult to realize the amount of additional risks and shocks to which they are then continually exposed. Yet without this knowledge it is scarcely possible to understand why such simple uniformity and such solidity are absolutely demanded for field appliances. It must be also remembered that it is essential to have these articles at all times in a thoroughly serviceable condition, so that they may be ready to meet urgent wants which may occur at any moment, and which, when they occur, no other means will probably be available to supply. If an engagement take place, and any considerable proportion of the stretchers which were depended upon for carrying away the wounded are found to be broken or unserviceable from any cause, experience teaches that great suffering, and perhaps loss of life, will not improbably result. Hence it is that army medical officers are so prone to reject all contrivances for the first conveyance of sick and wounded in the field which are either at all complicated in construction or which do not appear to contain sufficient elements of resistance to the exposures and violence they know by experience they will be subjected to. Inventors, who are informed that the principles of their inventions are approved, and who yet find that the inventions themselves have been rejected, are too apt to conclude that the officers whose reports have led to the result are over fastidious or prejudiced. They find articles sanctioned for use which are manifestly imperfect in some respects, and incompetent to fulfil some of the purposes which their own improved contrivances answer, and they are led to complain that they are not supported in their efforts at improvement. They do not see that the less perfect contrivance, if its continued serviceable condition can be relied upon with fair amount of certainty, is a more valuable article for use in the field than the most perfect machine with a liability to get out of order. Were the circumstances of British service different from what they are, were the proposed conveyances intended for such use as they would meet with if they were destined to be handled only by practised and careful mechanics, only in countries where well made roads would be constantly met with, under circumstances where opportunities of repair, or the means of speedy restoration of missing parts existed,

The contrivance which answers the greatest number of purposes not always the best suited for field service.

then there can be no doubt but that the decisions pronounced by committees of survey would occasionally be reversed. Practical acquaintance with the exigencies and actual circumstances of a state of warfare, joined with a proper understanding of the best method of achieving the particular objects in view, can alone enable a right judgment to be formed respecting the fitness, or otherwise, of any special contrivances which are proposed for use in campaigning.

Practical acquaintance with the actual circumstances of warfare can alone decide on the utility of proposed appliances for field use.

These reflections have been induced by studying the many inventions which were advocated as substitutes for the stretchers in ordinary use during the period of the Crimean war, and from being aware of the comments which were made by some of the inventors when they found their inventions disapproved.

We find the complicated nature of the design, and want of sufficient strength in the construction, advanced by committees of officers as causes of rejection of most of these inventions.

Complicated construction and insufficient strength, frequent causes of rejection of proposed field appliances.

In the year 1855 fifty "canvas stretchers with folding backs" were sent out to the Crimea, and reported upon by a committee of which the Principal Medical Officer with the army was president. The report stated:—"We admire the principle of the "stretchers with folding backs, and think they will answer "admirably for moving men about in hospitals and at fixed sta-"tions, but our experience of field service leads us to fear they "are too complicated and slightly made to bear the rough usage "such articles meet with in the field."

Stretchers with folding backs.

It is questionable whether, under any circumstances, even with sufficient solidity and without an objectionable degree of complication, a folding back is a desideratum for a stretcher of the primary kind. In the majority of cases for which field stretchers are ordinarily used the recumbent position is the best to be adopted for reasons explained in a previous chapter, and is the one in which the patient is most secure from falling during transportation, without the addition of special contrivances for preventing the occurrence of such an accident. The knapsack and great coat of the man who is being carried, or any other temporary arrangement, answers sufficiently the object of raising the head and chest in certain special cases of injury. With stretchers of the secondary kind, as those employed in hospital wagons intended for long journeys, in the disembarkation of sick soldiers, and for many purposes in hospital use, an arrangement which admits of the patient being in a semi-recumbent or sitting position, and at the same time safe from falling, is, on the other hand, often a very useful acquisition.

The utility of the addition of folding backs to ordinary field stretchers very questionable.

In the year 1861 two stretchers, differing in design and construction, were forwarded from Woolwich for experimental trial in the camp at Shorncliffe. They had been made at the carriage department, after the patterns of litters invented by M. Weisse, of Prague. The principal medical officer at the camp subsequently reported that neither of them appeared well adapted for field service, though both were ingeniously contrived. One stretcher, in which the handles were convertible by joints into legs so as to support and keep it raised from the ground, was objected to

Weisse's stretchers.

Stretchers with handles convertible into leg-supports.

CHAP. V.

because the handles could not be lowered and fixed without additional aid to the bearers. The two bearers were required to support the body of the stretcher when a man was lying upon it, while the change was being effected in the handles. The capability of converting the handles into legs was therefore obviously of no advantage so far as its qualities as a field conveyance were concerned; for the bearers, though desirous of resting during the transport, could not do so without placing the patient on the ground, as with the ordinary field stretcher, while on the other hand its simplicity of construction and probable power of resisting injury were interfered with.

United States' stretcher with hinged handles.

One of these stretchers with handles convertible into feet is shown in the illustrations which follow. The drawings are taken from an example employed in the United States. It does not appear however to have been much used; it is not alluded to in the description of the various stretchers issued to the United States armies which occurs in the well-known report emanating from the Surgeon-General's Office at Washington in November 1865. It is evident that in addition to the difficulty before mentioned of fixing the feet without additional aid during the transport of a patient, that the handles being only hinged to the side poles would be very easily broken off, and the stretcher so rendered useless. The first illustration (fig. 23) shows the under surface of the stretcher with the handles raised, the canvas being stretched by folding traverses; the second (fig. 24) shows the appearance of the stretcher with its handles lowered and fixed in position as feet.

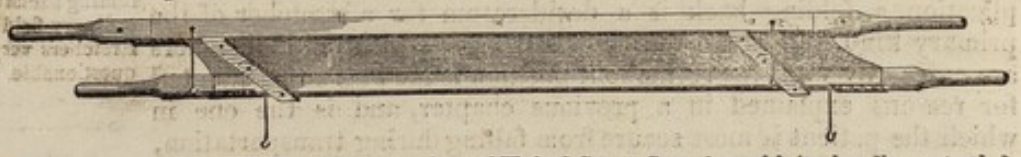


Fig. XXIII.—Under surface of United States Stretcher with its handles extended.

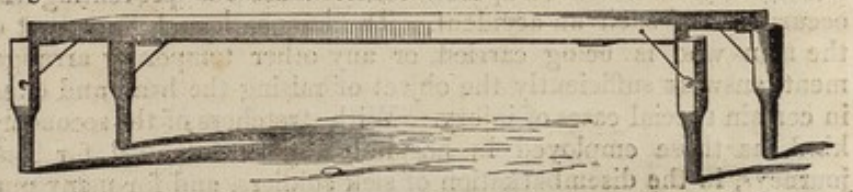


Fig. XXIV.—Side view of the same stretcher with its handles converted into feet.

Stretchers with moveable head-pieces.

The specialty of the second stretcher sent for trial to Shorncliffe consisted in its being fitted with a moveable head piece. This stretcher was objected to on account of its weight, but chiefly because the elevation of the portion intended to bear the weight of the head subtracted too much from the length of the canvas employed in supporting the body and legs, thus rendering the position of the patient uneasy and insecure. Another objection urged against it was that the nature of the apparatus for raising and lowering the head piece caused the stretcher to be too complicated for general use.

Bize's folding stretcher.

Faults of a similar kind were probably found to exist in the following invention, of which a model was submitted to the Army

Medical Department in the early part of the year 1855 by Mr. Bigg, the well-known surgical mechanist. The model represented a stretcher with a folding back, moveable feet, and several other appliances. The advantages of this stretcher, as enumerated by its inventor, were, that it would admit of a wounded man being carried in a wholly recumbent position, or in a sitting position, with the legs raised and supported, or sitting with the knees bent and the legs hanging down, the back and head of the patient being in all cases fully supported. It could be used as a camp bedstead, being fitted with moveable feet. It could be folded so as to serve the purpose of a tray for the conveyance of light parcels, its length being then about three feet, and its width about two feet; or it could be folded up for stowage into a parcel three feet long by one foot in width, when it could be easily carried on the back of a man. It was calculated that the stretcher would not exceed 14 lbs. in weight. But this was simply an estimate, the model never having been enlarged to a pattern of full size.

Enumeration of the purposes to which it could be applied.

The various advantages enumerated were obtained by the combination of a light metal outer frame, with a partial inner frame of the same material, and a canvas support. The outer frame was so jointed as to admit of the relative positions of its several portions being changed and fixed in order to adapt themselves for affording the necessary support to the patient under the several circumstances above mentioned, at the same time that it acted as the poles of a stretcher and formed the handles by which the whole machine was carried. The inner frame was so connected with the outer that it could be raised or lowered independently, and so served the purpose of supporting the head and back of the patient without regard to the position which the outer frame might be adapted to by the bearers.

Its construction.

A more substantial field stretcher, though nearly identical in its objects and in many respects in its construction, is the one known as Col. Clerk's field stretcher, of which a view in perspective, as well as a side elevation and upper and under plan, with measurements, are given ~~below~~ on the next page. The canvas of this stretcher, like that proposed by Mr. Bigg, is attached to a framework which is independent of the outer part of the conveyance, excepting for a certain distance in its middle. All the positions for a patient, mentioned by Mr. Bigg, can be obtained by the use of Col. Clerk's stretcher, the foot pieces and head pieces being capable of being fixed at different heights ~~and it~~ can also be used if necessary as a camp bedstead. The stretcher proper, however, is fixed between two side-poles, instead of being within a complete frame, and these side-poles are not jointed, so that they do not admit the attainment of some of the other purposes mentioned in describing Mr. Bigg's model. The stretcher, moreover, is made chiefly of wood, iron being used only in forming the necessary cross-pieces and connexions between its several parts. It has also the advantage of having a covered hood for the protection of the face and upper part of the body of a patient when carried upon it. The weight of Col. Clerk's field stretcher is, I believe, about 50 lbs.

Colonel Clerk's field stretcher.

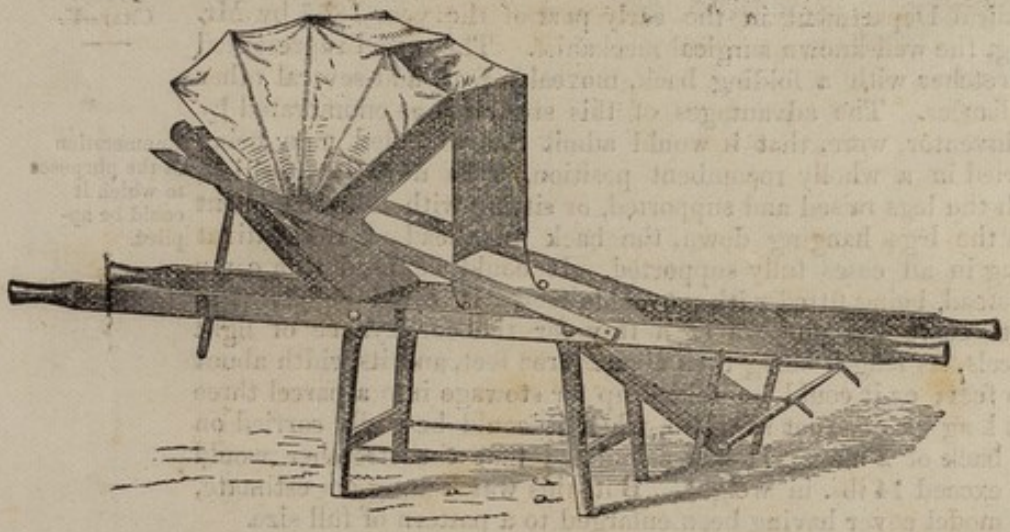


Fig. XXV.—Perspective view of Col. Clerk's Field Stretcher.

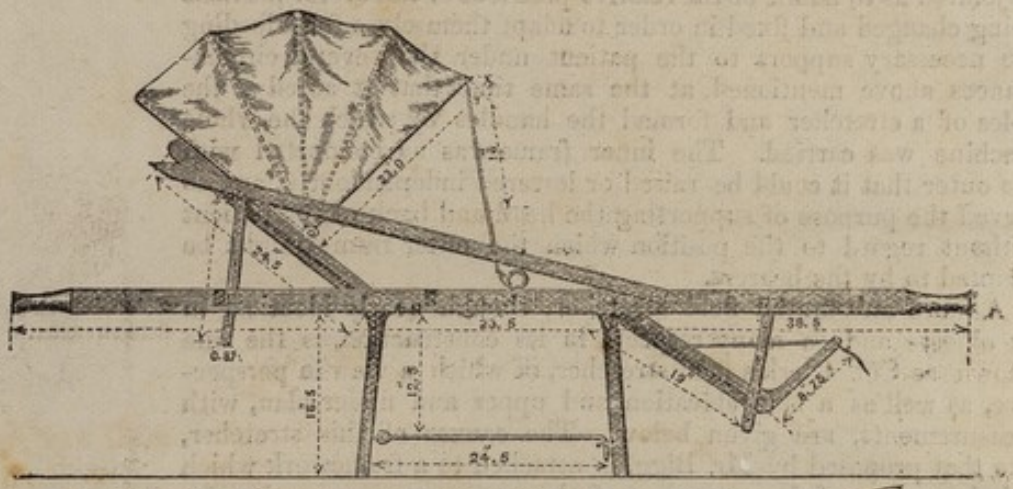


Fig. XXVI.—Side elevation of Col. Clerk's Field Stretcher, with measurements.

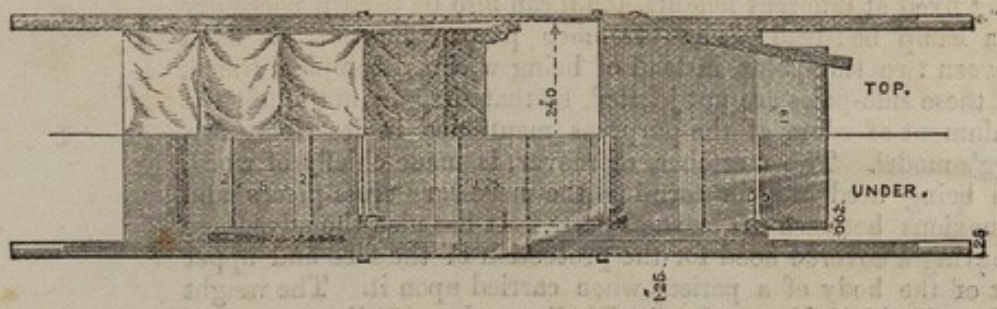


Fig. XXVII.—Upper and under plan of Col. Clerk's Field Stretcher, with measurements.

As a *field stretcher* the objections to this conveyance are its complicated construction, and the questionable utility before discussed of folding backs being applied to stretchers intended for use in the field. Its weight is also unavoidably increased by the nature of its construction. It is also open to the disadvantages common to all framed stretchers as regards campaigning purposes. These are mentioned in the remarks on framed stretchers in general.

The drawings on previous page fully illustrate the construction of Col. Clerk's field stretcher.

M. Wahl's "brancard pliant."

The idea of having a stretcher suspended, partially or wholly, within an outer framework, or between two outer side-poles, continues to be not unfrequently acted upon by inventors. In the Paris Exhibition of 1867 there were several such. On that occasion the Wurtemberg Committee for aid to wounded exhibited a "Brancard Pliant" folding stretcher, invented by M. Wahl. The stretcher in this instance was slung within a framework, and the whole was constructed so as to admit of being folded up. It was obviously too complicated for general use.

Another form of "brancard pliant."

A lighter kind sent by the same committee, but also too complicated for the general purposes of a field conveyance, was called a "Siége pliant pour le service de campagne," folding seat for field service. This stretcher was designed to carry a patient sitting, and the seat was within two side-poles. It rested on the legs attached to the seat when put on the ground.

French hand-litter for carriage of two patients.

The French National Committee exhibited the model of the "Brancard double à articulations," double stretcher with joints, "de MM. le Dr. Piotrowski et Vinois." This was arranged for the carriage of two patients back-to-back, in a semi-recumbent position. The jointed stretchers were carried within two outer side-poles, and could be folded up flat between them. An examination of the model showed that when constructed of full size its weight would be too great when loaded for general use in the field by a couple of bearers, for which number it was designed, at the same time that its complicated construction and unsuitableness for easy stowage would be also against its adoption as an article of field equipment.

Remarks on models of proposed conveyances.

With reference to *models*, in which form many inventors find it convenient to exhibit their designs, and especially with regard to *models* of such complex conveyances as those proposed for service in the field by Mr. Bigg, and by Messrs. Piotrowski et Vinois, I may observe that, useful as such miniature representations are for explaining the principles and illustrating their details of construction in the lecture room, it should always be remembered that they usually prove exceedingly fallacious guides when solely depended upon for arriving at conclusions on the actual fitness for service of the machines which they are made to represent. They are apt even to deceive inventors themselves as to the precise qualities and capabilities of the particular contrivances which they design them to illustrate, and should never be accepted by critical observers as sufficient for forming a reliable judgment of their practical merits.

Their use for purposes of illustration.

CHAP. V.

Models very apt to deceive if used as tests of the qualities and the capabilities of the machines which they are designed to represent.

It is only by much greater care and nicety than are usually given to such articles, that models can be made strictly to scale, so that the proportionate relations of dimensions may be accurately preserved in all of their parts. It would surprise, perhaps, no less than disappoint, many inventors, were the models which they exhibit to be employed, with all their relative proportions preserved, as the standards of measurement for the construction of *patterns* for actual use of the vehicles they represent; so obvious do small errors, which are scarcely noticeable in a model, become when they are magnified to the dimensions of the full-sized object. Many models are little better than toys because they are not made to scale. Other matters besides form and dimensions, such as strength of material in relation to weight to be carried, effect of increased mass, the relative bearings of the several portions in the machine itself, are also subjects which can seldom be rightly estimated in models. A complete *pattern* can alone enable committees who are ordered to pronounce opinions on the merits of such inventions as conveyances, of whatever kind they may be, to do their duty with equal justice to the inventors and to the public service; for only a pattern can be subjected to tests corresponding with the work in which the article will be actually employed on service in campaigning.

Patterns of conveyances can alone enable an accurate judgment to be formed respecting their fitness for the purposes intended by their construction.

Description of the field-stretcher in present use in the British service.

~~*British Regulation Field-stretcher.*~~—The field-stretcher authorized for use in the British service at the present time is shown in the illustrations which follow. It is thus constructed:—The two poles are round, made of ash, and are each eight feet long, and one inch and a half in diameter, or nearly five inches in circumference, excepting for a short space near their extremities, where there is a slight diminution in girth to adapt them for being handled. Two plain iron rods, each 22 inches in length, three-eighths of an inch in diameter, or about one inch in circumference, and terminating in a ring at one end and a hook at the other, are attached by their rings to two staples fixed at the distance of seven inches from the extremities of the two poles, but on opposite sides and ends of the stretcher. At a corresponding distance from the end of each alternate pole is an opening in the pole itself of a size proper for receiving the hooked end of the iron rod. The iron rods, when they are hooked across, form the traverses, and fasten up the stretcher. The sacking is make of a piece of stout canvas, and is folded over each side so as to form two plaits sufficiently large for the poles to be inserted into them. At one end is a small horsehair pillow, also covered with canvas. It is secured to the sacking by means of leather thongs, which are passed through openings in the sacking and tied together on its under surface. Two stout leathern straps or slings, looped at their ends, are provided for each stretcher, but not connected with it by any fixture; they are intended to be passed round the necks of the bearers to act as braces and assist in keeping up the weight of the stretcher when in use. One end of each strap is provided with eyelet holes and a buckle, so that it may be shortened or lengthened according to the respective heights of the bearers; the other has a loop only

for receiving one of the handles of the stretcher. There are no feet to these stretchers. When required to be packed for transport the iron traverses are laid closely in contact with the poles, the sacking with the pillow inside and the poles are rolled up together, the straps of the bearers are laid alongside, and the whole is fastened into one package by four cords attached for this purpose to the four corners of the sacking.

Fig. XXVIII.—Plan of British Regulation Stretcher, without pillow or straps, with traverses fastened.

Fig. XXIX.—Plan of the same, with traverses unfastened.

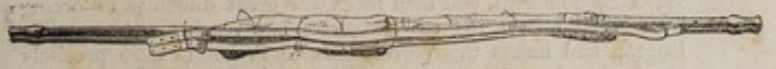


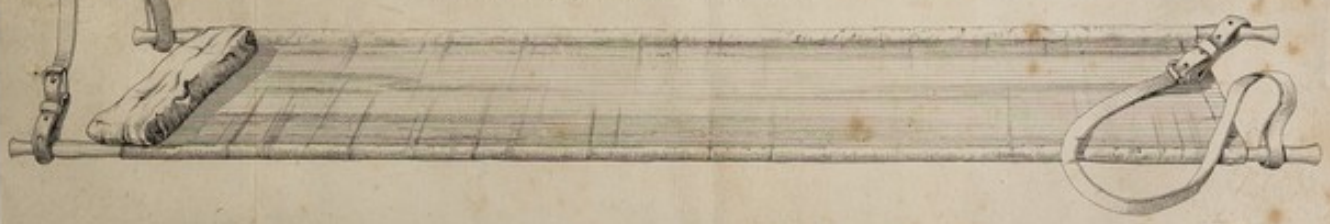
Fig. XXX.—The same, with pillow and straps packed for transport.

Fig. XXXI.—The same, with pillow and straps open for use.

46

Stretcher, with pillow and straps,
~~BEARER~~ PACKED FOR TRANSPORT

(with pillow & strap)
Stretcher ~~open~~ OPEN FOR USE



Scale-1 Inch to 1 Foot

CHAP. V.

The total weight of the regulation stretcher is 15 lbs. The pair of poles and connected iron traverses being 9 lbs. 5 oz.; the sacking, stays, cords, and pillow, 3 lbs. 14 oz.; the pair of leather slings, 1 lb. 13 oz. The weight varies to a slight amount in different stretchers, chiefly owing to variations in the dimensions of the circumference of the poles.

Advantages of the British regulation stretcher.

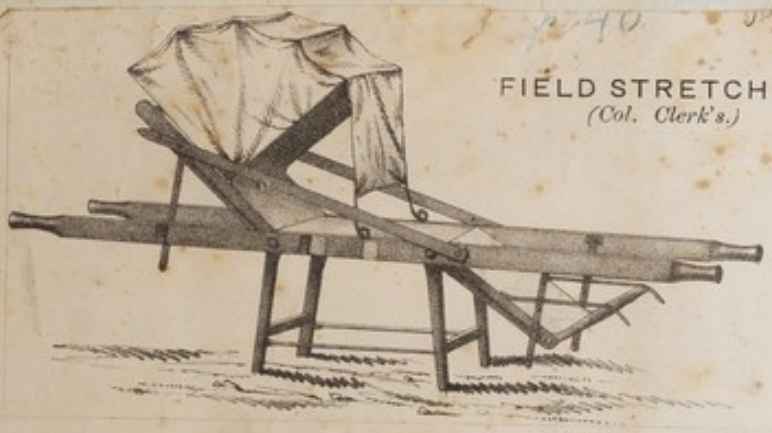
The English regulation field-stretcher has the advantage of being simple in construction, inexpensive, and portable. The canvas bottom is made easily removable, so that it may be at once washed if soiled by blood or dirt. It is questionable whether the cleanliness of the stretcher might not be still further secured if an impermeable covering of some kind were substituted for the plain canvas of the horsehair pillow, which cannot be so readily removed to be washed. The horsehair stuffing would be also better preserved. The separation of the canvas bottom, though convenient, cannot be regarded as a necessary arrangement. Even when removed, the canvas cannot be washed like ordinary linen by being rubbed between the hands; it must be laid on a flat surface and then cleaned by means of a scrubbing brush and soap, in the same way as canvas articles are cleaned on board ship. At least this is the usual method adopted for cleaning the canvas of stretchers. It is evident, therefore, that the canvas bottom could be scoured with almost equal ease although nailed or otherwise fixed to the side poles or traverses.

Its disadvantages.

The regulation stretchers are not free from important objections. Stretchers of the same kind were used at the commencement of the Crimean war, with the exception that no straps to assist the bearers were provided at that time. The inconveniences then experienced during their use in the field were two-fold. Not unfrequently the iron traverse, from being too slight for the strains to which it was subjected, became broken, and no means of repairing the damage were at hand. More often one or both of the traverses became bent, and then there was great difficulty in forcing by manual efforts the two traverses into exactly corresponding lengths, and unless this correspondence in length were precisely obtained, only one traverse could be hooked into its place. The unprotected openings in the side poles designed to receive the hooks of the traverses quickly became enlarged, weakening the side poles still further at those particular points, and leading to the inconvenience of the hooks being easily jerked by accidental blows out of their places, notwithstanding the weight of a patient upon the stretcher. Another serious inconvenience was the want of means of keeping the patient off the wet mud in the winter time, or the hard uneven ground in dry weather, when the bearers were compelled to rest themselves during the long carriage of the patient from the trenches up to camp.

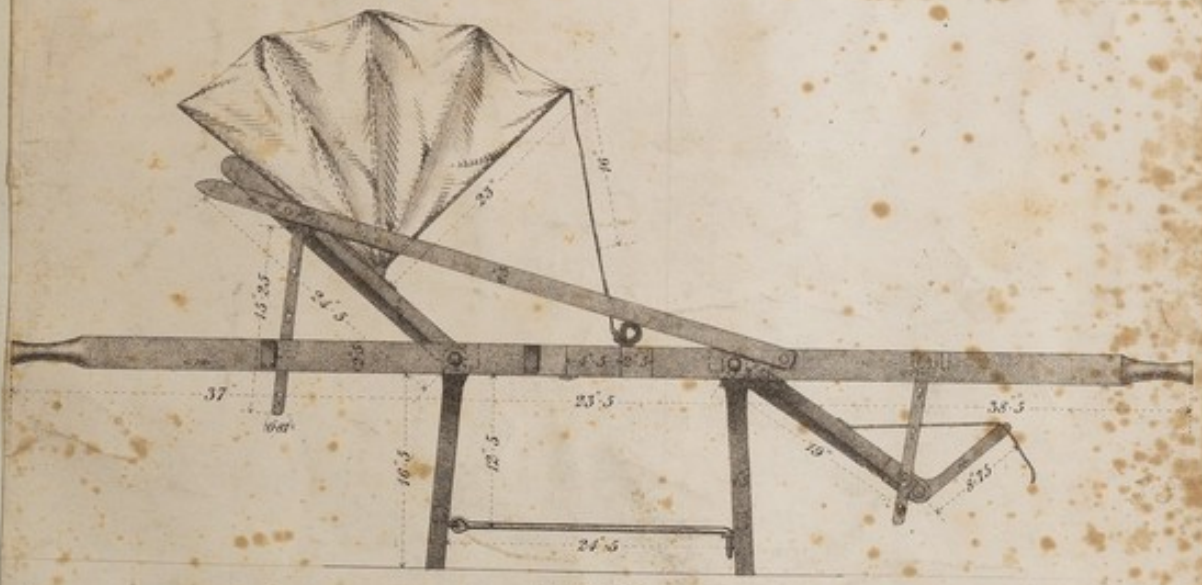
Stretchers without feet, and only essentially differing from the English regulation stretcher in the circumstance of the traverses being detached and made of wood, were employed at the com-

NAME	Troop or Company	Date of Crime	Crime	By whom Reported	Punish-ment	By whom Ordered	REMARKS

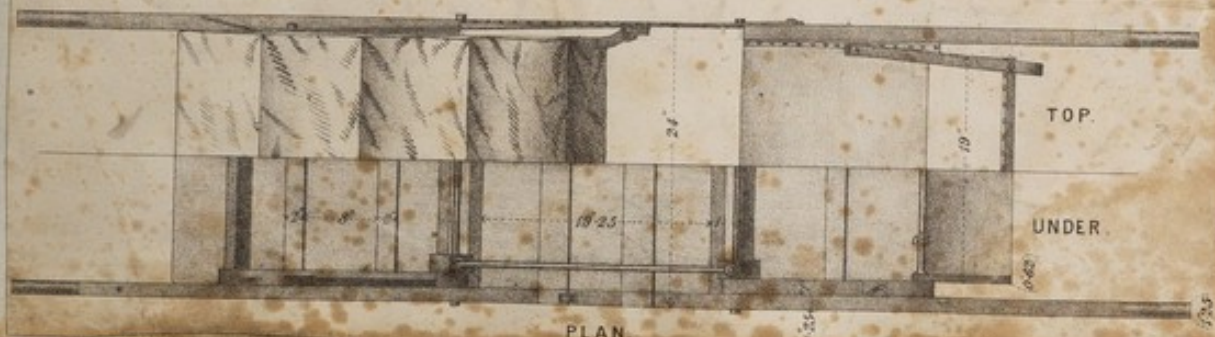


FIELD STRETCHER
(Col. Clerk's.)

32



ELEVATION.



TOP.

UNDER.

PLAN.

Conveyances

NAME	Troop or Company	Date of Crime	Crime	By whom Reported	Punish-ment	By whom Ordered	REMARKS

Borne by Men.

	Punish-ment	By whom Ordered	REMARKS

mencement of the late war in the United States in the northern armies.

The Surgeon-General of the United States army mentions in his remarks on the means of transportation of the wounded that in the early part of the war most of the regiments sent into the field were supplied with stretchers of the old regulation pattern. The form and construction of this stretcher are shown in the following drawing. It seems to have soon given way to stretchers of other patterns.

Fig. XXXII.—Stretcher of the old regulation pattern in the United States Army.

It is not mentioned that the absence of feet was one of the causes of its rejection; the only faults named in the report are that "the yoke pieces (traverses) were frequently lost, and that "when the canvas stretcher became damp the litter was put "together with difficulty."* The difficulty of fixing the traverses to the side poles, owing to the canvas shrinking under the effects of damp has never been noticed in the English regulation stretcher, the sacking being left sufficiently loose to avoid this inconvenience. It is obvious that a slight increase in the width of the canvas in the American stretcher would have equally obviated this objection, and that this could have been given to it without detracting from its capability or fitness for transportation of wounded, especially as no feet were provided to keep the patient off the ground. United States' stretcher without feet.

Feet to stretchers are not only of importance for keeping a patient off the ground when laid down for the temporary ease of the bearers during the transport, but also because they render the stretcher capable of acting the same part for the patient for a longer time if circumstances render it desirable or necessary. It has been urged as an argument against the addition of feet, that if stretchers can be used as camp bedsteads, they will be so employed by persons who have no right to use them,† to the detriment of those for Importance of having feet to stretchers.

* Circular, No. 6, Washington, Nov. 1, 1865, p. 81.

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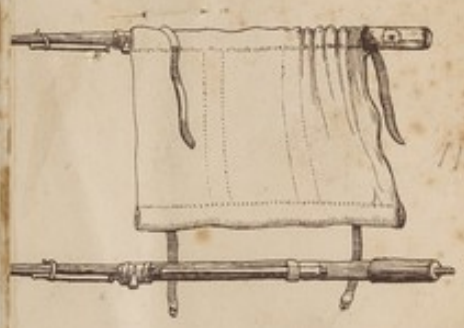
ALF OF A STRETCHER.



C JOINT. B. THE CROSS-STAY.

(1/3 THE FULL SIZE.)

THE STRETCHER COMPLETE.

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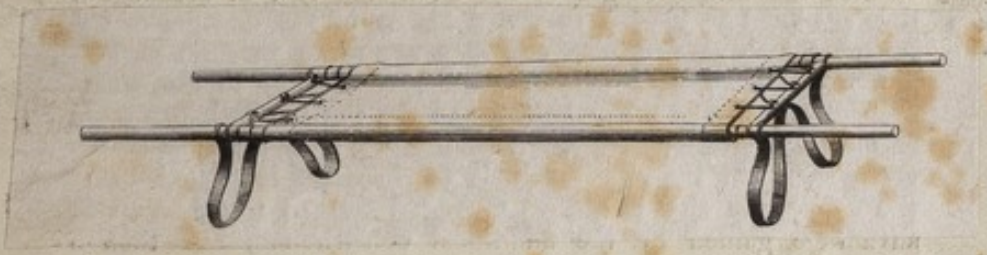

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CHAP. V.

whom they are intended. But there are other means in a well trained and disciplined service of guarding against such an abuse as this would be, and of meeting it if it occurred. To provide against the probability of abuse by putting a total stop to the use of an article, if that article be determined to be necessary, would in most matters be acknowledged to be an expedient no less puerile than mischievous. The question respecting the additional provision of short feet for stretchers therefore really resolves itself into this: are the advantages of these supports sufficient to counterbalance the disadvantages of the additional risk of breakage if they are fixed or jointed to the poles, or of the division of the stretcher into several pieces if they are made to form part of moveable traverses. The feet must project while in use, whatever contrivance may be adopted, and the liability to injury must be increased proportionably. A similar risk attends almost everything in which the extreme limit of simplicity is passed. But the amount of risk is always measured against the amount of advantage gained by the additional construction, and then a balance is struck in order to determine whether the addition is deserving of general adoption. Nine-tenths of the breakages which are ascribed to peculiarity of construction, supposing that the articles are properly made in the first instance, and are sufficiently substantial, are the result of want of previous training in the right mode of using the articles, or of want of care in the use, or of positively abusing the articles in such a way that breakage is an inevitable result. If responsibility were sufficiently defined and acknowledged on both sides, and such "accidents" could be practically followed up by proportionate penalties, they would occur much less frequently than they do under existing circumstances. As regards the question of feet being applied to field stretchers, there can be no doubt that the liability to breakage has been increased by all the expedients which have been hitherto hit upon for attaching them to the stretcher poles; but the advantages, already mentioned, resulting from having the feet are so great, that the additional liability to injury in consequence of them has been submitted to rather than the disadvantages of doing without them. The regulation field-stretchers of all countries excepting the English, I believe, are now provided with feet; and among all the field-stretchers exhibited at the Universal Exposition at Paris in 1867, there was not one modern stretcher exhibited without these appendages.

Value of the objections made to the application of feet to stretchers.

As a general rule, when the feet of stretchers are connected with the traverses, instead of with the poles, the traverses are detached, the object of this arrangement being to facilitate stowage, and to admit of the poles passing through the open hems of the sacking bottom. But even this arrangement is not absolutely necessary, either as regards easy package or to meet the views of those who consider the separation of the canvas desirable. One form of stretcher (Mr. Redford's) presents the feature of connecting both traverses and feet with the poles at the same time that

there appears to be no difficulty in using the canvas sacking with hems, as is done in the regulation field-stretcher. I have not, however, seen a pattern * of this conveyance, so that I am unable to say whether the strength would be impaired, or whether any difficulty in use would be likely to arise from the peculiar arrangement of the joints by which the traverses and feet are locked together. A description and drawing of Mr. Redford's stretcher will be found at another part of this chapter.

Regulation stretcher of the French army.

The stretchers employed in the French military service are composed of three separate parts, the poles, traverses, and the sacking. They are provided with feet, which are formed by portions of the traverses. The poles are independent of each other, are made of oak, and taper towards their extremities. The traverses are also made of wood, and besides terminating in feet, are provided at each end with a solid and firmly-secured metal ring, through which the poles are intended to be passed. The sacking is oblong in form, has down each side an open fold or hem for receiving one of the poles, and is fixed (nailed) by its short borders to the two traverses. It is strengthened at the four corners by pieces of leather. Small straps and buckles are attached in these situations for the purpose of fixing and bracing together the frame formed by the junction of the two poles and traverses. The several parts of these stretchers are carried in appointed places at the upper parts of the hospital store wagons (caissons d'ambulance), whence they can at once be removed for use; but, as the number is limited to three stretchers to each wagon, additional stretchers are taken for use in the field. These supplementary stretchers are rolled up in bundles and placed on bât mules. Leathern shoulder-straps are issued to the bearers to assist in the carriage of the stretchers.

The following drawings represent the forms of the traverses, poles, and mounted stretcher just described:—

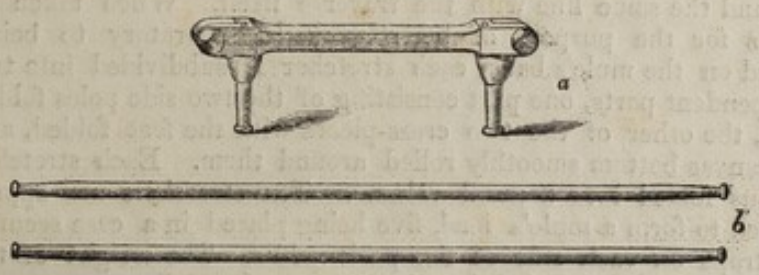


Fig. XXXIII.—(*a*) The traverse, and (*b*) the poles of the French Army Regulation Stretcher.

* A *model* of Redford's stretcher is contained in the Museum of Mil. Surgery at Netley, Spec. No. 1205.

Fig. XXXIV.—The Regulation Stretcher of the French Army mounted.

Regulation stretcher of the French army adapted for conveyance on bât animals.

It may be desirable in some expeditions to have stretchers so arranged that they shall occupy the least possible space and be capable of being transported without damage on the backs of bât animals. This has been a matter of necessity in many of the military expeditions of the French in Algeria, when detached columns of troops have had to operate for lengthened periods far from any military base in mountainous districts where wheeled transport was impracticable; and where, nevertheless, the sick and wounded of each column having to be carried with it, the ambulances could not be limited to containing simply the means of administering the first dressings as in Europe, but had to carry with them all the requirements for subsequent care and treatment. Under such circumstances economy of space in all the matériel that has to be transported becomes of first importance. In 1852 a commission sat in Algiers for the purpose of improving the system of ambulances as they then existed and adapting them better to the exigencies of Algerian warfare. The stretchers were taken into consideration with the rest of the hospital equipment, and the patterns which the commission decided to be best fitted for the service of such expeditions is represented in the drawings which follow. The poles are divided midway, but so united by hinges that the two halves can be folded back upon each other. The iron feet of each traverse are also arranged to fold back into one and the same line with the traverse itself. When taken to pieces for the purpose of being packed preparatory to being placed on the mule's back, each stretcher is subdivided into two independent parts, one part consisting of the two side poles folded back, the other of the two cross-pieces with the feet folded, and the canvas bottom smoothly rolled around them. Each stretcher is thus folded into a small volume. Ten stretchers are appropriated to form a mule's load, five being placed in a case secured by straps on each side of the pack-saddle. The weight of the stretcher all complete is kil. 10·500, or nearly 22 lbs.

In this stretcher a somewhat complicated construction, though one not readily put out of order, and the inconvenience of a division into separate parts, are submitted to for the sake of obtaining a still more portable form of package than is requisite for stowage in the ambulance store-wagon. The annexed sketches sufficiently explain the construction and mode of package of the "brancard à "hampes brisées."

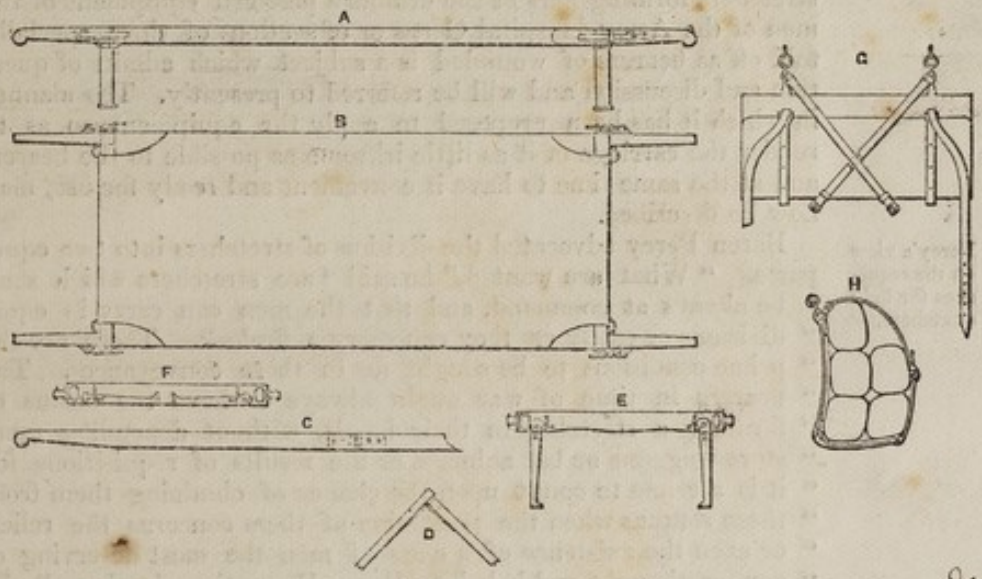


Fig. XXXV.—Portable Stretcher (Branchard à Hampes Brisées) adapted for carriage upon the back of a bât animal, for use in mountain warfare or under any circumstances where carriage in store wagons is not practicable.

A. Side view of the stretcher mounted.
B. Plan view of the stretcher with its canvas bottom.
C. Part of pole showing the side hinge.
D. Pole partly bent showing the mode of supporting the joint.
E. Traverse with feet unfolded.
F. Traverse with feet folded up.
G. Case for stretcher, front view.
H. Case for stretcher, side view.

Stretchers with divided poles.

The separation of the side poles of stretchers into two sections has been frequently suggested as a means of avoiding the inconvenience inseparable from the transport of the poles in their complete state, and also to enable them to form part of the personal equipment of men of the Army Hospital Corps, so that they may be at hand at all times with the attendants who are trained to use them. Now that provision is made for the transport of the stretchers in the hospital carts, the length of the poles will not be so much a source of inconvenience as it formerly was. Until a recent period it was the custom for the regimental stretchers to be distributed among the bandsmen when starting upon active service, to be carried by them during the march. The regimental stretchers were carried in this way on the march from the place of landing in the Crimea to the position before Sebastopol. As the bandsmen were not trained to any particular method of carrying them, and as they were not provided with any means of supporting them analogous to the belts for supporting the poles of standards, it depended entirely upon each man's care and handiness whether the stretcher he was carrying became an inconvenience to himself and his neighbours or not. It is not intended by the present arrangement that the stretchers shall be distributed until there is a near prospect of their being required for use. The advantages which would be likely to result from

The length of the ordinary stretcher-pole of less inconvenience now than it was formerly.

Stretchers carried by the bandsmen of regiments.

stretchers forming part of the ordinary personal equipment of the men of the Army Hospital Corps or of sections of them specially told off as bearers of wounded is a subject which admits of question and discussion and will be referred to presently. The manner in which it has been proposed to apply the equipment, so as to render the carriage of it as little irksome as possible to the bearer, and at the same time to have it convenient and ready for use, may now be described.

Percy's view on the requisites for field stretchers.

Baron Percy advocated the division of stretchers into two equal parts. "What are wanted," he said "are stretchers which shall "be always at command, and that the men can carry in equal "divisions as easily as they can carry a firelock. These are the "prime conditions to be sought for in these conveyances. The "bearers in time of war ought always to have the means of "forming a stretcher in their hands, without depending upon "store waggons or bât animals, or the results of requisitions, for "it is a crime to count upon the chance of obtaining them from "these sources when the possession of them concerns the relief, "or even the existence of a class of men the most deserving of "our forethought and help."* Baron Percy thought that all the stretchers should also be adapted to answer the purpose of camp bedsteads when necessary.

Stretchers adapted to form part of the equipment of bearers.

Dr. Millingen of the British service held similar views on this subject. The following is an outline of the plan advocated both by Percy and Dr. Millingen for the carriage of stretchers, and for making them part of the personal equipment of the bearers.† The several parts of one stretcher were divided between two bearers. Each bearer carried a pole eight feet long, with one end adjusted for the purpose of receiving an iron lance-head with its transverse guard, and with the other end protected by a ferule. The pole thus became a weapon of defence and offence, like the serjeant's pikes which were used during the Peninsular war, or the lances which are still employed by certain cavalry soldiers. The iron part of the lance was to be removed when the pole was used with the stretcher, and to be carried like a bayonet in a scabbard at the side of the bearer. Each bearer also carried one cross-piece, or traverse of the stretcher over his knapsack, its feet being fitted for the sake of steadiness into two leather sheaths, one of which was placed at each side of the man's pack. The sacking of the stretcher was divided longitudinally into two equal portions, each half being folded flat and worn round the waist of a bearer. When the stretcher was put together, the two halves were laced to each other by means of eyelet holes and a cord fastened to the sacking. Dr. Millingen so far modified this arrangement that he placed a complete sacking round the waist of every man of the hospital corps, so that the time which would be occupied in lacing up the two halves might be saved. The sacking had two hems or duplicatures along its two sides to receive the poles. Thus

Percy's plan.

Dr. Millingen's plan.

* Art. Cit., p. 577. The sketches of Percy's brancardiers are copied from the same Article.

† The "Army Medical Officer's Manual upon Active Service," Lond., 1819, p. 22.

provided, every two bearers of the hospital corps could at once put together a stretcher for the removal of a wounded man, or make a bed for a sick man; such a stretcher could be mounted or dismounted, Dr. Millingen states, in two minutes and a half. Two sling belts with sockets for the ends of the poles formed part of the equipment of each man, being provided to enable the men to carry the stretchers more easily. Dr. Millingen does not mention the weight of his stretcher, but he states that a man thus equipped and carrying his pack, havresack, and canteen would still carry a weight considerably lighter than that carried by a soldier in the ranks.

Fig. XXXVI.

Fig. XXXVI.—(*a.*) Brancardier, equipped and armed. One of the traverses of the stretcher is carried upon the knapsack. Half the sacking of the stretcher is seen worn round the waist. The scabbard to receive the iron part of the lance when the latter is arranged for use as one of the stretcher poles is seen at the soldier's side.

(*b.*) The same brancardier seen from behind. The manner in which the legs of the traverse are received into two leather sheaths at the sides of the knapsack are here seen.

(*c.*) A traverse separated from the knapsack.

Fig. XXXVII.—Two brancardiers are shown in this drawing in the act of carrying a wounded dragoon on one of the stretchers. The assistance to the hands of the bearers afforded by the straps into which the poles are received, the sheaths attached to the knapsacks from which the traverses have been removed, the iron top of the lance in its scabbard, are also indicated. (The bearers are represented to be walking in step, contrary to what is now known to be the proper mode of progression.)

Mr. G. Redford's stretcher.

Among those who have entertained the idea of separating the side pole of the stretchers into two parts, and equipping the men of the Army Hospital Corps with them, perhaps no one has discussed the question so fully as Mr. George Redford, who served as an acting assistant surgeon in the 58th regiment during the Crimean campaign. In 1858 he published a pamphlet* "On a "new plan of Equipment for the Medical Staff Corps, with port-"able Stretchers and Medicine Pouches," from which the following remarks on the subject and descriptive illustrations are extracted. They fully explain the mechanism of his proposed stretcher, and show the manner in which it was intended to be carried. The plan adopted for fixing the traverses and the feet to the side poles, and of jointing them together when the stretcher is about to be used are worthy of attention. They have been before referred to.† The exact weight, an important matter, has not been mentioned.

"The stretchers hitherto employed," Mr. Redford writes, "have been carried about in their complete form, or perhaps folded in two, the consequence has generally been that they have most of them got more or less injured or destroyed before the time came when they would have done good service. The kind of stretcher here described is more light and portable than any that I know of, and as it is capable of being closely and securely packed together when not in use it would escape most of the injuries likely to occur from the carelessness of soldiers or the accidents of a campaign. As it would always be in the hands of the men of the corps it would be less liable to injury than if con-

* London, John Churchill, New Burlington Street, 1858. † See page 139.

veyed by those not interested in preserving it. Each man also would be required to keep it in perfect order, precisely as the soldier does his musket."

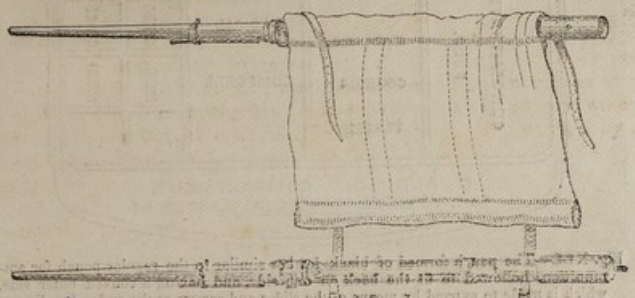


Fig. XXXVIII.—Half of Mr. Redford's Stretcher. This portion, however, is capable of being used should it happen that the other part is not immediately at hand, though this is not advisable.

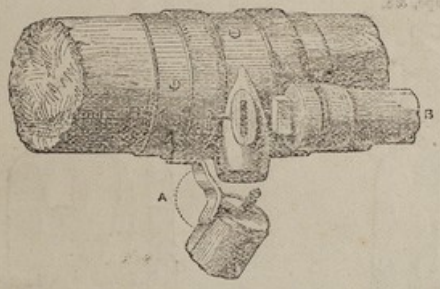


Fig. XXXIX.—The leg A, and cross-stay B, joints of the stretcher with the leather fittings.

($\frac{3}{4}$ the full size.)

Fig. XL.—The stretcher complete. It is composed of two halves precisely alike, one of which is carried by every man, and any one half fits the other.

The pole is in two pieces, of good ash, round and tapering, joining at the middle by a strong brass ferule and screw, the one sinking into the other like an Irish fishing rod. Length, 10 ft.

The legs are of hollow brass tubing, made with strong leather hinge or binding so as to fold up, but, when used, to screw upon the pole by means of the metal ring and socket.

A cross piece of wood folding to the pole in a similar way, and fixing into the metal ring on the pole.

Two leather straps useful for packing the poles together, and in case it may be necessary to confine the patient.

The canvas is strengthened with belts of india-rubber webbing, and made to slip on and off to allow washing and convenient packing. 2 ft. across and 3 ft. long.

FIG. I. HALF OF A STRETCHER.

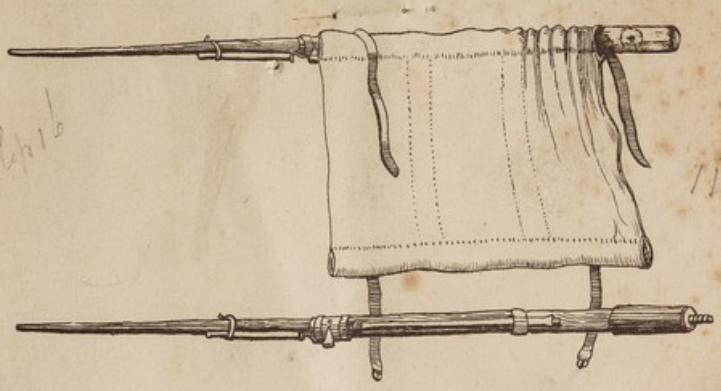
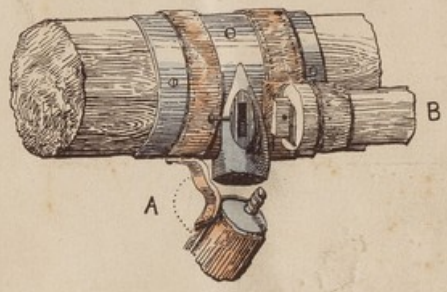


FIG. II.



A. THE LEG JOINT. B. THE CROSS-STAY.

($\frac{1}{3}$ THE FULL SIZE.)

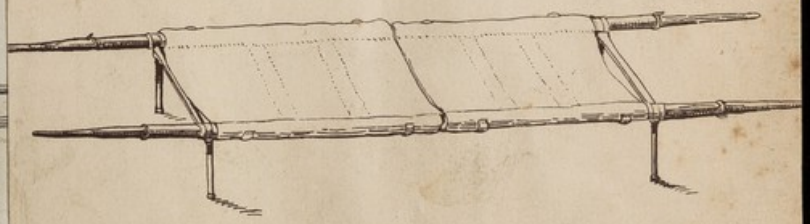


FIG. III. THE STRETCHER COMPLETE.

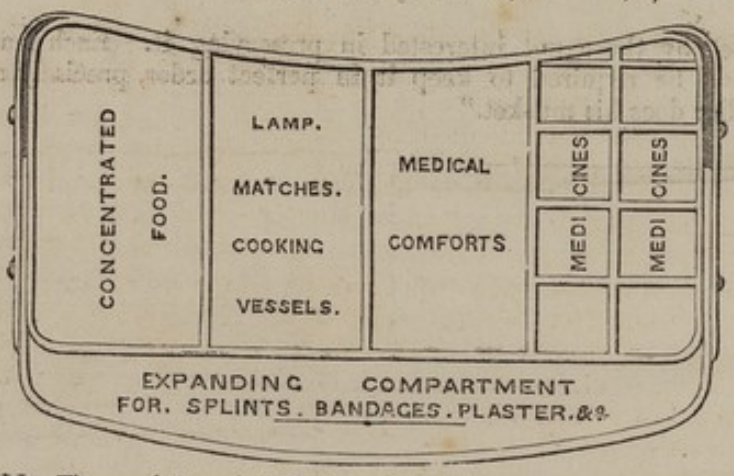


Fig. XLI.—The pouch formed of black leather similar to the regular pouch for ammunition, hollowed to fit the back on one side, and having a convex outer side, which is made to expand by means of the slides and screws at the end. Its dimensions are, 16 inches long, 8 deep, and 8 broad.

It is divided into five compartments, to contain—1. Sick food; 2. Medical comforts; 3. Light, heat, and cooking apparatus, for purposes of the sick; 4. Medicines; 5. The expanding compartment to contain splints, lint, bandages, tow, plaster, tape, &c.

Fig. XLII.—A man of this corps fully equipped in heavy marching order. The colour of the uniform the same as the present hospital dress, facings black. The cap of the same colour with black band and staff badge. Glazed white leather top and ~~poke~~.

peak

CHAP. V.

Propriety of spec men stre ers

The propriety of adopting a special equipment, such as that described by Dr. Millingen, Baron Percy, and Mr. Redford, for the men of the Army Hospital Corps, even though it should be adapted so as not to interfere with the carriage of the ordinary field kit, admits of question under any circumstances, but with the existing constitution of the Army Hospital Corps it is difficult to see in what way it could be rendered practicable. If a certain company of men were specially told off for the duties of stretcher carriers, like the bearer companies in the Prussian and Austrian services, then a special equipment might be held to be desirable. Such a company would have to practise from time to time the use of the equipment as a part of their training and drill, so that they might be habituated to it, and thoroughly versed in keeping it in order when equipped with it in time of war. But the formation of such a company could hardly be advocated as an economical arrangement, unless, at the same time, the men composing it were rendered competent for the performance of other duties, as they are for regimental duty in the services just now mentioned; for, under ordinary circumstances, it would comparatively rarely happen for the men to be occupied in the work for which they were specially equipped. When the field stretcher bearers are men who are not only engaged for carrying off the wounded from a field of action, but are also employed in all the general work of hospital attendants, as in the English service, then these latter duties will so greatly preponderate, both in time of war, as well as in time of peace, that a special stretcher equipment would be still less desirable. To the above conditions must be added the inconveniences likely to arise from each man being only partly equipped with the apparatus, so that two men must meet together in order for either to be efficient for duty. In like manner if three be present, one of them would be inefficient until a fourth had arrived. On the other hand, if a stretcher be complete in one man's hands, any other soldier on meeting him is, in a great degree, capable of rendering the assistance necessary for its carriage. All these circumstances require to be taken into consideration before admitting the propriety of adopting such special equipments for stretcher carriers as those which have been above described, notwithstanding that their use has been advocated by the able and experienced field surgeons whose names have been above quoted.

Obj a sy spec men ers

Fra stret

The general construction of framed stretchers has been explained in the opening remarks of this chapter. The object of connecting in a permanent manner the traverses to the sidepoles, and the canvas to the frame thus formed, has evidently been to do away with the occasional inconveniencies which arise from the parts being separated from each other in stretchers formed of detached pieces, as well as from the loss of time and impediments which sometimes occur in attaching the canvas and other parts together. The circumstance of framed stretchers not being capable of being reduced in bulk has not seemed a grave objection to some persons.

FIG. IV. PLAN OF A POUCH.

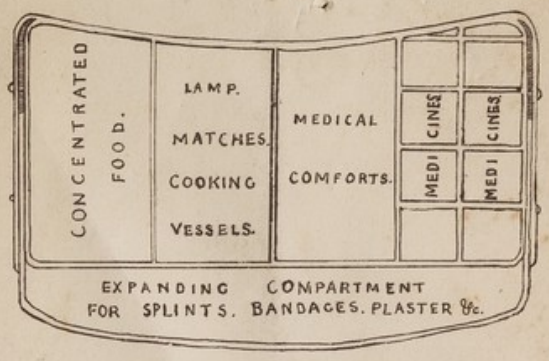


FIG. V.

CHAP. V.

It has been urged that although they cannot be rolled up for stowage, they can be formed into sufficiently convenient packages by being laid flat in certain numbers together, and without more loss of space than is represented by the intervals left between the canvas of the several stretchers as they lie one upon the other, or, in other words, than the sum of the vacant spaces within their frames.

Objections to framed stretchers.

But there are other objections to framed stretchers besides the loss of space in packing, and these will probably prevent them from ever being largely employed as primary stretchers in campaigning. Even the amount of space lost in packing is, however, of some importance in the field, although it is not of much moment on shipboard, in warehouses, or other situations where plenty of room is ordinarily available; for the bulk of packages of framed stretchers causes inconvenience when they have to be carried in field hospital equipment carts, where the space is very limited and necessarily has to be distributed with the utmost possible economy. The form of a framed stretcher renders it difficult of carriage by a single bearer, as compared with that of a stretcher which admits of the canvas being rolled round the side poles. The firm and expanded surface which it presents renders it especially difficult of carriage when there is a high wind. Although these objections are partly obviated by the frame being jointed near its centre, so that it can be folded in half, they still exist, though in a minor degree. Framed stretchers too are more exposed to injury on field service than others. They cannot be so well protected from the effects of wet as many other kinds of stretcher, so that the canvas is apt to get rotten, particularly where it is nailed to the frame; while the frames are liable to be broken, and the stretched canvas to be torn from the consequences of falls. The bottom is penetrated without difficulty if it be pressed with force against the projecting angles and edges of hard substances, or if such substances fall heavily upon it.

The objections urged against the use of framed stretchers for field purposes do not apply to them when intended to be used as stretchers of the secondary class; indeed, stretchers intended for use in hospital wagons, and those for other purposes connected with permanent hospitals, are almost universally of the framed kind.

With these preliminary remarks the following may be quoted as examples of framed stretchers employed on the field in recent campaigns.

Halstead folding stretcher.

The first illustration shows the appearance of a framed stretcher which was issued in considerable numbers during the late war in the United States. It was known by the name of the Halstead folding stretcher. The Surgeon-General in his abstract report of the war mentions, "Brigadier-general Satterlee issued 12,867 of "these litters for the purveying depôt of New York alone. They

"were too fragile for the hard usage to which they were sub-
"jected."*

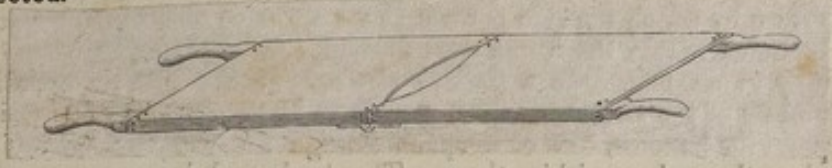


Fig. XLIII.—Halstead Stretcher.

Neuss's folding framed-stretcher used in the Prussian service.

A similar kind of framed stretcher, but having feet in addition, was used at the siege of Düppel in the war against Denmark in 1864. It has been described by Dr. Gurlt,† who says of it, that the framework was made in two parts of equal sizes; the two parts were connected by hinges, so that for portability one part could be folded back upon the other part. When thus reduced in length, it could be carried easily under the arm or on the back of one bearer. Four short feet were connected with the sides; these could be turned up within the sides of the framework when the stretcher itself was folded back. Its weight was about seventeen lbs. Stretchers of the kind mentioned were made by Messrs. Neuss, of Berlin. The manner in which the stretcher itself was folded as well as the position of its feet, is sufficiently indicated in the following illustration.

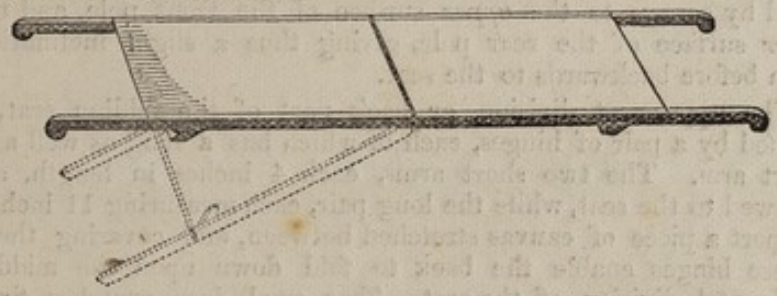


Fig. XLIV.—Framed folding Stretcher used by the Prussians in the war against Denmark in 1864.‡

Framed stretcher for patient sitting.

All the field stretchers hitherto described have admitted of patients being carried upon them in the recumbent position. The stretcher now to be described is only designed for a patient in the sitting position, and does not allow of one lying down upon it. It is called by the inventors, Messrs. Fischer and Co., of Heidelberg, a "chair litter, with jointed back and feet supports, or "cacolet, carried by two bearers, either marching abreast or in file "(Stuhlbahre mit beweglicher Rückenlehne und Fuss-stütze)," and they thus mention the special advantages derived from its construction. "This appliance is suitable for carrying a wounded "man a very great distance. According to the nature of the "ground, the two bearers may both face the road on which they "are marching, or they may walk one behind the other."

* Circular No. 6, p. 81. Spec. No. 1212 in the Mus. of Mil. Surg. at Netley is a model of the Halstead stretcher.

† See page 12, "Militär-Chirurgische Fragmente," by Dr. Gurlt.

‡ A model of this stretcher is in the Mus. of Mil. Surg. at Netley, Spec. No. 1214.

CHAP. V.

Fischer's Chair stretcher.

A glance at the drawings will show that the leading difference in this stretcher, as compared with others, is that the fixed traverses by which the side poles are kept apart, as well as the support included within the frame thus formed, the whole being intended only to accommodate a patient sitting, are brought so near the middle of the stretcher as not merely to leave portions of the side poles for handles, but also space enough for the two bearers to place themselves within them. The back and leg supports are thus merely accessories to a modification of an ordinary framed stretcher. The following is a more particular description of the contrivance. It consists of three principal parts, viz.: (1) a folding seat, supported (2) by two poles or shafts, and (3) of cross-belts made of canvas girthing for two bearers. All these parts are securely fastened together. The weight of the whole is 17 lbs. (See Drawing No. XLV.)

To Printer. Will not the smaller sized cros., such as are used with the Figs. referred to, be more suitable for this & similar quotations? Change them, or not, as may be thought best.

(1.) The *folding seat* is composed of three divisions; one for supporting the patient's back, the second for the seat proper, the third part for a rest of the legs and feet of the patient.

The middle division, or seat proper, is formed by a wooden frame, 19 inches from front to back, and 16 inches across, within which strong webbing is interlaced; over this webbing a covering of strong canvas is stretched. The frame of the seat is firmly fixed by screws to the *upper* surface of the front pole, and the *lower* surface of the rear pole, giving thus a slight inclination from before backwards to the seat.

The uppermost division, or back part of the folding seat, is formed by a pair of hinges, each of which has a long as well as a short arm. The two short arms, each 4 inches in length, are screwed to the seat, while the long pair, each measuring 11 inches, support a piece of canvas stretched between, and covering them. These hinges enable the back to fold down upon the middle, horizontal, division of the seat. Two small iron crutches fixed to the rear pole keep the back of the seat steady when it is raised.

The third and lowest division consists of a light iron frame 19 inches long, and about 16 inches broad, with stout canvas stretched over it, and is made to fold nearly perpendicularly downwards so that the thighs of the patient may rest against it. Two small sloping blocks of wood are nailed to the front pole, to act as stops to this division of the seat when it is lowered, and to prevent it from passing too far backwards. The uppermost bar of the iron frame is securely attached by hinges to the woodwork of the horizontal part of the seat proper, the bar itself forming the pin of the hinges. When closed, this division of the seat is folded over upon the seat proper, and overlaps the folding back part or uppermost division.

(2.) The *poles*, or shafts, are made of light wood, 4½ feet long, 1 inch broad, and 2¼ inches deep, and taper off at both pairs of ends so as to form handles. The dimensions between the poles are those given already of the seat proper.

Fischer's Chair Stretcher.

(3.) The girthing *cross-belts*, four in number, are each attached by one of their ends to the near pole, two on each side of the canvas seat, and two at the extreme ends of the pole near the handles. The other two pairs of ends terminate in leather straps furnished with buckles and holes, forming one loop each, capable of being slid on and off the front pole at pleasure. By the same means the belts can be lengthened or shortened, so as to be adapted to the different heights of different bearers. The two belts on each side of the seat are connected in such a way that each pair can at once be passed across the back and shoulders of its respective bearer, while the looped ends are adjusted one to each end of the front pole. A fifth belt connects the two pairs of cross belts, and acts as a rest for the shoulders of the patient who is carried on the seat.

This appliance is intended to be used in the following manner:—

The two bearers stand within the poles with the patient sitting on the seat between them. In marching, the bearers and patient look in the same direction, *i.e.*, the bearers move abreast with the patient, not one following the other, as in the case of ordinary stretchers. The alleged advantage of this arrangement is, that it enables the bearers to see the path before them, and to select their footing if they have to carry a patient over very rough and broken ground. The girths and straps are intended to lessen the fatigue of carrying their burden, and to allow the bearers to have their arms free, as the weight of the patient is thrown mainly on the shoulders of the bearers. The hands can be used at pleasure to steady the pole in front. (See Drawing No. XLVI.)

Should the bearers choose to carry the stretcher in the ordinary way of carrying stretchers, they can do so; but in that case they would not be able to use the shoulder straps, as they, being fixed to the poles, are only adapted for marching abreast. It would be easy however if required to alter the arrangement of the shoulder straps so that they might be used by the bearers in either position, but in that case they would have to be separate from the stretcher.

This contrivance was subjected to a series of practical trials at Netley, and the following were found to be their results:—

1. To place a disabled man upon the seat, the emp'oyment of a third person, independent of the two bearers appointed to carry the cacolet, is absolutely necessary. Such assistance cannot be dispensed with, even in case the cacolet be placed on the ground and the patient in a condition to seat himself with his legs extended horizontally; for the bearers are unable, after lifting the conveyance up, to take their proper position or to adjust their shoulder belts by themselves.

2. After the bearers are in position, a heavy person can be carried in this conveyance, in a sitting position, with great ease, and both bearers by marching abreast can see the path before them.

CHAP. V.

Fischer's Chair Stretcher.

3. The conveyance does not admit of the patient being carried in a recumbent position. It could only be used with propriety for slight injuries of the upper part of the body.

4. The shoulder straps are so fixed that they can only be used by bearers marching abreast, and are not capable, as arranged, to be made use of by bearers marching in file.

5. In the former case the conveyance is not adapted for narrow paths, and would expose both bearers and patient to much inconvenience and delay during a march along ordinary roads crowded by people or vehicles, owing to the space required for the passage of three men ranged abreast.

6. The bearers cannot wear their knapsacks at the same time that they carry the litter, provided they use the shoulder-straps.

7. When the bearers march without the shoulder-straps, either abreast or in file, the carriage of the patient sitting is more fatiguing to the bearers than of one recumbent, as the weight is more unsteady. If the patient be weak, he is liable to fall off; if he be strong, it would be a waste of labour to employ two men for his conveyance.

The conclusion drawn was, on comparing it with the ordinary regulation stretcher of the British service, that, as the latter only requires two bearers to place the patient on and off it, as well as during the transport; as it admits also of the patient being in the recumbent position; as it is at the same time simple in construction, more portable, and more generally applicable to the various exigencies of military service, the cacolet-stretcher cannot be recommended as a substitute for it, nor even as a supplementary article of field transport equipment.

Similar arguments would militate against the introduction of any field stretcher designed only for the carriage of patients in a sitting position.

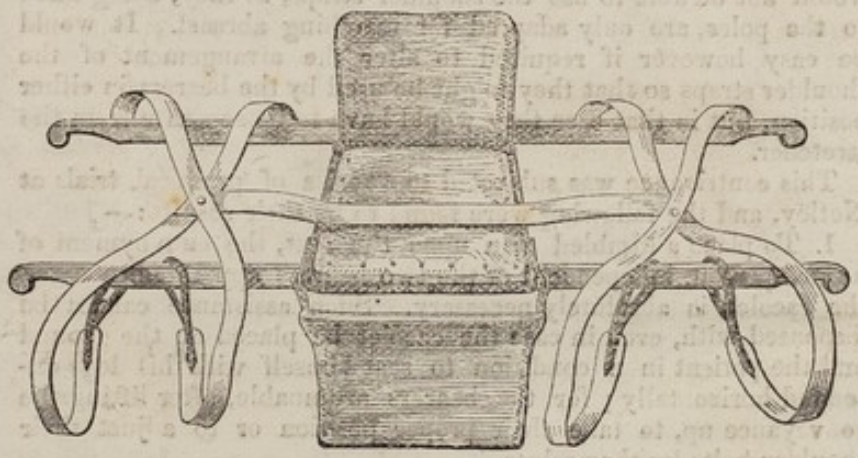


Fig. XLV.—Cacolet, or Chair Stretcher, for carriage by two bearers marching abreast, or in file.*

* Spec. No. 1221 in the Mus. of Mil. Surg. at Netley, is a pattern of this conveyance.

Conveyances

NAME	Troop or Company	Da of Cri

CHAP. V.

Fischer's Chair Stretcher.

3. The conveyance does not admit of the patient being carried in a recumbent position. It could only be used with propriety for slight injuries of the upper part of the body.

4. The shoulder straps are so fixed that they can only be used by bearers marching abreast, and are not capable, as arranged, to be made use of by bearers marching in file.

5. In the former case the conveyance is not adapted for narrow paths, and would expose both bearers and patient to much inconvenience and delay during a march along ordinary roads crowded by people or vehicles, owing to the space required for the passage of three men ranged abreast.

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Similar arguments would militate against the introduction of any field stretcher designed only for the carriage of patients in a sitting position.

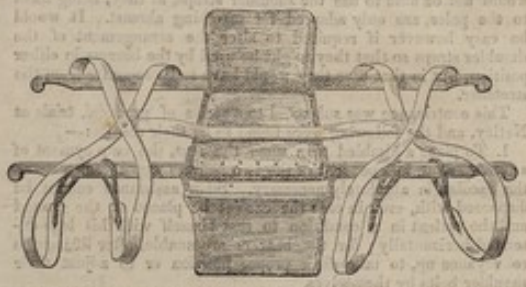


Fig. XLV.—Cacolet, or Chair Stretcher, for carriage by two bearers marching abreast, or in file.*

* Spec. No. 1[illegible] in the Mus. of Mil. Surg. at Netley, is a pattern of this conveyance.

are those given already of the seat proper.

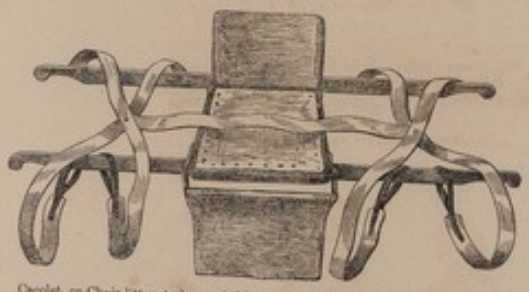
Borne by Men.

NAME	Troop or Company	Date of Crime	Crime	By whom Reported	Punishment	By whom Ordered	REMARKS

Conveyances

NAME	Troop or Compan		RKS

D. No. 1.



Cacolet, or Chair-litter, to be carried by two bearers marching abreast or in file.

Borne by Men.

Punish-ment	By whom Ordered	REMARKS

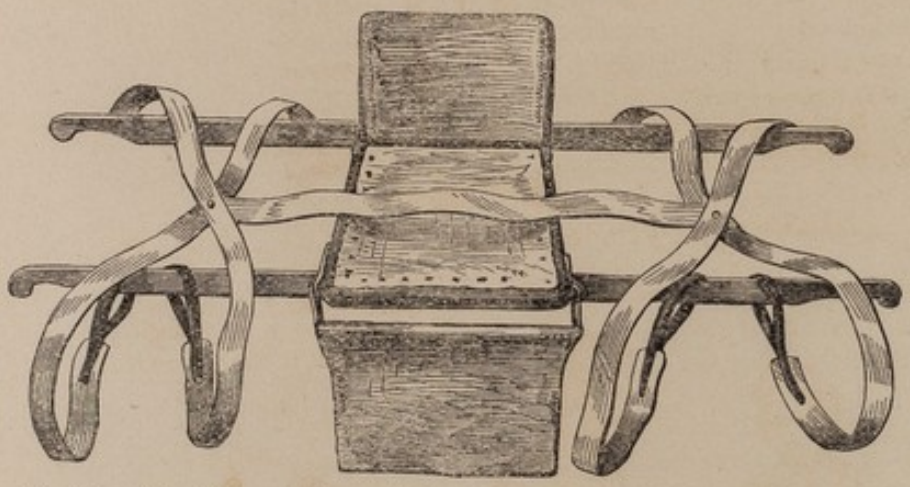
Fig. XLVI.—Chair Stretcher, with a patient, carried by bearers marching abreast.

Fig. XLVII.—Chair Stretcher, with a patient, carried by bearers marching in file.

it that a powerful tension can be exerted upon its whole extent by their action. The same tension also serves to keep the six legs of the stretcher secure. These legs cross each other from side to side, beneath the stretcher, and thus serve the purpose of traverses.

* Brancard plant, pouvant servir de table à opérations.

D. No. 1.



Cacolet, or Chair-litter, to be carried by two bearers marching abreast or in file.

Fig. XLVI.—Chair Stretcher, with a patient, carried by bearers marching abreast.

Fig. XLVII.—Chair Stretcher, with a patient, carried by bearers marching in file.

CHAP. V.

Weight of stretchers.

The weight of a stretcher forms a very important ingredient in determining its fitness or otherwise for field service. A stretcher should be light enough to be carried a day's march, if circumstances render it necessary, without causing over fatigue to a single bearer. At the same time, as there must be two bearers at least to carry off a wounded man, it is understood that every stretcher-carrier will be accompanied by a relief. Another object in having a stretcher light is to prevent it from being such an encumbrance to a bearer as to hinder him from running with it easily a considerable distance on occasion. Speed, consistent with proper movement, is necessary in the carriage of wounded men, on the one hand to remove them from situations of danger, on the other to carry them to the places where help may be obtained with as little delay as possible. Keeping these requirements in view, it is obvious that the interests of the wounded, as well as of the bearers, are involved in the circumstance of field stretchers being made as light as is consistent with the necessary strength and durability required for such articles. Under any circumstances the weight of a field stretcher ought not to exceed 20 lbs.; if it can be reduced to 15 lbs., which is the weight of the present regulation stretcher of the British service, so much the better. Every ounce reduced, other necessary qualities being maintained, is a gain. Stretcher-bearers ought to be able to carry a weight of from 15 lbs. to 20 lbs., in addition to the rest of their field equipment, without much interfering with their activity, and without being overburdened, when two or three are acting together, by their journeys to and fro in carrying the wounded to the field hospitals.

Consequences of over-weight.

If the weight be over-great the stretchers will certainly be broken. Dr. Chisholm, in his manual of military surgery, has indicated how this may happen without being the result of fair usage, especially if, as was perhaps the case in the instances referred to, discipline be not very strictly enforced. In the Confederate service ten stretchers formed the quota for every regiment in the field. They were of simple construction. The side-poles eight feet long; the canvas two feet wide, with side hems; the traverses square bars of wood with iron loops at each end through which the handles of the poles were passed when the stretcher was prepared for use. The canvas was nailed to the side-poles, but secured to the traverses by straps and buckles. Short folding legs, working upon iron pivots, were placed outside the stretcher poles near their handles. They could either be in line with the side-poles, or be turned round till they formed an obtuse angle with the body of the stretcher so as to act as feet. They were kept in place by a small stop-block when used in the latter way.

Dr. Chisholm mentions that the weight of these stretchers was a source of constant annoyance to regimental surgeons, and of complaint with the men of the ambulance corps, who had to carry them in consequence of wheeled transport for such stores being very deficient. The men, he says, resorted to various ways of getting rid of them. Some bearers to relieve themselves of the weight *accidentally* broke the woodwork against rocks or trees. They then ripped off the sacking, which they afterwards used, hammock

fashion, by making holes in the four corners and cutting poles from trees by the roadside when they were called upon to convey wounded men. Others threw them away altogether.*

Field Stretchers peculiar from some of the materials employed in their construction.—Some few stretchers are worth allusion to on account of the materials used in their manufacture.

Berlin iron net-work stretcher.

The Prussian National Committee exhibited at the Paris collection of 1867 a stretcher wholly made of iron. It folded in three parts. Instead of canvas the bottom was formed of a pliable elastic galvanized iron network. The head-part could be raised to different heights. Short folding traverses were fitted below the network to act as feet when required. It was made by M. Speier, of Berlin, at an ordinary selling price of 12 thalers.

The stated advantages of this manufacture are its great elasticity, combined with its firmness, durability, cheapness, and non-absorbent quality. The material has been largely employed in forming the mattresses of hospital beds, easy chairs, and other articles of hospital furniture; and for these purposes it is said to have answered well in respect to the qualities mentioned, and to its freedom from liability to harbour insects. It was evidently not suited however for field use. Neither the form nor the complication of a shifting head-piece are desirable, for reasons already explained. The material was heavy, and, though resisting enough to bear a general strain, and thus fitted for use in fixed hospitals, did not appear to possess the qualities which would enable it to resist the local shocks to which it would certainly be subjected to in campaigning, or long to withstand the effects of exposure to vicissitudes of weather.

Iron-band stretchers.

A simple, cheap, and cleanly form of framed stretcher, with iron bands as a substitute for canvas, was proposed a few years ago by Serjeant-Major Jones, of the Royal Engineers.† This non-commissioned officer devised an ingenious plan of rapidly and effectively locking together narrow strips of iron, like hoop-iron, so that they might be combined in length or thickness, and the strength thus increased at pleasure in either direction. These bands were first designed for use in the construction of gabions, and after having been examined and favourably reported on by the Royal Engineer Permanent Committee and the Ordnance Select Committee, they were ordered by the Secretary of State for War to be adopted for this purpose in the service. (W.O. Authority, 13th December 1860.) An objection has, however, since been made, I am informed, against the iron-band gabions, that they are liable to inflict wounds among the men in the trenches owing to splinters being scattered from the iron bands when they are struck by heavy projectiles. These bands were intended to be applied, however, not only to the construction of gabions, but in addition, to a variety of other engineering purposes, such as

* Op. cit., p. 102.

† See a pamphlet entitled "The Iron band Gabion and its applicability to various Military Field Purposes," by Serjeant-Major John Jones, R.E., Chatham, 1860.

CHAP. V.

Jones's iron-band stretcher.

military suspension bridges, rafters for field stabling, &c. When used for the construction of hand litters four or five of the bands are to be fastened at their ends to two pieces of scantling, each 3 feet 6 inches long by 2½ inches broad and 1½ inch deep, the bands being between 3 and 4 inches apart. The pieces of scantling or traverses are to be lashed or pinned to two side pieces, 9 feet long, but of the same width and depth as the cross-pieces. The alleged advantages of this contrivance are, its cheapness, the bands being useful for other purposes when not required for stretchers; its portability, the iron bands being capable of ready separation, and so occupying very small space in package; its durability, the bands, from their nature, being little susceptible of injury by fair wear and tear, or during transportation; the ease and certainty with which it may be made, if the iron band material is to be always found with an army in the field; and lastly, from the simplicity of its construction, so that any soldier can put it together. It seems however to have become a settled principle that all appliances specially required for the sick and wounded in the field shall be provided beforehand, so as to guard against the risk of the material, labour, and skill which would be necessary for their manufacture not being available for surgical purposes when the appliances were suddenly wanted, on account of their being more urgently required at the time for military purposes. Moreover, under many circumstances, in campaigning, although the iron bands might be available, wood of length and proper quality might not be forthcoming for forming the frame. It seems, therefore, that it would not be prudent to depend under present circumstances upon means, such as are here described, for providing conveyances for the wounded. At the same time as the iron bands would certainly answer the purposes suggested by their inventor, it is interesting to be aware of the power of applying them in the way described, in case of their forming a part of military engineering materials; for a certain number of stretchers thus constructed might at any time be employed with advantage to *supplement* the authorized number of regular stretchers in case of an assault or general engagement creating an extraordinary demand for them, and this too without interfering with the subsequent use of the iron bands for other field purposes. The following sketch represents one of these stretchers.

Fig. XLVIII.—Iron-band Ambulance Stretcher.

M. Arrault's field stretcher.

M. Henri Arrault, of Paris, some of whose improvements of the matériel of ambulances are well known and have been highly commended, has constructed a field stretcher with laced cord

* Spec. No. 1,203A in the Mus. of Mil. Surg. at Netley is a model of this conveyance.

Palasciano's stretcher.

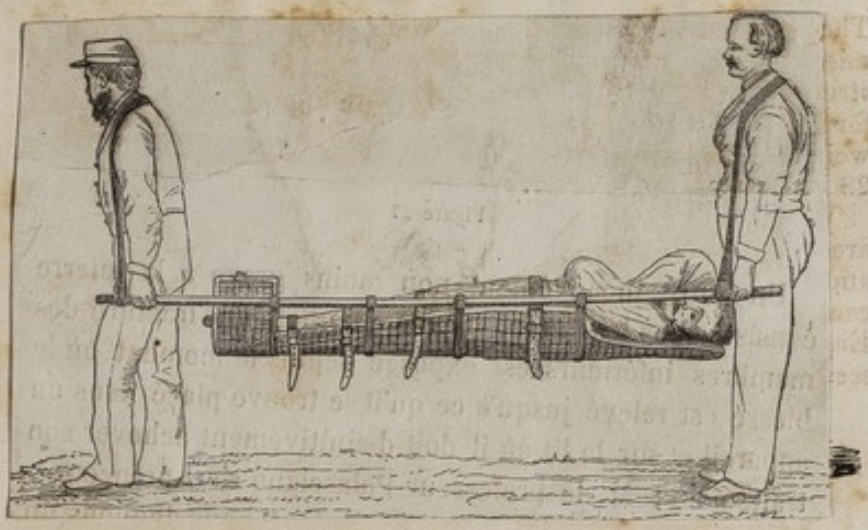


Fig. LI.—The same Stretcher with a patient being carried upon it.

This was one of the special stretchers exhibited at Paris in 1867. It has been devised with the idea that it would be advantageous for a man suffering from a gunshot wound in the lower extremity, especially if the thigh-bone be broken, not only to be protected against the derangements to which the broken bone is liable during transportation and the transfer from a stretcher to his hospital bed, but also for him to be put at once, on the place where he may have fallen, into an apparatus from which it would not be necessary to remove him until he had recovered from his injury. The apparatus of Palasciano comprehends, therefore, not only the purposes of a stretcher, but also an arrangement for fixing the upper part of the body of the patient, and making extension of the upper fragment of the fractured bone, either in the straight or semiflexed position; and also a plan for counter extension being effected by tractions practised on the sound limb. The apparatus, when placed on two boxes or otherwise raised at the head and foot, serves as a bed. The circumstances under which such an apparatus is likely to be brought into use must be so exceptional as to render a further description of its construction unnecessary here. The construction is, moreover, sufficiently explained by the illustrations.

Arrault's stretcher and operating table combined.

Another stretcher invented by M. Arrault of Paris, whose name has been before quoted, is called by him "a folding stretcher, serving also for an operation table."* In this stretcher the supporting part is made of canvas, and straps are so connected with it that a powerful tension can be exerted upon its whole extent by their action. The same tension also serves to keep the six legs of the stretcher secure. These legs cross each other from side to side, beneath the stretcher, and thus serve the purpose of traverses.

* Brancard pliant, pouvant servir de table à opérations.

The stretcher is fitted with a moveable head-piece, which, when raised, is also maintained in position by straps. In this way the stretcher is adapted to furnish a firm, yet not too hard, support for a patient who has to be subjected to a surgical operation. The weight of this stretcher is stated to be 13 kilo., or more than 28 lbs.; its supporting powers, a weight of 150 k.lo.

When about to be folded up the head-piece is lowered, the legs are disconnected from the straps, shifted to their respective sides, and placed along and within the side poles; the sides and canvas can then be rolled up together, in the way that the regulation English stretcher is packed. The straps serve to fasten the whole securely into one package.

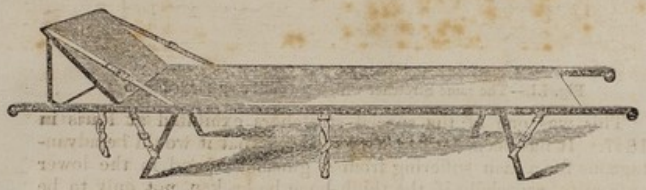


Fig. LII.—Arrault's Folding Stretcher, adapted to serve as an Operation Table.

Stretchers adapted to Wheels.—Within the last few years efforts have been made to adapt stretchers of the same form and fulfilling the same purposes as some of those which have been already described, for being placed upon wheels. With such an addition they could be either used as hand litters, or wheeled over the ground. The object has been to ensure greater speed than can be obtained while they are limited to being carried by hand, as well as to lessen the fatigue of the bearers, and thus to economize labour. These wheeled stretchers will be described with the other conveyances of Class 2.

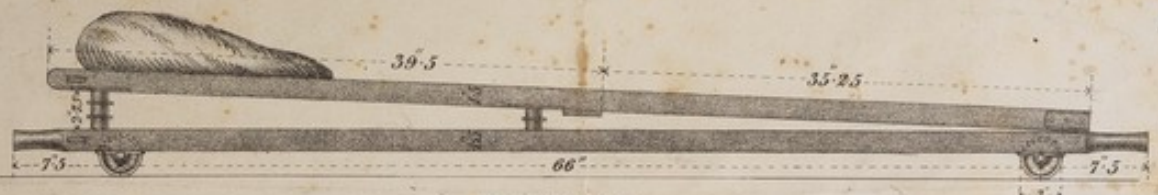
SECTION III.—STRETCHERS WITH ADDITIONAL ADAPTATIONS TO SUIT THEM FOR USE IN WHEELED VEHICLES.

Secondary Stretchers.—The stretchers which have been hitherto described have either been employed in the field or have been designed for field use. Those which follow have been designed especially for being carried with wheeled vehicles, or for use in standing camps or garrisons. They therefore belong to the second category of stretchers, as already explained in the opening remarks of this chapter.

British regimental ambulance wagon stretcher.

This stretcher is double, the upper stretcher upon which the patient lies being supported upon another stretcher below, with intervening india-rubber springs. The upper stretcher is padded, covered with waterproof canvas, and is sloping, being raised four

STRETCHER FOR AMBULANCE WAGON.



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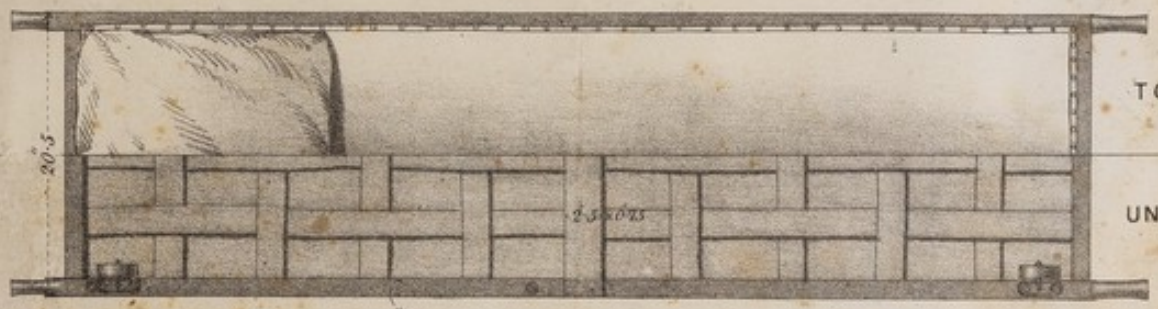

PLAN.

slope and smoothness of the surface on which the patient lies, and the absence of provision against his rolling off. The handles have been chiefly designed to facilitate the manœuvring of the stretcher when being lifted in and out of the wagon. The construction and dimensions of the stretcher are shown in the following drawings.

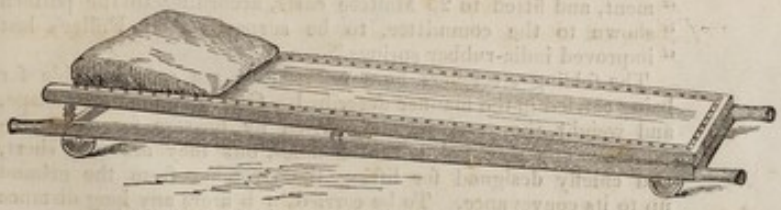

Fig. LIII.—Perspective view of the British Ambulance Wagon Stretcher.

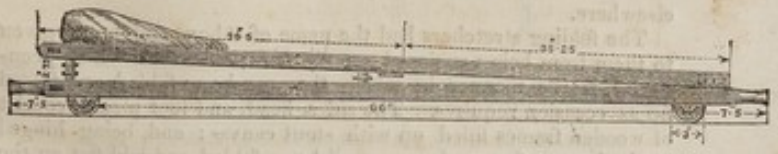

Fig. LIV.—Side elevation of the same, with measurements.

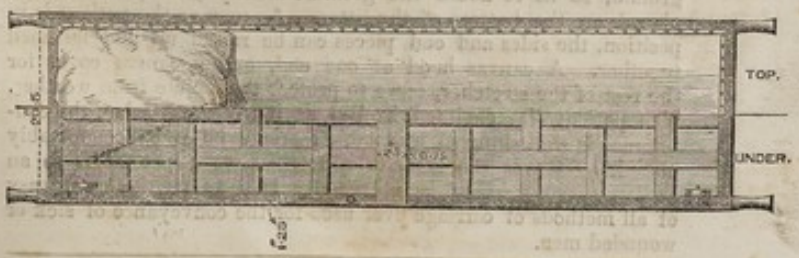

Fig. LV.—Upper and under plan of the same, with measurements.

Box Stretchers designed by Mr. Holmes.

Fig to page 153

CHAP. V.

Holmes' box-stretchers or folding litters.

These are the stretchers which are used with the Maltese ambulance carts.* They were originally designed by Messrs. Holmes, the carriage builders of Derby, who furnished many of the conveyances supplied to the Government during the period of the Crimean war. They were applied by them to certain ambulance carriages which were submitted, among others, to the notice of a committee constituted by Lord Panmure, then Secretary of War, under date 9th of April 1855, to consider the question of hospital conveyances generally. This committee, of which Colonel Tulloh, Royal Artillery, was president, did not approve of the carriages then furnished by Messrs. Holmes, but they greatly approved of the "folding" or "box stretchers" slung within them.

"The box stretchers," reported the committee, "slung in india-"rubber springs with which they are fitted, and which can be "applied to other carriages, seem to be by far the easiest mode of "conveyance which has been as yet produced, especially for the "removal of patients amputated on the field or very seriously "wounded, and requiring to be carried to a greater distance than "can be done by the ordinary hand stretchers. They have such "advantages as to justify us in recommending that 50 of them "should be immediately supplied to the royal carriage depart-"ment, and fitted to 25 Maltese carts, according to the pattern "shown to the committee, to be suspended on Fuller's last "improved india-rubber springs."

The folding stretchers here referred to are only suitable for being carried in the manner described. Owing to their size, shape, and weight, they can only be carried by bearers for short distances. The side poles have handles, but they are very short, and chiefly designed for lifting the stretcher from the ground up to its conveyance. To be carried by bearers any long distance these stretchers would require the addition of poles, such as are used with some of the conveyances of the dhooly class described elsewhere.

The folding stretchers had the name of "box stretchers" given to them from being enclosed on all sides; but their chief peculiarity is the manner in which they can be unfolded and folded up as occasion requires. The sides, head, and foot pieces consist of wooden frames filled up with stout canvas; and, being hinged to the bottom frame, they may all be unfolded and laid flat on the ground, so as to afford the greatest facility for a patient being placed on the bottom of the litter. As soon as the patient is in position, the sides and end pieces can be raised up and fastened together. A canvas hood at one end, and a canvas cover for the rest of the stretcher, serve to protect the inmate from weather. The patient lies enclosed, in bed as it were, and when the conveyance is well slung in a suitable carriage he is as comfortably placed, so far as the litter is concerned, as a patient is in an Indian dhooly, which is universally held to be the most easy of all methods of carriage ever used for the conveyance of sick or wounded men.

* See Spec. No. 1321 in the Mus. of Mil. Surg. at Netley.

Arrault's netting-bottomed stretcher.

instead of canvas for the bottom. M. Arrault advocates the use of netting in preference to canvas, on account of its lightness, as well as its freedom from the inconveniences caused by canvas when steeped by rain.

The following illustrations show the plan of M. Arrault's stretcher. Although lightness is named by M. Arrault as one of its advantages, the weight given is 11 kilo., or upwards of 24 lbs., so that it is heavier than the French Algerian stretchers, with which it corresponds in several respects. Moreover, the traverses do not fold up, and it cannot be regarded, therefore, as having the elements of portability to the same extent as that conveyance. The netting is lighter than canvas, and has the advantage of not contracting inconveniently under the effects of damp; but it seems questionable whether it can be depended upon for not becoming entangled, becoming torn, or otherwise getting out of order under the circumstances to which it must be exposed on field service. The netting of the stretcher is stated to be capable of supporting a weight of 437 lbs.

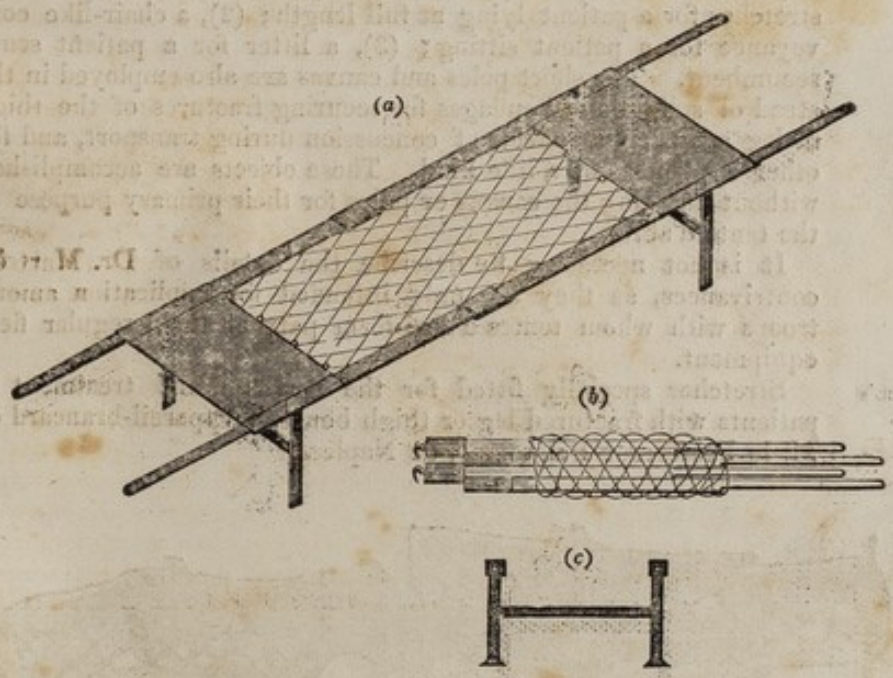

Fig. XLIX.—(*a.*) Arrault's Stretcher mounted and ready for use. The half-poles enter one into another and are fixed together by hooks.
(*b.*) The stretcher-poles, dismounted, and enveloped by the netting and canvas bottom.
(*c.*) Iron supports of the stretcher-poles, and feet of the stretcher.

Stretchers designed to fulfil other Purposes in the Field besides those to which they are usually applied.—A desire, laudable in

STRETCHERS FOR MALTESE AMBULANCE CARTS

to page 97

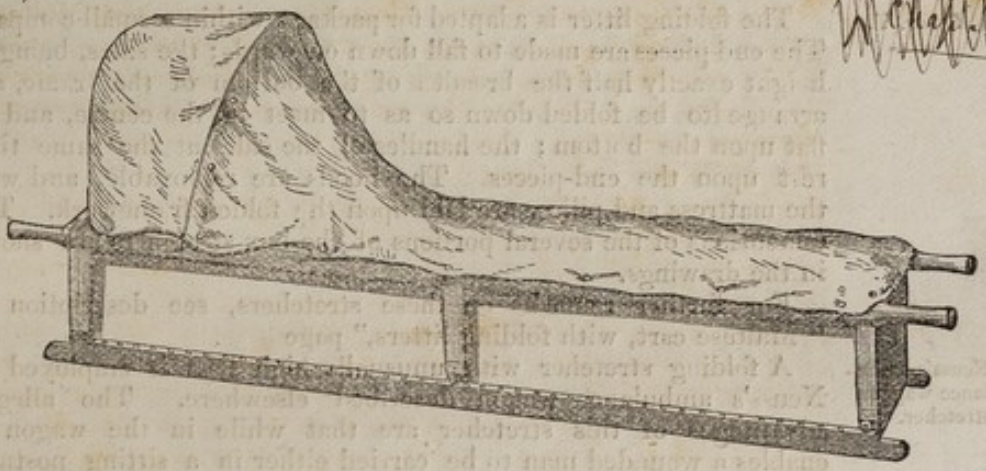

Fig. LVI.—Prespective view of Holmes's Box Stretcher used with the Maltese Ambulance Cart.

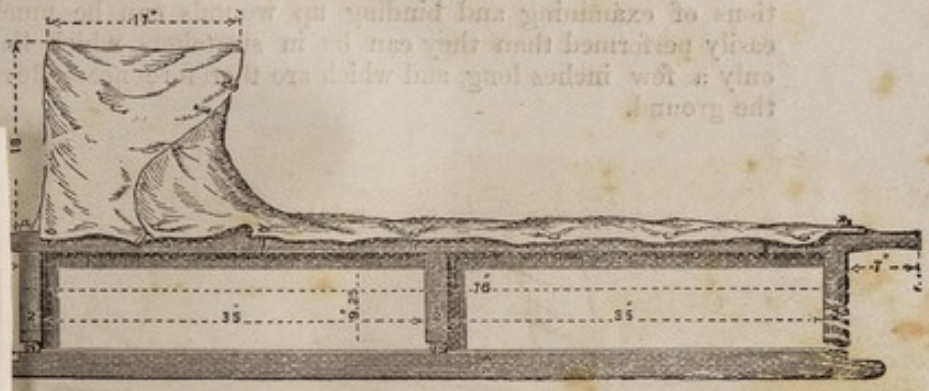

Fig. LVII.—Side elevation of the same, with measurements.

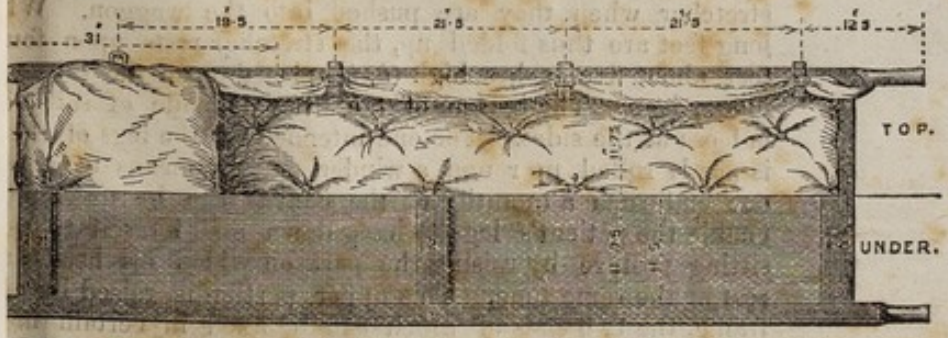

Fig. LVIII.—Upper and under plan of the same, with measurements.

CHAP. V.

The folding litter is adapted for package within a small compass. The end pieces are made to fall down outwards; the sides, being in height exactly half the breadth of the bottom of the frame, are arranged to be folded down so as to meet in the centre, and lie flat upon the bottom; the handles of the sides at the same time rest upon the end-pieces. The hoods are removable, and with the mattress and pillow are laid upon the folded framework. The dimensions of the several portions of the box stretchers are shown in the drawings.

For further remarks on these stretchers, see description of "Maltese cart, with folding litters," page .

Neuss's ambulance waggon stretcher.

A folding stretcher with unusually high legs is employed in Neuss's ambulance wagon described elsewhere. The alleged advantages of this stretcher are that while in the wagon it enables a wounded man to be carried either in a sitting posture, half upright, or in a wholly recumbent posture, and that the patient's whole body is well supported in any one of these positions; and in the second place, when it is taken out of the waggon, and placed upon its high legs on the ground, the operations of examining and binding up wounds can be much more easily performed than they can be in stretchers which have legs only a few inches long, and which are therefore nearly level with the ground.

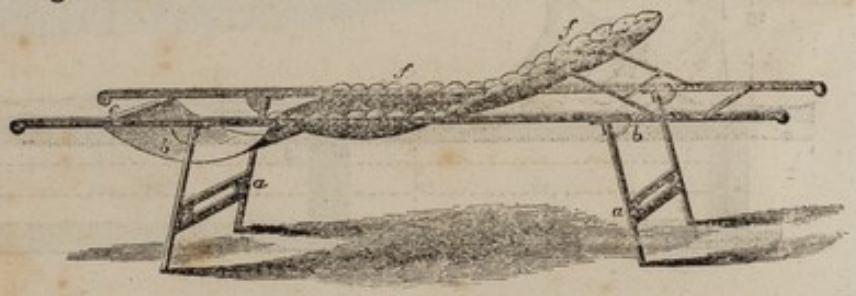

Fig. LIX.—Neuss's Ambulance Wagon Stretcher.

The two legs (*a*), (*a*), upon which this stretcher stands are 18½ inches high; they are united to the side poles of the stretcher by hinges, so that they can be bent under the body of the stretcher when they are pushed into the waggon. When the long feet are thus folded up, the stretcher rests upon four short feet, about five inches high (*b*, *b*), placed near the joints of the longer legs. The bottom of the litter is made of sail-cloth. It is loose at the sides. The end intended for the legs of the patient is partly rolled up round a winder, and by means of a wheel at one end such a quantity of the canvas can be unwound as to enable the patient's legs to hang down and himself to assume a sitting posture by raising the part on which his head and back rest at the same time. This upper portion is raised by a hinged frame, the two ends of which can be fixed in certain notches in the side poles so as to be shifted to any desired height. The support for the head of the patient, and the upper surfaces of the

The portions of the two side poles, are padded and covered with American leather.

The sketch of this stretcher is copied from a drawing in Dr. E. Gurlt's Militär-chirurgische Fragmente.*

Stretcher of the "Voiture Magou."

Stretcher of the French two wheeled Ambulance Cart, known as the "Voiture Magou."—This is a framed stretcher, specially designed for the cart above named. Its chief peculiarities are, firstly, that it is fitted with a permanently raised head-piece, and secondly, the means by which feet are formed, whenever it is taken out of the cart to which it belongs.

The head-piece.—The upper raised part of the stretcher, which commences about four feet distance from the lower end, is supported laterally upon two triangular frames, the bases of which are formed by the corresponding portions of the side-poles. The two frames are connected above at their upper angles by a cross-piece, and below by the adjoining traverse of the stretcher. The head-piece forms with the horizontal part of the stretcher, on which the patient lies, an angle of about 153°. The purpose of thus raising the head of the stretcher, which, when in position, is at the back of the cart, is to obviate the objectionable inclination which would otherwise be given to the head of the patient in going up hill, owing to the intimate connexion between the shafts and body of the vehicle in which the stretchers are placed.

The stretcher-feet.—The following is the manner in which the feet of this stretcher are contrived. Within the side poles, at each end of the stretcher, are shifting pieces of wood which act both as handles and form the feet just referred to. When the stretcher is placed in the cart neither the handles nor feet project; they lie close against the inside of the stretcher-poles. On drawing the stretcher out of the cart, the handles can be readily pulled out and in the act of doing so the feet drop down.

The handle and foot are made of wood, oblong in shape, $1\frac{3}{4}$ inch by $\frac{3}{4}$ inch thick, together about 16 inches long, and work within a square shaped iron case fixed to the inside of the side-pole. They are connected by a piece of iron which passes along the upper part of the case, the foot being hinged to its extremity. This piece of iron projects beyond the handle to a distance which exactly corresponds with the length of the foot; and thus, when the foot is brought up and closely applied to the piece of iron just named, the handle and foot are in one and the same line within the case, and are nearly in contact with each other. When the handles are drawn out, the foot is pushed backwards and downwards, by means of a spring, through an opening of corresponding size in the under surface of the casing. On pushing the handle in again, the back of the foot is pressed against the edge of the iron case beyond the opening and folds up.

In other respects the stretchers are of ordinary construction. They are slightly over 6 feet 1 inch in length when the handles

* Ueber einige neue Transportmittel für Schwervenwundete, p. 10. Berlin, 1864.

Secondary Class.—It has been the opinion of some persons that the requisite qualities for a field stretcher, and for one of the secondary kind, may be combined in one and the same conveyance. This was the opinion of a majority of the Committee that examined the hospital transport equipment in the universal Exposition at Paris. It was argued that all stretchers, while made light and portable enough to be carried by bearers with facility in large numbers to the scene of action, should have in themselves contrivances for ensuring the patients who may be carried upon them against the direct effects of direct concussions, and that they should be fitted for being attached to wheels when the ground is favourable for rolling movement. The main point insisted upon was that the stretchers should themselves be provided with springs, so as to be capable of being used, not only with a spring wagon, but also on the floor of a country cart or store wagon without springs, on a railway truck or a boat, and yet be effective for carrying patients with tolerable freedom from the injurious effects of violent shocks. The deficiency of regular vehicles for ambulance purposes, which is always experienced on occasions of great battles, can only be met, it was maintained, by utilizing the common vehicles of the country in which the hostilities are carried on, and it is only by the means described that the evils arising from these common vehicles being without springs can be counteracted.

Netley spring-stretcher.

In accordance with these views efforts have been made at Netley to add feet and springs, and to adapt to wheels, the existing regulation stretcher of the British service, without detracting from its important qualities of simplicity of construction, strength, portability, and little cost. It is believed that an improved pattern has been devised in which these objects have been in a great degree attained. The trials necessary fully to establish its fitness in these respects have not, however, been yet completed, and a description of this appliance is therefore postponed to a future occasion.

Dr. Gauvin's spring-stretcher.

This stretcher was designed by Dr. Gauvin, Médecin-Major of the French army, with a view to combine the various qualities which have been just enumerated. It consists fundamentally of a frame formed of two side-poles connected by three iron traverses. One traverse is in the centre and and one near each end, portions of the side-poles being left free at the ends to form the handles. From this frame there start upwards four curved metal springs, and by these the canvas is sustained which forms the portion of the stretcher in which the patient lies. It is therefore a double stretcher, like the stretcher in the British ambulance waggon, with the upper stretcher slung from steel springs, instead of being placed upon india-rubber springs. The frame was adapted to a pair of wheels, and was then used as a wheeled stretcher. It will be noticed in this capacity in the chapter on wheeled conveyances moved by hand labour.*

* Page , where also will be found a sketch of the stretcher off as well as on the wheels.

CHAP. V.

The following is Dr. Gauvin's own description of the stretcher which he has invented:—

"The stretcher is based on a new principle, viz., the application of suspension and elasticity to the stretcher itself. It is composed of two horizontal frames joined at their four extremities by swan's-neck springs, affording great elasticity. To facilitate package and transport the traverses, or cross-pieces, of the two frames are jointed, so as to permit the longitudinal side-poles to be brought together. The stretcher which has a total width of 65 centimetres (nearly 26 inches), when in use, is reduced to 32 centimetres (12½ inches) when folded.

"The stretcher can be fitted with two wheels; in this case the side-poles of the lower frame are fixed, and this can be done with great facility, to two iron triangles fixed to the axle, connecting the two wheels.

"It is thus a stretcher-bed with springs adapted for all methods of transport and preserving its elasticity.

"It is capable of fulfilling the five following indications:—

"1. It can be carried by hand by two bearers, like the ordinary field stretcher.

"2. It can be placed on any carriage or cart with or without springs. The conveyances obtained by requisition, though having the advantages of being suited to the country, and being everywhere found when a sufficient supply of ambulance carriages is not forthcoming, being without springs have the enormous inconvenience of jolting the wounded and leading to complications on their injuries which often prove fatal. With this spring-stretcher, the patient will preserve the advantages of suspension and elasticity.

"3. It can serve for transport purposes on boats, and especially on railways, the four springs at the angles destroying and annihilating all trembling movement and jolts.

"4. It makes an excellent bed at a field hospital. A man very severely wounded, carried upon it from a field of battle, can remain on it while under treatment, or for transportation elsewhere, without having to be changed from a stretcher to a waggon, from a waggon to another stretcher, and so on.

"5. It can be put upon two wheels, if the terrain permits, when a single bearer suffices to move away a wounded man, and that too softly and gently.

"The weight is 32 kilog. ·5 (nearly 72 lbs.), without the wheels, and 54 kilog. ·5 (about 120 lbs.) with the wheels.

"The price with the wheels about 150 francs (6*l.*)."

Having thus noted the general features and purposes of Dr. Gauvin's stretcher, I refrain from discussing ~~the question of its probable fitness for use as a field-hospital stretcher, because, as far as I am aware, no sufficiently careful experiments have yet been made on the subject.~~ The conviction produced on my mind by observation of it at Paris was, that it was too complicated for general use on field service; that parts of it would be liable to be broken or deranged under the rough usage it would inevitably be

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subjected to in campaigning; and that, without the wheels, the stretcher would be too heavy for the services for which hand stretchers for removing wounded are ordinarily employed. As a stretcher for being placed upon springless carts or waggons having adequate length and floor space its advantages were beyond doubt. No other hand-litters or wheeled litters, in the Paris Exhibition, possessed arrangements ensuring to them similar advantages of suspension and elasticity when placed upon a vehicle without springs. There were special contrivances to answer the same purposes, particularly for railway carriages, and these were capable of being used as hand-litters for short distances, but only for very short distances, on account of their very great weight; they were not intended to be used as stretchers for general field use. It is the combination of the many qualities which Dr. Gauvin has sought to achieve in his stretcher which forms its most marked feature, viz., the design for it to act equally well as a field-stretcher or hand-litter, as a wheeled litter, and as a spring or swinging litter, for a patient upon a railway truck or any springless vehicle. Could such a combination be satisfactorily accomplished, a very economical and practically useful article would be found for the equipment of field hospitals; and one source of great suffering as well as of loss of life, in all campaigns hitherto, the shaking and jolting of the wounded while being conveyed from the neighbourhood of the scene of action, or from the field hospitals to the permanent hospitals in rear on common country carts or railway waggons, would be materially diminished.

Chap. V.

Gauvin's Spring Stretcher.

Section IV.—Essential Qualities of Primary and Secondary Stretchers.

Primary Stretchers.—On taking a general view of the various forms of primary stretchers which have been above described, it may be seen that the several objects which have been sought to be attained in the construction of the best among them have been the following. They are indeed the necessary qualities for every good field-stretcher:—

Resumé.

Qualities necessary to constitute a good primary or field stretcher.

1. A firm, but not hard, support for the patient, and one capable of being readily freed from blood or dirt.
2. Lightness to facilitate carriage by the bearers.
3. Strength to resist shocks from rough usage.
4. Simplicity of construction, combined with—
5. Capability of being folded up to economize space in stowage, and to lessen liability to injury.
6. Such a connexion of the component parts as to prevent risk of loss or absence of any one part when the stretcher is required for use.
7. Provision for keeping the patient a certain distance off the ground when the stretcher is laid down.
8. Economy as regards cost.

Gauvin's Spring Stretcher.

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8. Economy as regards cost.

CHAP. V.

It cannot be said that a combination of all these qualities has been attained in any one form of stretcher. In each some one quality has predominated to the exclusion, either wholly or in part, of others. The first three and the sixth qualities may be said to have been attained sufficiently for practical purposes in several of the stretchers described. The fourth quality appears to have been most obtained in the English regulation stretcher, but at the expense of the seventh requirement, and with other inconveniences which were referred to in the remarks upon it. The French and several other stretchers are defective in the fifth requirement, from consisting of detached pieces, but to a certain extent this defect is obviated by the methodical manner in which the parts of the stretchers are packed in the caissons, and by the systematised training of those whose duty it is to look after and use the stretchers. It is also counterbalanced to a considerable extent by the advantages of the feet, which form part of the traverses. The construction of a still more perfect stretcher for field purposes combining the qualities ~~above~~ named seems therefore to be a matter still to be desired.

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Qualities necessary for secondary stretchers.

Secondary Stretchers.—Some of the qualities which are essential for a primary stretcher may be modified or almost wholly dispensed with in secondary stretchers. Thus the second quality of lightness to facilitate carriage by bearers need not be insisted upon to the same extent, for they are neither likely to have to be carried for similarly long distances nor is there the same demand for speed as there is with primary stretchers. The fourth quality, simplicity of construction, and the fifth, capability of being folded up, may be in a great measure dispensed with. As to the former of these, a more complex construction is quite admissible, and, indeed, unavoidable, to meet the additional requirements of secondary stretchers; and as to the latter, inasmuch as, whether in a wagon or in a hospital, there is always space available equivalent to the stretcher when fully extended, the capability of being folded up ceases to be of much importance. On the other hand, certain qualities are advantageous in secondary which are not required for primary stretchers. Such is a construction enabling the position of a patient to be varied, for the head and back to be raised, the knees to be supported in a partially flexed position, for these circumstances materially affect the comfort of sick men when carried for considerable distances in wagons. They should also be provided with springs, so that, whether suddenly placed on the ground or whether during the movements of a carriage, the force of the concussions communicated to the stretchers may be in some degree broken before reaching the patients lying upon them. Such are the chief differences between the conditions required for primary as compared with those necessary for secondary stretchers.

As already noticed, if the essential qualities of a primary and secondary stretcher can be combined in one and the same article, a great improvement in this department of field hospital equipment will be effected.

SECTION V.—ON THE TEMPORARY CONTRIVANCES WHICH MAY BE EMPLOYED IN AN EMERGENCY INSTEAD OF STRETCHERS.

Contrivances designed to act as temporary substitutes for stretchers.

In the unavoidable absence of regular stretchers, substitutes may be improvised in the field, though not so readily as for conveyances of the hammock-kind. Thus the frame of a litter may be formed by lashing together four muskets, two being placed upon the other two at right angles with each other, and at proper distances apart, while a blanket or great coat is secured to them so as to form the support upon which the patient is placed; again, three or four knapsacks may be fastened between two firelocks, and thus a sufficiently firm support be obtained as a temporary expedient for removing a wounded man away from the field. If the opportunity exist of making fascines and gabions for the military operations, there will also exist the opportunity of making by the same tools and artificers hand-barrows, and these will form very serviceable substitutes for stretchers to meet an unusual demand for such conveyances.

A variety of other similar expedients will readily suggest themselves on an emergency, it being understood that the substitutes thus provided are only fitted to answer the immediate wants of the occasion, and not to be either of a durable nature or fitted to be carried on for further use elsewhere.

"Brancard à l'improviste."

An impromptu form of stretcher was exhibited at the Universal Exposition of 1857 at Paris, and gained the prize offered by the International Committee of delegates from the societies for aid to wounded in time of war for the best field stretcher, combining qualities of lightness, solidity, moderate cost, and facility of package. It was invented by the Comte de Beaufort, who gave it the name of "Brancard à l'improviste." It was composed only of roughly cut pieces of wood and cord, being put together without mortices, nails or screws, or horizontal traverses. Crossed or X-shaped pieces of wood placed below the side-poles and at a certain angle of inclination to them, answered the purpose of traverses and at the same time of feet. The pieces of wood were fastened together, and undue yielding of them in any direction prevented, by a certain arrangement of the cords; at the same time a portion of the cord, being passed to and fro through small holes in the pieces of wood which formed the side poles, acted instead of canvas as the litter on which the patient was intended to be carried. The object of the sample was to illustrate the manner in which a firm stretcher or hospital bed may be constructed wherever pieces of wood to form the frame, and rope, cord, iron-wire, or any other means of connecting the frame together, can be obtained, as well as the best method of disposing these materials to attain the object in view.

There could be no doubt that Comte de Beaufort's stretcher possessed in an eminent degree the qualities named in the terms

CHAP. V.

Beaufort's improvisée stretcher.

on which the prize was to be given, yet it was evidently not a stretcher that any one would recommend as a field stretcher for military use, excepting in cases of emergency when no other ordinary stretcher could be obtained. It was light, being formed only of sticks of deal connected by cord, without any iron or other metal being used in its construction; it was solid, at least sufficiently so under ordinary circumstances, for it would bear the weight of a man lying upon it, or even standing upon it; it was cheap, the cost of the materials being almost nominal and its manufacture of the simplest kind; it was easily packed up, for the poles and the crossed pieces of wood that answered the purposes of traverses and feet could all be laid side by side, and bound together by the cord which when the stretcher was in use tied them together, and also took the place of the ordinary sacking. But its want of compactness; the time that would be required to adjust and tie together properly the pieces of wood; the liability there would be in cases of hurry of all the parts not being properly secured, and the consequent risk of accidents; the difficulty there would probably be, under ordinary circumstances, of getting untrained men, deficient in skill and dexterity, of putting the stretcher properly together; are qualities which unfit it for the general purposes of campaigning. As an ingenious illustration of the simple means by which a stretcher or bed can be formed, whenever wood of appropriate length, and means of tying it together, are available, it will be useful to bear in mind its construction in case circumstances render it needful to improvise stretchers or camp bedsteads to supply deficiencies. At the same time, nothing but the test of continued use will give assurance that a bedstead so framed will be capable of remaining in shape and sufficiently firm, under the various movements and unevenly distributed application of weight to which such articles are usually subjected. Moreover, although stated that branches of willow or bands of any kind in the absence of rope, cord, or wire, will answer for the construction at a given moment of any number of these stretchers, it remains to be shown that the pieces of wood could be practically and satisfactorily connected by such means; and if not, and cord or wire are necessary to establish the connexion, the necessity for such articles being at hand would to a certain extent interfere with its value as an article intended to be improvised at any moment. I was present and assisted at some experimental trials which were made with the improvised stretcher at Paris in the Exhibition park on the 3rd of June 1867. The weight of the sample under examination was kil. 4·6, or a little more than 10 lbs. avoirdupois. On the question of cost it was remarked that if made near a wood it need not cost any money at all, as branches of trees unprepared, and any means of tying them together, whatever their nature, that might be at hand, would suffice for the construction of these stretchers; but if one wished to despatch a number of them to an army by order from a town near to the scene of operations, the probable cost would be 5 francs. In

Beaufort's improvised stretcher.

answer to an objection that the stretcher was not completely rigid, it was urged that the absence of complete rigidity was an advantage, as, in consequence, a certain degree of elasticity was given to it which thus acted as a substitute for springs. Another objection which was made was the length of time which would be occupied in passing the cord which forms the lace and acts instead of a sacking through the holes pierced in the side poles; but it was remarked in reply that if the stretcher were improvised near a field of battle, it would be sufficient to establish a zigzag of cord by making it pass alternately round the two poles, notches being cut at the points where the cord turned, and this would only be a work of two or three minutes. The Comte de Beaufort particularly called attention on this occasion to the fact that the object of his invention was to show how a practicable and convenient means of carrying wounded from a field of battle might be improvised without difficulty whenever there is a wood near at hand, the problem he had mainly in view being to ensure that there should be a sufficient number of stretchers on every occasion of a battle for carrying away the wounded with the least delay. This was the consideration, in common with the cheap and ordinary nature of the materials used in the construction, as well as the simple means employed for this construction itself, that led the majority of the Committee at Paris to consider it as a stretcher to be recommended for use by the volunteer "sociétés de secours aux blessés militaires." It was seen that for an impromptu service, as it were, the invention of Count de Beaufort furnished impromptu hand conveyances sufficiently stable for any particular occasion on which they might be required, and so cheap that their main portions, the wood, might be thrown away when no longer required without any loss; thus saving the expense that would be occasioned by providing means for their conveyance. These were, no doubt, also the views which chiefly influenced the jury who awarded to the brancard à l'improviste the prize announced for the best hand-stretcher at the Paris Exhibition.

SECTION VI.—ON THE STEPS TO BE TAKEN FOR THE PREVENTION OF HARM TO PATIENTS WHOSE REMOVAL HAS TO BE EFFECTED BY STRETCHERS.

Certain rules require to be enforced in the use of stretchers.

On the proper carriage of Stretchers.—A few remarks upon the manner of placing wounded men upon the conveyances which have just been described, and a few rules as to the proper plan for the bearers to carry them, are necessary to be pointed out, and to be enforced in practice, in order that the patients may be transported with as little risk of aggravating their injuries as is compatible with their removal, and with as much ease as each kind of conveyance included in this class is capable of affording. These rules require to be attended to more especially in carrying stretchers, but most of them are applicable also to those conveyances

CHAP. V.

which are carried by suspension from the shoulder. The rules to be followed are themselves simple, and appear particularly so from description; but, as observation shows, they are constantly ignored in practice, and those who are carried suffer proportionally.

Objects to be kept in view in the carriage of these conveyances.

The main purposes to be kept in view in carrying these conveyances are, firstly, that as little as possible of the impulse connected with the progression of the bearers shall be communicated to the litter which they are bearing; and secondly, that the conveyance may be kept level and as near the ground as is consistent with free carriage and the absence of risk of contact. If one of these conveyances be badly carried, it may be shaken in such a way by the movements of the bearers as they step along that, if it be a stretcher on which the patient is lying, he may be rolled upon it from one side to the other alternately; or, if it be a dhooly or hammock, he may be subjected to a lateral swinging movement, nearly as unpleasant and fatiguing as the rolling just described. Again, the machine may have such a motion communicated to it that the patient may be jerked *upwards* with every step, and this motion may be in addition to the swinging or lateral rolling before named; or the patient may be so placed that his head is lower than his feet, or his body may be unevenly supported, in either of which cases the ill results of the movements just described will be felt with more severity. The conveyance, again, may be raised so high that the patient upon it may be kept in constant apprehension of falling off, or, in case of one of the bearers accidentally stumbling and allowing the conveyance to fall, he may receive such additional injuries as to lead to serious consequences. All these objectionable movements and wrong positions, which would be irksome enough to men in sound health, entail serious suffering and risks to men who are worn by illness, or who are labouring under fractures of bones or other severe wounds. Fortunately this suffering may be in a great degree prevented by a systematic observance of the rules hereafter mentioned, whatever the circumstances of the locality or whatever differences there may be as to height or strength among the bearers.

Ill consequences of a rough mode of carriage.

One of the first things to impress upon bearers is that every movement of a man who is just wounded must be made with considerate care and gentleness to prevent pain and aggravation of his injuries. Care when raising him from the ground where he has fallen, when placing him upon the stretcher, when lifting the stretcher with the patient upon it, when halting and laying it down for the purpose of resting. In each of these cases care is as essentially necessary to obviate suffering and additional mischief as is a properly regulated step during the transport itself.

Carriage of patients with recent wounds.

Very particular care is required when the patient has had a bone recently shattered by gunshot. The proper manner of accomplishing the delicate task of lifting and removing a man with such an injury, the various modes of protecting the broken limb during the transport are subjects in which all bearers of wounded require to be specially instructed.

Carriage of patients with chronic wounds.

But it is not only in *recent* wounds that a disciplined system of proceeding is necessary for bearers; it is equally requisite, if not more so, for those which have passed the recent state. Great as the torture is of wounded men when they are carried badly shortly after their wounds have been received, the torture is greatly aggravated under the same circumstances after inflammatory action has set in. Nature then increases her demands for rest and quiet, in order that the processes of repair may go on, and by every means in her power makes the demand known. Interfere with her under these circumstances, and she resents the interference not simply by the infliction of pain, but, if the interference be great, by pain that is past expression, and, if sufficiently prolonged, by pain that is past endurance, for the sufferer will succumb under its overpowering influence.

As stretchers alone are the authorized conveyances *borne by men* in the British service, the rules for the guidance of bearers during transport are given with a view mainly to the proper carriage of these conveyances.

It is usual in the British service to tell off only two men to every stretcher. For several reasons, however, it is most desirable that three men should accompany every stretcher which is to be used for carrying wounded from the field of action. The third bearer is required in case of either of the other two bearers becoming wounded, to act as a relief to the bearers during the transport, and to assist in placing upon the stretcher men who have been rendered quite helpless by their wounds, especially those who have met with serious fractures of bones from gunshot. For these latter cases the presence of a third bearer is of essential importance. A patient with a fractured thigh or leg should never be lifted up and put on a stretcher by two bearers only, unless under extreme urgency. The position of patients after they are on the stretcher, too, both on starting and during transport, frequently require rectification, owing to displacement from bellying of the canvas after they are lifted up, or to the effects of movement during the carriage, and this can only be done, without laying the stretcher down on the ground, when a third bearer is present.

Arrangements necessary before lifting a wounded man on a stretcher.

Before attempting to remove a badly wounded man from the spot where he has fallen the stretcher should be brought close up to him; the wounded man should not be carried by hand farther than can be avoided. In placing the stretcher for this purpose *it should not be laid by the side of the patient*, but at his *head*, and should not be placed crosswise, but the length of the stretcher should be in the same direction as that in which the wounded man happens to be lying. If placed by his side it interferes with the movements of the bearers in lifting him up, necessitates their moving to the end of the stretcher, or stepping across it, and is liable to cause them to stumble when they are depositing the patient upon it. If placed crosswise at the patient's feet or head it leads to the necessity of the bearers turning round, and again causes the risk of one or other of them falling over the side poles. These objections are avoided by the stretcher being placed longitu-

dinally, the patient is readily carried head forward over the canvas on which he is to lie, and the bearers move with a clear view of the stretcher before and between them until the patient's head is directly over the pillow on which it is to rest.

The bearers told off for carrying a stretcher must be severally distinguished by some ready appellation, and one must take the direction of all the duties connected with the transportation of a patient. The bearer who marches foremost is usually designated the front or No. 1 bearer, the one who is behind, the rear or No. 2 bearer. If a third bearer be told off to assist in the transport, he is designated No. 3 bearer. The rear, or No. 2 bearer, must assume the direction, for his position enables him to see not only the patient on the stretcher but the front bearer also; while the front bearer can not see either, but only the ground or other objects before him. There are certain parts of the transport which should always be conducted by short words of command. These are especially (*a*) the lifting up and placing a wounded man on the stretcher, (*b*) the start, and (*c*) the laying down the stretcher. The object is not so much to ensure the alert and sharp movement which is required in military exercises as it is to ensure, without loss of time, the necessary caution, steadiness, and well-concerted action of the bearers.

(*a*.) Manner of lifting up and placing a wounded man on the stretcher.

As soon as all essential preliminary attention to the general condition of the patient, or to the particular injury he has received; the necessary prevention of movement of a limb, if a bone be broken, by any available support at hand; the preparation of stays or supports on the stretcher itself, if needed for the injured part, by arranging the man's clothing or accoutrements for the purpose; and when all other such matters, which, it is presumed, the sick bearers are familiar with, have been attended to, the next proceeding is to place the patient on the stretcher.

With three bearers, this is best done by two of the bearers stooping down on opposite sides of the patient, near his haunch bones, the two bearers facing each other. The third bearer places himself in a stooping position near the wounded part of the patient ready to give to it his undivided attention. The two bearers facing each other gradually get, each one hand, under the back of the patient, their other hands being passed and mutually grasped under the upper part of his thighs as close to his breech as possible, while the third bearer at the same time takes charge of the limb or other injured part itself. As soon as this is done the bearer who takes the direction gives the word "ready." At this word the bearers secure a firm grasp of the patient. The order "lift up" follows. Immediately all the bearers acting together slowly rise from the stooping posture, and, bringing their knees together, stand up. As soon as the erect position is gained the order is given to "march." The bearers march until the patient is exactly over his place in the litter, and, the order "down" being then given, he is carefully lowered, each bearer at the same time dropping slowly down into the stooping position, and is deposited upon it.

(*b.*) Arrangement on starting.

The start in every instance will be best accomplished by dividing the action into four parts, and assigning to each its distinct word of command. As soon as the patient is properly settled upon the stretcher which is lying upon the ground No. 2 bearer gives the word "fall in." At this command No. 1 and 2 bearers get into their proper positions at the head and foot of the stretcher, and No. 3 by the side of it. As soon as this is done No. 2 bearer gives the word "ready." The two bearers at once adjust the ends of the shoulder straps and take hold of the handles of the stretcher poles. This being done No. 2 bearer gives the word "lift," and immediately the two bearers raise the stretcher steadily together. No sooner is the stretcher raised, and all is seen to be right, than the word "march" is given by No. 2 bearer, and both bearers at once move off.

(*c.*) Manner of laying down a stretcher with a patient upon it.

In like manner when the stretcher is to be lowered and placed on the ground, it will be best done by corresponding divisions of the action and words of command. No. 2 bearer calls "halt," at which both bearers stop, but without any abrupt or sudden jerk; the word "ready" is then given, which is the signal for getting into position to stoop; the word "down" follows, when the stretcher is lowered and laid gently on the ground; and lastly, at the word "fall out," the two bearers quit their hold of the handles and move away from the stretcher.

A systematic performance of these duties in the manner described is easily acquired, and, when the bearers are trained to it, is calculated to prevent many a mishap, and to lessen the pain to wounded or sick men on all occasions. Every bearer should be trained to take the duty of a No. 1, 2, or 3 bearer at any moment his services may be required in either capacity.

Other general rules as to the manner of carrying stretchers *during the transport* of patients now follow.

The bearers to break step in marching.

Rule 1.—The front and rear bearers of the conveyance must start with opposite feet. They must not move "in step," but, on the contrary, must march out of step, or, as the ordinary expression is, must "break step." If the man in front step off left foot forward, the man in the rear must step off at the same moment right foot forward, or *vice versâ*, and this broken step must be maintained throughout the whole distance of the transport.

Special training needed to enforce this rule among drilled soldiers.

It is not an easy matter at first to enforce this rule among men who have been serving in the ranks of the army; indeed, it is only by systematic instruction and practice that the proper method of carrying a stretcher can be acquired by them, and it therefore becomes one of the first lessons in the instruction of men whose duty it is to carry sick and wounded. Marching in step is rendered natural to drilled soldiers by the force of habit, and the importance which really attaches to the accurate preservation of the proper cadence and correspondence of step in the combined movements of military exercises they are apt to attach to it under all circumstances.

CHAP. V.

Reasons of the rule for breaking step.

The reason which dictates the rule I have named is readily apparent on examination. If two men carrying a stretcher between them keep step in starting as a front and rear-rank soldier do in commencing to march, that is, if both men advance their right feet together, there must at the same time be an inclination of the body of each man towards the same side in proportion to the distance to which his foot is advanced, and equally so of the stretcher which they are carrying. When next the left feet are advanced together the inclination will be changed from the right to the left side, and this alternate change of inclination will be unavoidably communicated to the wounded man lying upon the canvas stretcher, and will be continued so long as the step is kept. The wounded man is placed in much the same circumstances as regards this kind of movement as a man who is riding on a camel, instead of being, as he should be, in the position of one on the back of a horse when the animal is walking. But when the step is broken at starting, that is, when the front rank man advances his right foot and at the same time the rear man advances his left foot as the horse does his opposite feet, the dipping motion down to either side is avoided, and the surface of the stretcher is maintained on a horizontal plane. With each step of the bearers there is a moderate upward and downward movement of the stretcher, chiefly owing to the pace and the elasticity of the side poles, but, with this exception, the general level is preserved. There is no lateral movement giving the patient a tendency to roll from side to side.

The rule equally applies if the stretcher be carried by four instead of by two men. The step must be broken by the front and rear-rank men, so that the level of the stretcher may still be preserved.

The bearers to march with a firm, not a springy, step.

Rule 2.—The bearers must march with a steady but easy step, particularly avoiding elevation of the bodies by springing from the fore part of the feet. The foot should be planted without any wavering on the ground at each step, and in moving forward it should only be raised sufficiently to clear the ordinary impediments on its surface. Some bearers, unless this rule is enforced, will make a slight spring in their movements, which spring is of course communicated to the more or less pliable conveyance they are carrying. They do so on the belief that the weight is sustained more easily in consequence of the elastic movement which is thus obtained, but they take no note of its ill effect on the person conveyed.

The length and kind of step best suited for bearers.

Marching with stretchers to be conducted on different principles from marching in the ranks.

In carrying a stretcher the pace should not be so long as it is in marching in the ranks, and the movement of the lower limbs should be conducted on different principles. When a combatant recruit is under instruction he is taught, in practising the balance step which forms the foundation on which the art of marching is built up, that the knee should be kept stiff, and the whole limb straight when it is either advanced in front or extended behind. The movements of his lower extremities are all to be from his

hips.* The toe of his foot is to be advanced, and the foot brought to the ground at 30 inches distance, measured by the pace-stick from heel to heel. This is the slow step; in stepping out the pace is lengthened to 33 inches. In the ranks, not only is length of stride and consequent speed of movement gained by this proceeding, but it enables an uniform pace to be preserved with bodies of troops. At the same time the length of the marching stride and the movement from the hips unavoidably induce an upward and downward movement of the parts of the soldier's body above the hips. The trunk sinks as the foot is advanced; it is raised as the limb is again brought vertically under it. This alternate elevation and depression is sufficiently manifest to any one who observes a line of troops advancing toward him, or more conspicuously still if they are moving on the other side of a hedge with only the upper parts of their bodies exposed. The kind and length of pace just described will not answer so far as stretchers are concerned if they are to be carried to the best advantage. The gait of the hawker who habitually carries a basket of crockery, or of a man carrying a bucket of water on his head, is the most suited to the circumstances of a patient carried on a stretcher; for with such a gait the trunks and arms of the bearers, and consequently that which they are carrying, are least lifted up or moved. The peculiarity of this gait is, that in it the hip joints are used as little as possible, the advance is made with the knees kept bent, and the step is shorter. The knees are never wholly straightened as in marching. The length of the pace is about 20 inches. This is the kind of gait which is assumed by the native dhooly-bearers in India when they are carrying sick, and is the most effective for stretcher-bearers too when trying to prevent undue movement of the stretcher.

Effect of length of pace in marching with stretchers.

The difference in the rise and fall of the upper part of the body between a pace of 30 inches and a pace of 20 inches is greater than might be suspected. When two men holding a stretcher without a man upon it make together a pace of 30 inches, measured from heel to heel, the dip of the stretcher is 3½ inches; with a man upon it, the arms being then stretched to the full by the weight, the dip is 4¼ inches. When the pace is 20 inches, the dip, without a man upon the stretcher, is only 1½ inches; with a man, 2¼, or about one half of the dip in the longer pace. Of course in marching at either pace there is an alternate rise and fall to the same extent, and the effect of this on the elastic poles of a stretcher can readily be imagined. The extent of elevation and depression which has just been mentioned is irrespective of jerking or any other movement, having been carefully measured when the bearers were standing still at each position.

There is another difficulty in applying the ordinary marching step to men engaged in carrying stretchers. The position of the

* "The movement of the leg must spring from the haunch." "Both knees must "be kept straight, except while the leg is being carried from the rear to the front, "when the knee must necessarily be a little bent to enable the foot to clear the "ground without grazing it."—See "Position in marching," Field Exercise, 1867.

CHAP. V.

traverse causes it with a pace of 30 inches to press very severely, especially an iron traverse, upon the front and upper part of the advanced thigh of the rear, or No. 2, bearer. The traverse also touches the back of the rear thigh of the front or No. 1 bearer; but, as the motion of this limb is away from the stretcher, it does not cause any marked inconvenience. The result is, that in trying to march with a pace of 30 inches, the rear bearer is subjected to a sharp blow from the traverse on one or other of his thighs at every step. A jolt is also at each contact communicated to the stretcher and patient upon it. With a pace of 20 inches, the traverse being placed, as it is in the regulation stretcher of the British service, at a distance of 7 inches from the ends of the handles, the thigh of the rear bearer is just cleared, and no impediment in this respect is given to the forward motion.

For *perfect* carriage of a stretcher the feet of the two bearers who are marching with it should not be brought to the ground at the same instant of time. A certain interval, about half the time occupied in the whole stride, should elapse after the No. 1 bearer has planted his foot on the ground before the No. 2. bearer plants his foot on the ground. Supposing every step to occupy half a second of time, then with this arrangement each of the four feet of the two bearers would be successively planted on the ground at intervals of one-fourth of a second of time. The right foot of No. 2 bearer would step on the ground a quarter of a second after the left foot of the No. 1 bearer had been planted on it; the right of No. 1 bearer a quarter of a second after the right of No. 2 bearer; the left of No. 2 the same time after the right of No. 1; and so on. The walking pace of a horse would be imitated by the adoption of this method of movement, though not exactly as regards the relative duration in time of each separate part of it.

The walking pace of a horse.

If a horse be observed when walking slowly, it will be seen that no two feet of the animal are put upon the ground at one and the same time. Two limbs are always in movement together, but the movement is not arrested at the same moment; the pace is, in short, broken throughout. The easy motion of a horse as regards riding is no doubt due in a great measure to this fact. But though additional ease would be equally gained by applying the same system of movement to the four feet of the two bearers who are supporting a stretcher, it is found most difficult in practice to attain it. It is comparatively an easy matter to teach bearers to carry a stretcher *out of step*, that is, to move with opposite feet, but it is almost impracticable to teach men who have been drilled in the ranks to carry a stretcher *out of time*. It is well to be aware that there wonld be less unevenness of movement of the stretcher if the bearers did not step in even measure of time; but, considering the great impediments to stepping otherwise, especially among men whose duty is but very rarely to act as stretcher-carriers, it seems hardly wise to try to insist upon uneven time being one of the rules for carrying stretchers.

The bearers to march with steps of even distance.

Rule 3.—Whether even or uneven as regards measure of time, great care must be taken lest the steps of the front and rear bearers

are invariably *even and alike in distance.* If the steps do not well and accurately agree in length, there will constantly be a hasty "catching up" of one or other of the bearers; and the stretcher and patient will be jolted on every occasion when an effort is thus made to readjust the distance. If the bearers march with an exactly corresponding step as regards length this source of disturbance will be avoided.

Bearers to be as nearly equal in height as possible.

Rule 4.—When distributing bearers, as far as circumstances permit, men nearly of the same height and strength should be selected for acting together. When a stretcher is supported by men of equal height and proportion, if the ground be level the stretcher will necessarily assume a horizontal position also, and men possessed of like degrees of strength will carry the weight and move together more evenly. If the ground be uneven the bearers will have to mutually adapt the height of their respective ends of the conveyance to the irregularities in order to preserve its level condition.

The loops of shoulder-straps to be at equal distances from the ground.

Rule 5.—When braces or shoulder straps are used to assist the bearers in carrying stretchers care should be taken at starting that they are buckled so that the parts supporting the poles are all at equal distances from the *surface of the ground.*

To keep stretchers level when the surface of the ground is uneven.

Rule 6.—As most ground over which wounded have to be carried is likely to present irregularities of surface it becomes an important matter for bearers to practice the carriage of stretchers, so as to acquire a facility of keeping the stretcher level, notwithstanding the ground is uneven. Bearers trained and habituated to this duty perform it with ease and dexterity, irrespective of differences in their own respective heights; while those who have not practised it are not unlikely to cause considerable distress to the person carried, when they have to carry him up and down hill, in consequence of their deficient training. A concerted action of the front and rear bearers is necessary, and each must be aware what part he is to perform according as the end of the stretcher at which he is placed is rendered higher or lower by the unevenness of the surface over which they are passing. The act can readily be acquired by practising the carriage of the litter up and down steps. In this practice the front and rear bearers should occasionally change their respective positions. A bearer should also be carried on the litter in turn, so as to be made practically aware of the effects of even and uneven carriage.

When ascending sloping ground with bearers of different heights.

Rule 7.—If the ground over which the conveyance has to pass presents a general ascent, and the bearers are of different heights, then the rear or No. 2 bearer should be the taller and stronger man, for his greater height and the greater strength of his arm will be useful in supporting and raising the stretcher up to the level of the end carried by the foremost man. The weight of the stretcher will naturally be thrown in the direction of the man on the lower level.

When descending sloping ground with

Rule 8.—If the ground presents a general descent the front or No. 1 bearer should be the taller and stronger, for the same

CHAP. V.

bearers of different heights.

reasons as those just given as regards the No. 2 bearer under the opposite circumstances mentioned in Rule 7.

Position of patient on a stretcher when the ground is level.

Rule 9.—A sick or wounded person on a stretcher should be carried, if the ground be tolerably level, with his face looking toward the direction in which the bearers walk. The front or No. 1 bearer then supports the end of the stretcher at which the patient's feet are placed; the bearer near the patient's head is the rear bearer.

Position of patient on a stretcher if he is being carried up hill.

Rule 10.—If the bearers have to carry the stretcher up hill, the front bearer should support the end of the stretcher on which the patient's head is placed, excepting in the case mentioned under Rule 11.

Position if he is being carried down hill.

Rule 11.—If the bearers have to carry the stretcher down hill, the rear or No. 2 bearer should support the end on which the patient's head is placed. The reverse position should be assumed by the bearers both as regards going uphill and going down hill, in case the patient being carried is suffering from a recent fracture of the thigh or leg.

The patient's comfort and welfare will be best consulted as a general principle by the arrangements named in Rules 10 and 11. Although under all circumstances the level position should be sought for as much as possible, still, if the slope of the ground be such that it cannot be attained, it appears desirable that the inclination downwards should be towards the feet rather than towards the head of the patient. But with regard to the exception named, a reverse position of the patient is directed in order to prevent the weight of his body pushing the upper end of the broken bone down upon the helpless and motionless portion of the limb below the seat of fracture.

Stretchers not to be carried over walls or fences.

Rule 12.—No attempt must be made to carry a helpless patient over a high fence or wall, if it can possibly be avoided; it is always a dangerous proceeding. The danger is of course increased in proportion to the height of the wall or fence. But even if the wall be not much higher than one over which the bearers can step, the stretcher must be made to rest upon it, to the inconvenience, and probable pain, of the patient while each bearer in succession gets over the obstruction; and it is better to avoid even this inconvenience, provided the avoidance does not entail great delay. If the fence or wall be high, either a portion of the wall should be thrown down, or a breach in the fence made, so that the patient may be carried through on the stretcher; or, if this be not readily practicable, the patient should be carried to a place where a gate or opening does already exist, notwithstanding the distance to be traversed may be increased by the proceeding. It is better that the transportation should be somewhat delayed than the safety of the patient's limbs or life risked.

Mode of carrying stretchers across dykes or hollows.

Rule 13.—In crossing a ditch, dyke, or hollow, the stretcher should be first laid on the ground near its edge. The first bearer then descends. The stretcher with the patient upon it is afterwards advanced, the first bearer in the ditch supporting the front of the stretcher while its other end rests on the edge of the ground

above. While thus supported the second bearer descends. The two bearers now lift the stretcher to the opposite side, and the fore part being now made to rest on the edge of the ground while the rear part is supported by the second bearer in the ditch, the first bearer is left free to climb up. The stretcher is now pushed or lifted forward on the ground above, and rests there while the second bearer climbs up. The two bearers then carry the stretcher on.

Stretchers not to be carried on the shoulders of bearers.

Rule 14.—On no account should a stretcher be permitted to be carried on the shoulders of two or four bearers. The evil of such a proceeding is not only that it is difficult to find several bearers of precisely the same height, so that a level position may be secured, but also that the wounded or sick person, if he should happen to fall from such a height owing to the helpless condition in which such a patient usually is, is not unlikely to sustain a serious aggravation of the injuries he may already be suffering from. Moreover, one of the bearers of a stretcher ought always to have his patient in view, so as to be aware of hæmorrhage, fainting, or other change requiring attention, taking place, and this cannot be done when the patient is carried on the shoulders. The height, too, is calculated to cause the patient uneasiness and fear of falling off, which it is also desirable to avoid. For all these reasons, notwithstanding that bearers will often attempt to carry a patient in a stretcher upon their shoulders, from the weight being borne more easily in that position, or with a view of relieving a fatigued condition of the arms, the practice should be strictly forbidden.

Mode of transferring wounded men lying upon stretchers into ambulance wagons.

Rule 15.—If the wounded man lying upon a stretcher have to be transferred into an ambulance wagon, a third bearer should invariably be employed to assist in the proceeding. This is provided for if three bearers accompany the stretcher, as contemplated in the foregoing instructions. On the arrival of the stretcher at the wagon the bearer at the end which is first to be inserted should be ready to move round the end of the pole in his left hand, retaining while he does so the support of this pole only. Before he makes this move, however, the No. 3 bearer must grasp the right hand pole; the hold of it should on no account be given up by the first bearer until he has quite ascertained that the pole is fully supported by the No. 3 bearer. When this is known to be accomplished the first bearer turns round, supporting the left pole at the side as he does so; and then, acting in concert with the No. 3 bearer, these two bearers together raise the ends of the poles which are now free into the compartment of the wagon which is destined to receive them. The bearer at the head of the stretcher at the same time takes care to maintain it level, and assists in effecting its entrance into the wagon by pushing it forward. With this system the admission of the stretcher is effected with ease, rapidity, and perfect security; while two bearers can only accomplish the object with difficulty, and not without risk of an accident to the patient.

C.—DHOOLIES.

INTRODUCTORY REMARKS ON DHOOLIES.

We come next to the third subdivision of the first class of conveyances, viz., the various kinds of dhoolies. These conveyances are almost exclusively used in the East, but they have not unfrequently been strongly recommended for employment in Europe, and some forms have even been designed and constructed specially for home use. Dhoolies differ from the last-mentioned subdivision—that of stretchers—in presenting a more substantial construction, and, in most instances, in being covered and enclosed; thus showing that protection against the sun's rays, against damp and inclement weather of all kinds, has formed an important feature in their design. Hence they do not appear as if they are intended for such temporary and occasional use as stretchers. A further difference is that they are all arranged to be carried from the *shoulders* of the bearers. The natives of India and of the East generally are not in the habit of carrying heavy weights by the hands; they either carry their burdens upon their heads or suspended from poles resting upon their shoulders, and the litters belonging to this order are adapted to this latter mode of carriage. The various forms of these eastern conveyances are known under the names of dhoolies, palkis, muncheels, jhampans, and ton-jons.*

Characteristic features of dhoolies.

In what respects they differ from stretchers.

SECTION I.—DESCRIPTION OF PARTICULAR FORMS OF DHOOLIES.

I will describe in this section the leading varieties of dhoolies, and in a subsequent section refer to the circumstances connected

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* The derivations of these several terms have been given to me by my friend Dr. De Chaumoynt, and are interesting as elucidating to some extent the original nature and design of the hand-conveyances which they are employed to signify.

PALKI, a litter, apparently from the Sanskrit palna, to nourish, and secondarily meaning a *cradle*. The palki was formerly a conveyance of distinction. Thus, palki-nishin, "entitled to be carried in a palki," was an honour at one time conferred by kings and viceroys.

DHOOLEY, although the common way of spelling the word, ought to be *doli*. Its root appears to be the Sanskrit verb dolna, to shake or to swing; *doli* being, therefore, the thing swung. The doli was formerly chiefly used as a litter by women, either wives of inferior grade or concubines. It is not improbable that the word doli was originally combined with the word palki; palki-doli meaning a swinging litter, just as palki-gari, a fixed litter, is still used in India for a palki on wheels. Gari, like doli, is now used alone for certain conveyances.

MUNCHEEL is a term principally used in the southern and south-western parts of India, and is possibly a Tamal word. It appears to come from *Manchāl*, which means an elevated platform, covered with a roof of palmyra leaf, on which the natives sit to frighten away birds from their crops. In Hindustan proper this stage is called *machan*, and this appears to have been corrupted from the Sanskrit root *manch*, which means something raised, a daïs, a throne or chair of state, a bedstead.

JHAMPAN, and TON-JON, are terms peculiar to the hill districts in the Himalayas where the conveyances are met with. Their derivation is uncertain.

Conveyances

NAME	Troop or Company	Dat of Crin

CHAP. V.

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Borne by Men.

NAME	Troop or Company	Date of Crime	Crime	By whom Reported	Punish-ment	By whom Ordered	REMARKS

Conveyances

NAME	Troop or Company	Date of Crime	Crime	By whom Reported	Punish-ment	By whom Ordered	REMARKS

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Borne by Men.

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with their use in India, and to their proposed employment in Europe.

CHAP. V.

Indian hospital dhooley.

The dhooley employed for hospital purposes in India is evidently a modification of the palki, or ordinary hand-litter of the country, only made of less solid and less ornamented materials than those of which the native conveyances are usually constructed when kept for private use. It is carried by four bearers.

Dhooley-bearers.

Every European military hospital establishment in India has a certain number of dhoolies attached to it, with a staff of bearers, and superior men (sirdars), who act under the orders of the surgeon and are paid by Government. When the troops are quartered in barracks or cantonments, the dhoolies are used for carrying men who fall sick during the heat of the day, or who are too weak to march, to the hospital, which is often placed at a considerable distance from the men's quarters. When the troops are on the line of march they are employed for carrying those who fall sick by the way. The sick are thus kept up with the column to which they belong. A third use to which they are devoted is the conveyance of soldiers wounded in action from the field of battle to the rear or spot where the field hospitals are placed. When troops on the march are halted and the dhoolies are not being employed as conveyances, they are capable of being turned to useful account as resting places for the sick in the hospital tents.

Purposes to which hospital dhoolies are applied.

Proportion of dhoolies issued to European regiments in India.

The number of dhoolies supplied to an European regiment in India varies according as the regiment is quartered in barracks or is on the march; and again, whether the march be made in time of peace or war. In cantonments every full regiment, whether of infantry or cavalry, is allowed by Indian medical regulations two dhoolies. If the regiment be marching in time of peace, that is, for changing station only, the allowance is one dhooley to every 20 men; the average number of sick for whom carriage is required on an ordinary march in India being calculated at 5 per cent. of strength. If the regiment be marching on active service, the allowance is ten dhoolies to each company; the necessary carriage being then calculated for 10 per cent. of strength. As six bearers are required for each dhooley, a regiment 1,000 strong will have attached to it 600 bearers on active service, besides upper men. Even this large number is insufficient in certain cases. "Even with the "liberal allowance of dhoolies supplied by the regulations of the "service," writes Inspector-General D. Macpherson,* "any one "who has marched with a force afflicted with cholera, must have "observed how villagers are pressed to carry the sick, and how "bearers who have reached the encamping ground are sent back "with their dhoolies to pick up straggiers who have been unable "to come on with the column."

Proportion on the line of march in time of peace.

In time of war.

* Report as to improvement of the means of sick conveyance in the Madras army, by Inspector-General D. Macpherson, dated 6th November 1857, then Acting Garrison-Surgeon, Bangalore.

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CHAP. V.

The following drawing represents the ordinary military dhooley issued to regiments for hospital service in Bengal :—

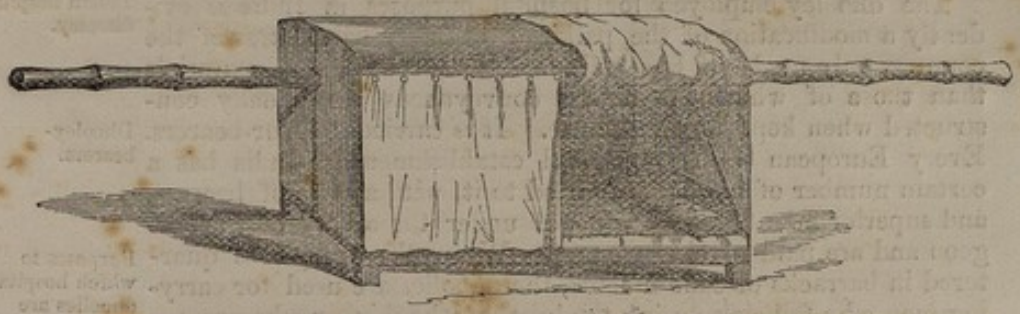


Fig. LX.—Bengal dhooley and bamboo pole complete, half of the side-curtain being thrown over the top in order to show the interior, with the mattrass and pillow.

Construction of the Bengal dhooley.

This form of dhooley essentially consists of three parts, viz.: 1st, the *litter or cot*, upon which the patient lies; 2nd, the *pole*, by means of which the litter is carried; and 3rd, the *cover*, by which the patient is protected, both above and at the sides, from excess of heat or cold and inclement weather. The construction of the litter, its mode of suspension, and the manner in which the cover is connected with it require explanation.

The litter, or horizontal part.

The Litter.—This consists of a horizontal piece and two upright ends. The horizontal part is formed by a moderately stout wooden frame, about 6 feet in length and 2½ feet in width, with an open canework bottom firmly connected to its four sides. It is raised a few inches from the ground by short wooden feet fastened beneath the four corners of the frame. A series of small iron projections are placed along the outer surfaces of the wooden sides of the frame; these act as buttons, to which the curtains of the dhooley can be fastened, when necessary, by corresponding openings or loops.

The end-pieces.

Each upright end consists of a triangular frame of wood, the base of the triangle being of the same width and attached at right angles to one end of the horizontal piece, while the apex of the triangle has resting upon it an iron ring for the pole to pass through. The lower part of the triangular frame is filled up by a small frame of wood and canework, similar to that forming the bottom of the dhooley. These are necessary for preventing the pillow at the head of the patient, as well as the patient's feet, from slipping beyond the ends of the litter. The triangular end-pieces require to be very firmly secured to the horizontal frame, or from the length of leverage and occasional forcible movements exerted at the points of suspension, they would be liable often to become detached, and the dhooley would thus be rendered useless. They are, therefore, not only secured by strong fastenings at the ends, but are additionally bolted by iron stays connecting the two sides of each upright piece, near their centres, with the sides of the horizontal frame a few inches from each of its four corners. The upper part of the triangle is strengthened by the iron, which forms the ring, being continued for some distance down each side, so as to brace the two sides more firmly together.

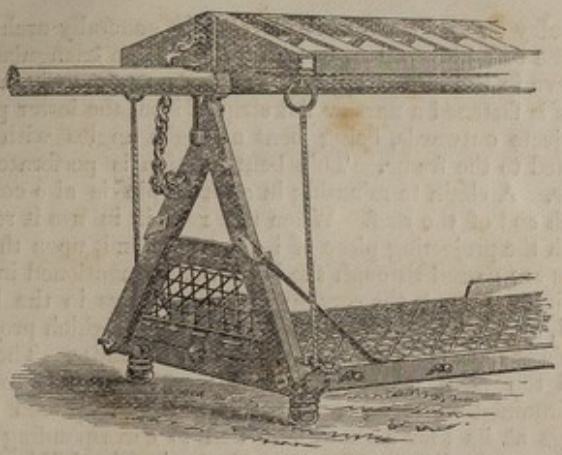


Fig. LXI.—Sketch of part of the framework, showing the manner in which the ends are secured to the horizontal part of the litter, and also the plan by which the cover is maintained in position.

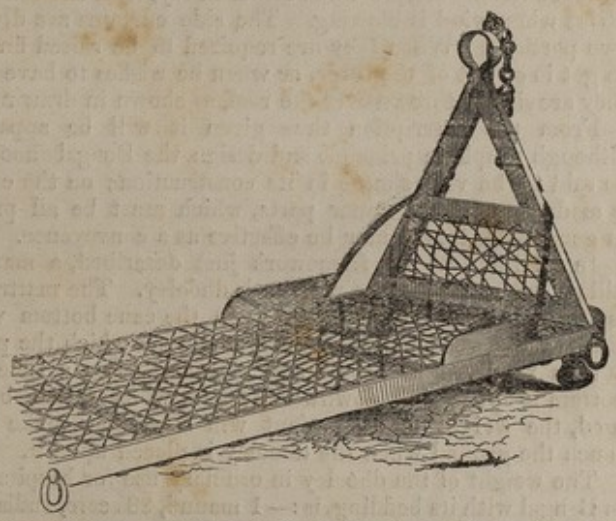


Fig. LXII.—The cover, curtains, and pole removed, showing its condition when used as a camp bedstead.

The pole.

The Pole.—This is simply a piece of strong hollow bamboo, of suitable girth for passing through the iron rings of the upright ends of the litter, and of sufficient length to rest on the shoulders of the two bearers in front and, at the same time, on those of the two bearers behind the dhooley. Two holes are bored in it, at a convenient distance apart, for receiving two iron pins, by means of which the pole is secured both to the cover and to the upright ends of the litter.

The cover.

The Cover.—This consists of a wooden frame, with pieces of split bamboo crossing it, so as together to form a roof for supporting the upper portion of the canvas which is securely nailed to it, as well as the curtains which hang downwards and enclose the

CHAP. V.

dhooley on all its sides. This roof is generally arched as shown in the first illustration, but sometimes more triangular in form, as shown in the second figure. Upon the surface of each end of the roof is fastened a narrow flat strip of iron, the lower part of which projects outwards, being bent at right angles with the portion nailed to the frame. This bent portion is perforated by a small hole. A chain terminating in an iron pin is also connected with each end of the roof. When the roof is in use it rests, together with the projecting piece of iron at each end, upon the pole. The pins are passed through the holes before mentioned in these pieces of iron, through the corresponding openings in the bamboo pole, and, lastly, through two small rings of iron which project from the upright ends of the litter near their summits. The cover, pole, and top part, are thus pinned together. The roof is further maintained in position by cords, which are passed through iron rings at its four corners, and tied to corresponding rings in the frame of the litter. These are shown in Fig. LXI.

See remark on p. 142

The canvas covering is very coarse in texture and is painted; it is thus rendered waterproof and rather heavy, so as not readily to flap about when wind is blowing. The side curtains are divided into two portions. When they are required to be raised for a patient to get in or out of the litter, or when he wishes to have more air, they are simply thrown over the roof, as shown in drawing No. LX.

From the description thus given it will be apparent that, although simple in principle and design, the Bengal dhooley cannot be said to be very simple in its construction; on the contrary, it is made up of many minor parts, which must be all present and in good order that it may be effective as a conveyance.

In addition to the framework just described, a mattrass and pillow are issued for use with each dhooley. The mattrass, which is stuffed with cotton, is placed upon the cane bottom within the sides of the wooden frame. The bed upon which the patient lies is thus rendered both soft and elastic. After a time the cane bottom is apt to sink downwards; and, when it has been much used, the weight of the patient will sometimes make part of it touch the ground when the dhooley is placed upon it.

Weight of the Bengal dhooley.

The weight of the dhooley in ordinary use for hospital purposes in Bengal with its bedding, is:—1 maund, 28 seers, Indian weight; or about 136 lbs. avoirdupois.

The following shows the respective weights of its several parts:—

—	Indian Weight.		European Weight.
	Maunds.	Seers.	lbs.
Weight of the cot part - - -	0	29	58
Bedding (mattrass and pillow) - -	0	18	36
Cover (frame and painted canvas) -	0	10	20
Pole (bamboo) - - - -	0	11	22
Total - - -	1	28	136

Training of dhooley-bearers in India.

By the systematic training to which the dhooley-bearers of India are subjected, and by force of habit, these men are enabled to carry this comparatively heavy conveyance with its freight for five or six hours continuously, at the rate of 2½ miles an hour, including halts, without inconvenience. Untrained persons of much greater physical strength than the Hindoo bearers would find such a task beyond their powers of accomplishment. The regular bearers are trained by a definite system; they are not allowed to commence the work until they are of a certain age; and are not allowed to carry a dhooley with the additional weight of a person in it until after considerable practice in the carriage of it while empty. The chief object of practice is so to carry the conveyance that its weight is divided equally among all the four bearers, and that no jerk or strain shall be thrown upon one or other of them through the changes of position which take place in the act of progression.

System on which dhoolies are carried in India.

It is the absence of jolts, and the steadiness maintained by the whole conveyance during its progress, which, combined with other qualities, makes the dhooley so useful for the carriage of sick and wounded. But such steadiness is only attained when the dhooley bearers march properly. It is a curious fact that the regular native bearers march when carrying the dhooley in India on the same system as that which has been proved to be best for carrying stretchers in Europe, viz., with broken step. The two bearers that march together in front of the dhooley break step in walking, as do also the two behind. If the foremost of the two front bearers have his left foot advanced, the bearer immediately behind him will have his right foot advanced at the same instant, and so with the two rear bearers. But this is not all. The two bearers in front, looked at together, again break step as regards the two bearers behind, that is, they march with opposite sides advanced. Thus supposing at a given moment the foremost of the two bearers in front has his left foot advanced, then, at the same moment, the foremost of the two bearers behind will have his right foot advanced; and the second of the two bearers in front will have his right foot advanced, while the second of the two bearers behind will have his left foot advanced. From this mode of progression, it follows that the two *left* feet of the two *bearers in front* will be separated when the two *right* feet of the two *bearers behind* are separated; the two *right* feet of the two *men in front* will be close together, when the two *left* feet of the *men behind* are closed up together. It is by the peculiar arrangement just described that the horizontal condition of the base of the dhooley is maintained during the transport. Any other system of movement on the part of the bearers would certainly cause the conveyance to swing from side to side; and, in addition, probably lead to the communication of uneven jolts and concussions to the person carried in it.

It is also interesting to observe the manner in which the pole is carried on the shoulders of the bearers; for on this depends the even distribution of the weight of the dhooley and its occupant among them, and also the mutual support which the bearers are

CHAP. V.

enabled to afford each other in sustaining it as they march along. The pole is placed so as to rest on opposite shoulders of each pair of bearers; or, in other words, the two bearers in front severally march on different sides of the pole, as do also the two bearers behind. When the pole rests on the right shoulder of the front rank bearer he has his left shoulder and arm extended, with his hand advanced and grasping the pole, while the bearer behind him has the pole on his left shoulder and keeps his right shoulder and arm extended. Sometimes the arm of one of the men will be thrown over the pole and embrace the disengaged shoulder and upper part of the chest of the other bearer by his side. The plan on which the dhoolies are carried, as well as the movements of the bearers, are thus seen to be regulated on fixed principles; and, indeed, any attempt to use the conveyances without such a system, at least along the distances they are usually required for, would certainly prove a failure.

Proposed changes in construction of dhoolies.

Several changes in the construction of the dhooley have been advocated since it has formed part of the equipment of European hospitals in India. One of the most important changes proposed, as regards simplicity of construction and portability, was suggested by Inspector-General Taylor, C.B., when he was surgeon of the 80th regiment which formed part of the force engaged in the Burmese war of 1852. When the troops disembarked at Rangoon, and advanced towards the city and great Pagoda, the dhoolies were of course immediately required; but, upon getting the packages of the different parts on shore, it was found that some of the iron parts were bent, others, such as the feet, broken off, and that a number of screws, hooks, and chains were missing, so that few of the dhoolies could be made available until after a very objectionable consumption of time and trouble. Most of them, indeed, required to be sent to the engineers' workshop before they could be put into proper order. Surgeon Taylor afterwards had a new form of dhooley made at Pegu according to his own design, and, on his return to Calcutta at the conclusion of the war, he presented it to the medical board. This dhooley consisted of three pieces without the pole or cover, viz., the cane bottomed horizontal piece on which the razái, or quilted cotton bed, was to be laid, and two separate triangular upright pieces which were made to pass through openings at each end of the horizontal piece. The upright pieces were so shaped that they themselves raised the litter and prevented its contact with the ground. The necessity for short wooden feet being fastened to the frame was thus abolished. Each upright piece terminated, like the regulation dhooley, at the top in an iron ring for the pole to pass through. Attached to this ring, not to the cover, was a small chain and iron pin, and the pole was secured to the dhooley so as to prevent it from slipping backwards or forwards, by the pin being made to pass through openings in the ring itself as well as through the pole. Another change was made in the construction of the cover. Instead of the comparatively heavy regulation framed cover, the one suggested by Inspector-General Taylor was made simply of pieces of bamboo about six inches apart, stretched and secured together by strong

Inspector-General Taylor's dhooley.

bands of tape. When applied it was tied to the top of each upright piece by the tapes which passed along its centre, and at the four corners, like other covers, to rings at the corners of the horizontal frame of the cot. The cover was thus rendered light, and, at the same time, capable of being rolled up when not in use. Over it a mosquito curtain could be readily suspended (this protection being generally requisite for a good night's rest in Burmah), or, in case of rain, a waterproof cover could be similarly adjusted.

The three portions of which the dhooley were composed were capable of being at once taken apart by, firstly, untying the cover; secondly, unpinning and removing the pole; and thirdly, lifting the horizontal piece over the two upright pieces. The upright pieces could then be laid flat on the horizontal portion for packing and stowage, and the cover rolled up, and afterwards secured either with the pole or cot part. In like manner, they could easily and quickly be put together again by passing the horizontal piece over the two upright pieces, inserting the pole, and fastening the cover.

Result of examination of Inspector-General Taylor's dhooley by the Medical Board at Calcutta.

The dhooley thus constructed was examined by the medical board, and the board, through their officiating Secretary, Surgeon Macpherson, in tendering their thanks for the suggestion to Surgeon Taylor, expressed their opinion that his plan of construction was a great improvement, for the dhooley was rendered by it "much better as a bed, was strong and compact, and especially "well suited for stowage."*

The following sketches illustrate the plan of construction suggested by Inspector-General Taylor:—

Fig. LXIV—The cot, and one of the upright pieces in situ, of Inspector-General Taylor's dhooley.

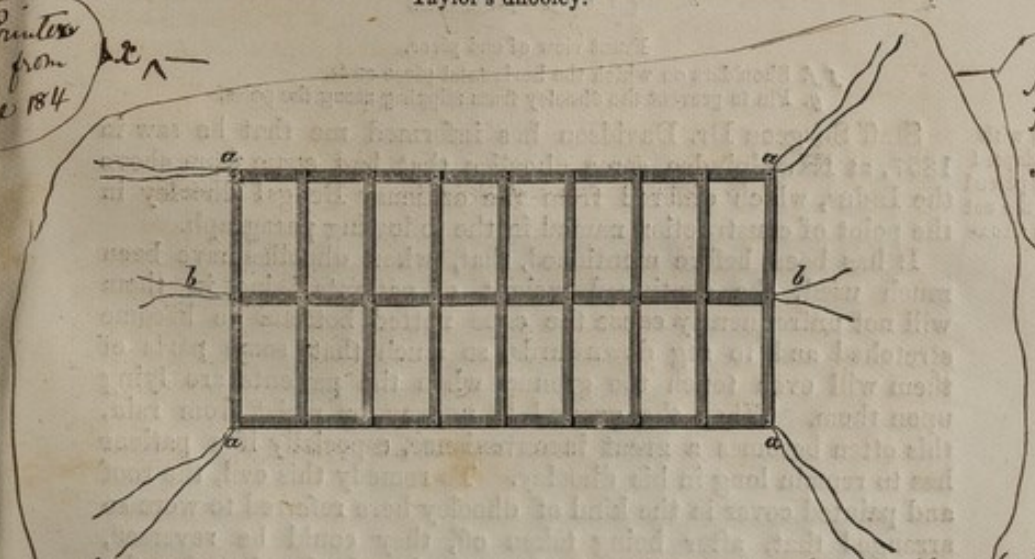


Fig. LXIV.—Frame of Cover of Inspector-General Taylor's dhooley.

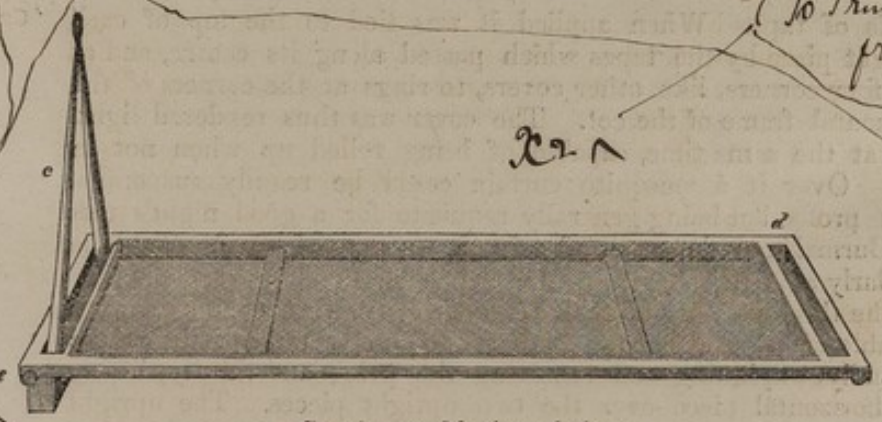
a a a a. Tape ends to tie cover to corners of horizontal piece.
b b. Tape ends to tie to end pieces.

* Letter from Medical Board Office, Calcutta, 15th December 1863.

Dhoolies with Reversible Covers

To Printer This is Fig. 63 transfer to Pl page 183

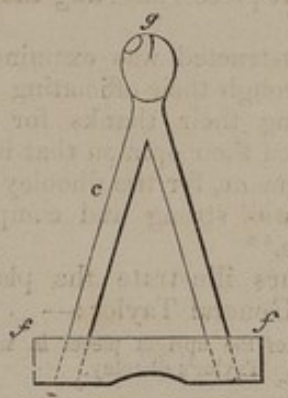
To Printer. Bring from Page 183



Cane-bottomed horizontal piece.

c. End piece with iron ring for pole to pass through.
d. Opening for end piece to pass through.
e e. Rings for tape ends.

~~Fig. LXIV. End of one of the upright pieces of the~~ same dhooley.



Front view of end piece.

f f. Shoulders on which the horizontal piece rests.
g. Pin to prevent the dhooley from slipping along the poles.

Dhoolies with covers adapted for being placed beneath the cot in damp situations.

Staff Surgeon Dr. Davidson has informed me that he saw in 1857, at Rawulpindee, some dhoolies that had come from above the Indus, which differed from the ordinary Bengal dhooley in the point of construction named in the following paragraph.

It has been before mentioned, that, when dhoolies have been much used, the continued weight of patients lying in them will not unfrequently cause the cane netted bottoms to become stretched and to sag downwards, so much that some parts of them will even touch the ground when the patients are lying upon them. When the ground is uneven, or moist from rain, this often becomes a great inconvenience, especially if a patient has to remain long in his dhooley. To remedy this evil, the roof and painted cover in the kind of dhooley here referred to were so arranged that, after being taken off, they could be reversed, having the top turned towards the ground, and placed under the canework bottom of the dhooley. The four feet of the dhooley fitted into openings adapted to receive them at the four corners of the under aspect of the cover. The painted canvas top was thus placed between the canework and the earth, and thus pro-

tection was afforded to the patient in the dhooley from the effects of damp ground in an hospital tent, or elsewhere, when the troops were in camp; while the cover and top, which from being painted were not likely to be injured by the position, were neatly and securely packed away. These dhoolies were understood to have been designed by an officer of Indian engineers.

Dhoolies constructed for use in the China war of 1860.

When the last China war of 1860 was undertaken it was uncertain what kind of sick transport the country between the mouth of the Peiho river and Pekin might be adapted for, and several kinds of conveyances, including stretchers, cacolets, litières, carts, and hand-barrows, were therefore despatched to accompany the expeditionary force. As a considerable proportion of the troops for the expedition was furnished from India, dhoolies were also sent, but they were found too heavy for the Canton and Hong-Kong coolies who were enlisted to carry them. Six hundred dhoolies were consequently manufactured in the country, the weight, including the pole and furniture of each, being reduced to 58 lbs. "They were each composed of a light "frame of wood, upon which a cane bottom was stretched, and "this was suspended from a bamboo pole by means of thin "slings of iron, which, being jointed, could be laid flat, and the "dhooley readily stowed on board ship. The pole passed "through an iron hoop at the top of each sling. Over the "whole a light canvas cover was spread as a protection against "sun and rain."* These dhoolies were constructed in the expectation that they would answer for hospital or camp bedsteads in case of their not being required for the carriage of sick or wounded on the march. At the conclusion of the campaign Inspector-General Muir, C.B., the principal medical officer of the army, noted among the practical results deducible from the experience gained in it, "that there is no kind of sick transport "equal to the dhooley, but that the dhooley or litter made use "of in the past campaign is still capable of improvement."† To this observation a note is appended, that an improved dhooley had since been designed, which it was hoped would meet every requirement when human labour was made use of for the carriage of sick.

Improved China dhooley.

A pattern of the dhooley made for use in China in 1860, as well as of the improved dhooley here referred to, are in the Museum of Military Surgery at Netley,‡ together with several models designed to illustrate other proposed improvements in the construction of these conveyances. The principal objects sought to be attained in the alterations in construction shown in these patterns and models have been three, viz.: 1. Diminution of weight; 2. An improved plan of package of the several parts of

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* "Medical History of the War in North of China," by Inspector-General Muir, C.B.; "Army Medical Reports" for the year 1860, p. 377.

† Op. cit. p. 394.

‡ *See* Catalogue, Nos. 1227*a* and 1228*a*.

Chap. V.

the conveyance for its better stowage on board ship; and 3. Protection of the feet of the dhooley from accidental breakage, either in packing or on the line of march.

I will briefly allude to the three objects just noticed.

Improvement in regard to weight.

1. In regard to *diminution of weight*, it is not probable that a lighter dhooley can be made to be really serviceable than the dhooley made for use on the occasion of the China war of 1860. A stout China bamboo pole weighs 16 lbs., leaving about 42 lbs. for the weight of the dhooley, which is thus reduced to nearly half the weight of the ordinary Bengal dhooley. This diminution in weight has been obtained by omitting the head and foot cane-work pieces, as well as the framed top; and by substituting light canvas for the heavy painted canvas cover and sides, as well as light iron uprights for the wooden ends bound by iron, of the Indian dhooley. The effect of these changes has been to lessen considerably the space within the dhooley when it is closed, and to lessen the power of resistance of the curtains against wind. The curtains should be stout enough to prevent them from flapping, as well as to prevent rain from beating through the canvas upon the patient. It will require experience to determine how far the rod iron uprights will answer for general service. I am informed that the iron uprights of the dhoolies made in China in 1860 were often broken, but that they did not afford a fair test of strength as they were hastily made for the special occasion for which they were wanted, and the iron was not of best quality.

2. Improvement in regard to stowage on board ship, &c.

2. *Facility of package* is gained by the iron ends being jointed, but not more so than by Inspector-General Taylor's proposed plan, in which wooden ends were retained. In the China dhooley of 1860, the iron ends were secured *outside* the two rails of the horizontal framework of the cot. This prevented them from being folded down below the top of the framework; indeed, the arrangement made them project a short distance above it, and to that extent increased the space required for stowage and the liability to injury. In the improved China dhooley the iron ends are arranged to fold down *within* the side rails of the cot, so that no additional space whatever for stowage is required, so far as the ends are concerned. A very ingenious contrivance in this improved dhooley is the manner in which the feet are removed out of the way when it is prepared for storage or package. There are only two feet, they extend to the same width as the dhooley, and are each composed of two vertical iron pieces connected together by a horizontal iron rod. They are secured in their places a few inches from each end of the dhooley. The horizontal rods of these frames rest on the ground, and at such angles, viz., about 30°, with the horizontal cot-part of the dhooley, that the greater the weight upon the cot, the firmer will be the support afforded by the feet on which the cot rests. These feet are securely connected with the upright iron ends, near to the joints by which they are enabled to be folded down within the cot;

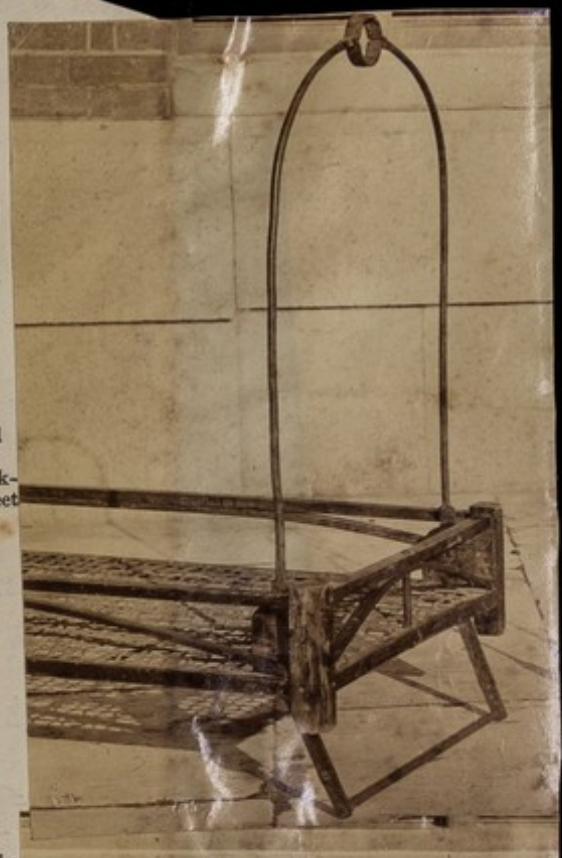
and the connexion is so mechanically contrived and adjusted that the same movement which causes the upright ends to fold *down* upon the *upper* surface of the canework bottom of the cot, causes the feet to fold up and be brought into contact with the *under* surface of the canework. The connexion is simple, and does not appear likely to get out of order. Thus no demand of space is made for stowage but that which the size of the cot itself requires, and one cot can be laid upon another in direct contact.

3. Improved protection against breakage of the feet

3. *Protection of the feet of the Dhooley from breakage.*—In the attack upon Canton, in 1857, a source of considerable inconvenience was the frequent fracture of one or other of the feet of the dhoolies, and the constant succession of jolts inflicted on the patients within the conveyance by some of the feet coming into collision with irregularities on the surface of the ground, especially when the bearers were moving up an inclined path. This defect, on the occasion named, was partly owing to too great length of the feet. The mode of suspension of the dhooley from a pole resting on the shoulders of the bearers unfits it for use on steep inclines, and, in consequence, other modes of conveyance, to be mentioned presently, have been adopted for the hill countries of India. In slopes of moderate declivities, trained dhooley bearers manage to maintain the cot in a horizontal plane, by the two bearers at one end stooping in proportion to the slope, while the bearers at the other end maintain a fully erect posture. But as the cane bottom of the cot is only about seven inches from the ground on a road that is perfectly level, it can be readily seen how bearers, not thoroughly versed in the use of this special form of conveyance, would be likely under such circumstances to strike the feet against small mounds or other impediments in the road, especially if the feet were of unusual length. So great was the inconvenience felt in the Canton war of 1857, that Inspector-General Dr. Anderson, who was on duty there at the time, has informed me they had to have the feet removed from all the dhoolies. Profiting by this experience, the feet were made so short and strong in the China dhoolies of 1860, that, joined to the fact that the roads over which they were carried proved to be generally level, this inconvenience was not felt. But in the improved dhooley, the ingenious contrivance, just now described, by means of which the feet are folded completely out of the way when the dhooley is packed and not in use, would certainly prove a source of trouble when the dhooley was in use, if the road happened to be rugged or much inclined. For as the feet fold up when the ends fold down, so they unfold when the ends are raised for carriage. They are eight inches in depth, and, therefore, under similar circumstances, would give rise to the same objections which were experienced in the Canton war of 1857.

Defects of the dhoolies used in the China war of 1857.

The following illustrations will serve to indicate the form of the dhooley which was constructed in large numbers for use in China in 1860, and of the dhooley which has been proposed as an improvement upon it.



? Chap. V.

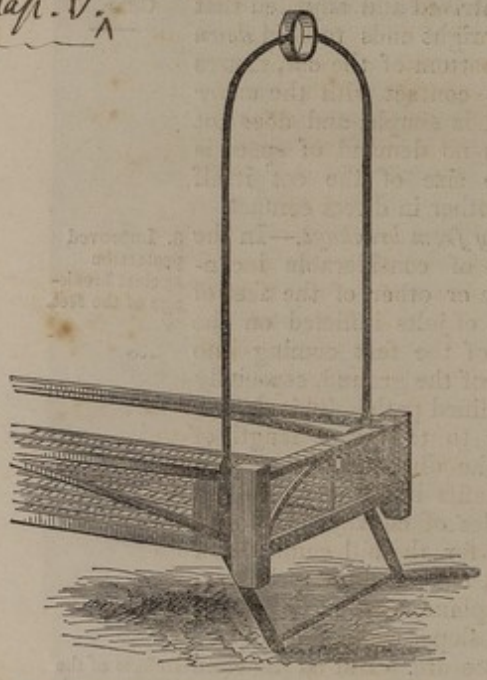


Fig. LXV.—End of improved dhooley. Pole-ends fixed inside the frame of the dhooley and connected with folding iron feet. Mil. Surg. Museum, Spec. No. 1,227 *a*.

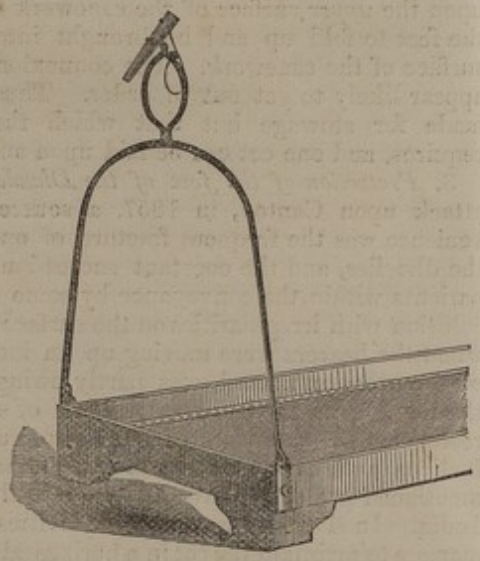


Fig. LXVI.—End of dhooley constructed for use in China during the war of 1860. Pole-ends fixed outside the frame of the dhooley. Mil. Surg. Museum, Spec. No. 1,228 *a*.

Among the models of improved dhoolies in the museum of military surgery, several suggestions are exhibited for substituting pliable ends of rope, or leather straps, instead of rigid iron ends; but as these contrivances bring the conveyances within the category of muncheels, the remarks upon them will be included in those upon this latter variety of conveyance.

Dr. Francis' improved dhooley.

Surgeon-Major Francis, of H.M.'s Indian army, has suggested some improvements in the present form of Bengal dhooley. Admitting it to be a most valuable mode of transport, he objects to its bulk, weight, and division into so many separate parts. He advocates its being made light enough to be carried by two men, and that instead of one pole there should be two, the bearers standing between them with a pole resting on each shoulder, as the Bareilly dandie is sometimes carried. Although this mode of carrying is peculiar to the hills, Dr. Francis thinks that bearers in the plains, though they would at first raise some opposition to it, might ultimately be induced to adopt it.

The following is Dr. Francis' description of the manner in which he proposes to carry out his suggested alterations:—

"To allow of a bearer standing comfortably between two poles, the breadth of the litter must be reduced. As at present made, the dhooley is unnecessarily wide. A width of thirty inches is

quite sufficient, and the two poles might pierce the litter, at a point towards the centre,—not necessarily at each extremity, as now,—which would admit of their resting easily on each shoulder of the bearer. Nor would this, in any way, disturb the balance of the litter. Or, the poles might be run through four stout iron hoops, fixed to the four corners of the litter. I would propose that the covering of the dhooley be made in one piece. A light frame, (of bamboo, or other light wood), covered over with stout canvas made waterproof, would answer very well. Spaces should be left for the poles (when these are thus connected, as at present, with the litter); but they need not be the huge, unwieldy, ill shaped bamboo trunks, which add so much to the general weight of the conveyance. Light dandie poles would be much better. The shape of the covering should not be four-sided, like those now in use, with a roof almost flat; but rounded, like the roof of a wagon, so that rain may flow off readily. It might be fixed to the body of the litter, by iron hooks and eyes, admitting of easy adjustment, and removal. A small doorway, on either side, fitted with a waterproof curtain, would be necessary, with a window, before and behind. The body of the litter should be made of the lightest possible wood, consistent with solidity and durability; and for bedding, there can be nothing better than *newar*, fixed firmly to the four sides. The reduced price of cotton will soon render the universal employment of this quite feasible. With newar, separate bedding is scarcely required, as it presents so soft and yielding a surface in itself. A litter, so constructed, with everything complete, should not weigh more than 60 lbs. And this weight would be divided between two men. One man (vern. a banghy burdar) will carry a couple of boxes (the two together weighing 60 lbs.), one strung to either end of a pole, which he supports on each shoulder alternately, with great facility. I have known a Kumaon coolie,—notoriously the weakest of all hill coolies, and even weaker than the majority of bearers in the plains,—carry shot or potatoes, banghy burdar fashion, weighing 60 lbs. The weight of such a litter as the one proposed cannot, therefore, be considered too much for two men.

"The construction of the roof, as proposed, will secure protection against the elements. Under the present system, the protection is very incomplete. In windy weather, the covering is apt to be blown about, leaving the inmate exposed to wind; with rain, or sun, as the case may be.

The framework, constructed as proposed, with the poles, can be removed with facility, quite as great as that with which the present "belongings" of the dhooley are removed.

The ordinary palanqueen used by Chinese officials is supported by long double poles and carried by two bearers. A short traverse, fixed to each end, crosses immediately behind the bearer's shoulders, and helps to keep the poles steady and to equalize the weight. But this is a comparatively small and light conveyance, only a chair designed to accommodate a person in the sitting

CHAP. V.

position, it is not capable of carrying any one in a recumbent position.

The following sketch represents the improved form of dhooley suggested by Dr. Francis. He estimates the cost of manufacture in India to be from eight to ten rupees.

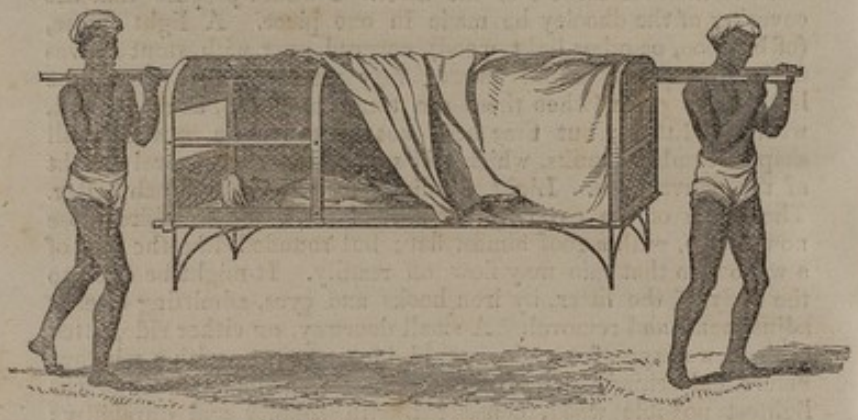


Fig. LXVII.—Dr. Francis' Improved Dhooley.

Should this kind of dhooley be found to be practically efficient the saving that will be effected by it in consequence of the reduction in number of bearers will be a most important boon. The doubts that suggest themselves in regard to it are, its being sufficiently substantial and resisting to withstand the usage dhoolies are ordinarily subjected to in long marches and field use if made light enough to be carried by two bearers, and whether the continued pressure on the shoulders can be endured by the bearers for sustained movements along nearly level roads, if made sufficiently strong for ordinary use. With the single-pole dhooley the bearer is enabled to relieve each shoulder alternately, and the pressure is never of such a fixed character as it must be with the double-pole arrangement, notwithstanding that the poles can be supported from time to time by the hands. In the hills the constantly shifting inclination of the surface of the ground prevents an uniform direction of the pressure. These doubts can only be properly solved by experiments, and the advantages that would be gained by having a dhooley capable of being carried by two bearers, other things being equal, cause it to be very desirable to have the trials made.

Madras dhooley.

Its general qualities.

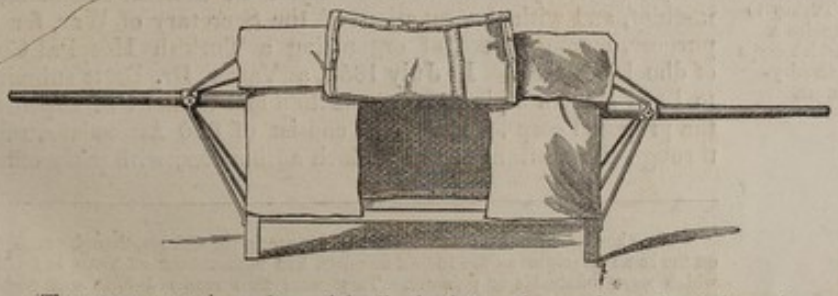
The Madras dhooley.—The construction of the Madras dhooley differs in several respects from that of the Bengal dhooley. Its general characteristics are greater compactness and solidity, closer protection in very rough weather, with less capacity for package on board ship, and less adaptability for a variety of military purposes to which the Bengal dhooley is suited. It has undergone little change from the palki in ordinary use in civil life. It is not composed of several parts like the dhooley already described, but the horizontal part, sides, and pole are permanently joined

together, so that the whole forms one structure. The pole does not pass through the litter, but rather assumes the character of long wooden handles, being divided into two parts, each of which is connected with the wooden framework which supports the canvas covering the ends of the conveyance. Each handle is firmly secured in its place by being screwed to an iron plate within the end framework of the dhooley, as well as by being supported by three iron stays outside. The ends of the outer two stays are bolted to the corresponding feet and to corners of the upper part of the framework, the third and middle supports the pole by a crutch and is itself fastened below to the frame of the cot by a screw and nut which at the same time secure the iron plate within the dhooley to which the handle is fastened (see drawings No. LXIX. and No. LXX.) The top, sides, and ends are made of strong painted canvas securely nailed to the framework of the litter. The openings by which the dhooley is entered are situated in the centre of each of its sides, and over each of them a curtain falls when the dhooley is closed; the canvas panels on each side of these entrances do not admit of being opened. Hence both ingress and egress are rendered more difficult than happens in the Bengal dhooley. It is not possible to place a patient while in the recumbent position within it, nor can surgical attention be given to him, especially in the instances of injuries to the upper or lower parts of the body, without great inconvenience to all concerned. Its fitness is thus obviously lessened for the purposes of hospital use or field service. When a patient is once within it, he is somewhat more secure against the accident of rolling out, and against the influences of wind or rain, than in a dhooley the sides of which are formed by loose curtains, but by no means to a degree sufficient to compensate for the inconveniences before mentioned. Moreover, as the pole and coverings are fixed, the Madras dhooley is quite unsuited for being carried into a hospital tent and so forming a substitute for a camp bed. A patient can, however, remain in it in the open air with impunity. The following illustrations are taken from a model in the Museum of Military Surgery at Netley.

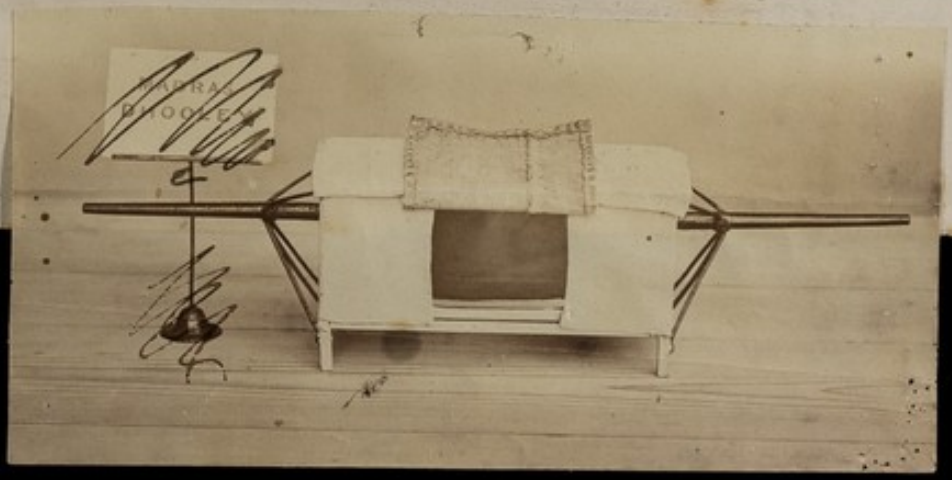
Its construction.

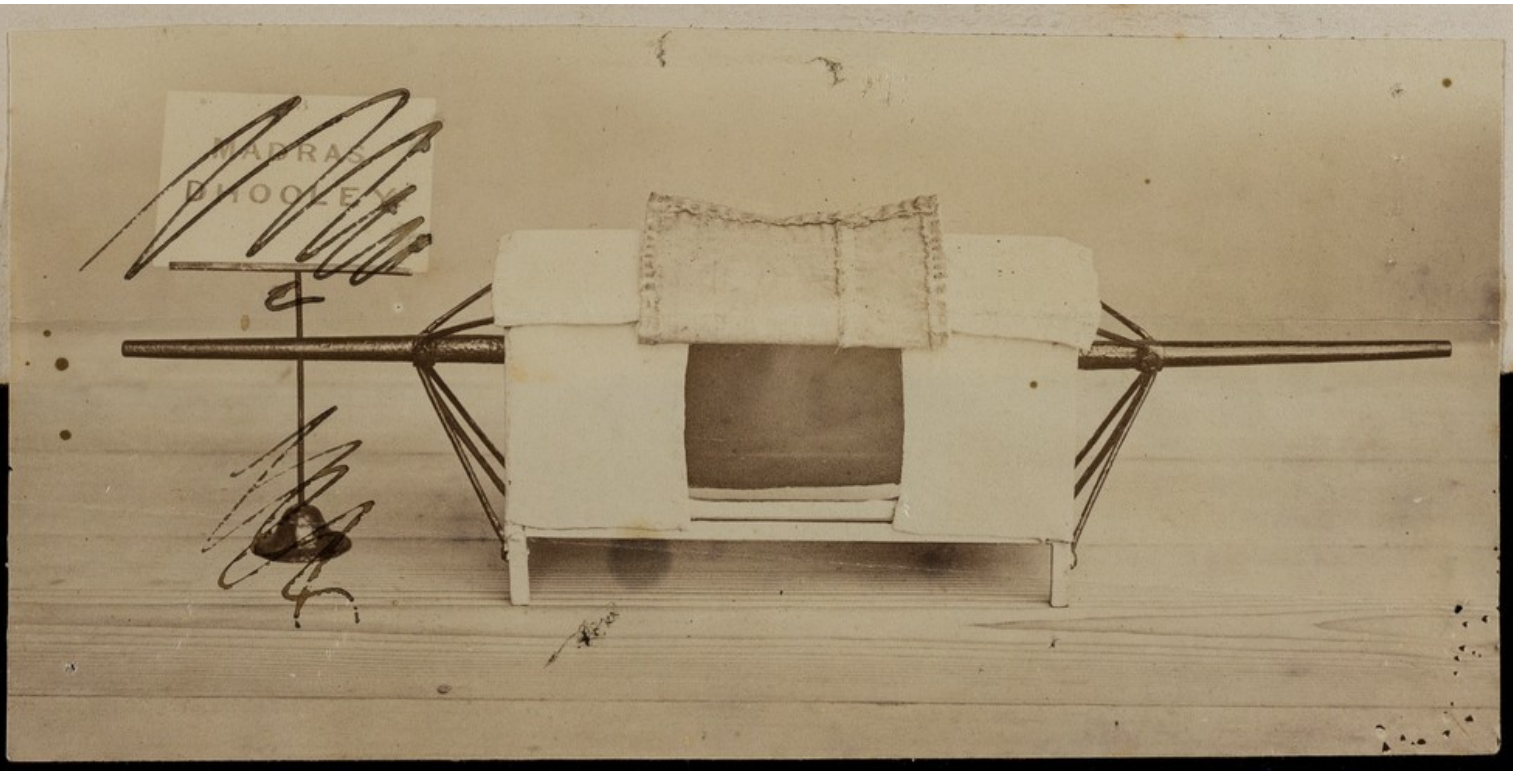
Its inconveniences as regards the surgical treatment of patients.

Fig. LXVIII.—Madras Dhooley. ~~No. 1.~~

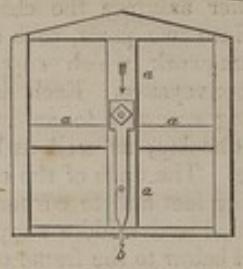


The entrance curtain, or door, of the dhooley is turned over the roof and shows the interior of the conveyance.




MADRAS
D. TOOLEY

End of Madras Dhooley.



~~No. 2.~~—Interior View.

a a a a. Cross pieces of wood supporting the canvass.

Iron bar within the frame by which the pole is fastened to the end of the dhooley. The bar extends to the lower horizontal part of the frame into which it is inserted and secured by the screw and nut indicated at *b*.

~~No. 3.~~—External View.

x. The pole.

y y. Two outer iron stays.

z. Middle iron stay, supporting the pole, and secured at *b*. by the same fastening which secures the bar shown in No. 1.

Bombay dhooley.

The Bombay dhooley resembles the Madras dhooley in construction, with the exception that it has the side canvas curtains differently arranged. Instead of a partial opening in the middle, the whole side curtain can be raised together, and by this means a patient can be carried on a mattress and easily laid on the cane-work bottom without any change of posture. This gives it a superiority over the Madras dhooley.

SECTION II.—ON THE PROPOSED EMPLOYMENT OF DHOOLIES IN EUROPEAN ARMIES, AND ON THEIR USE IN INDIA.

Proposed introduction of dhoolies for army use in Europe.

Advocated for employment in the Crimean campaign.

Dr. Brett's dhoolies.

Dr. Brett sent to Turkey to organize a Turkish corps of dhooley-bearers.

The introduction of dhoolies into European use has been not unfrequently advocated. A proposal to organize an establishment of dhooley-bearers for service in the Crimean war was made to the Government some time before the campaign opened, and was urged several times while it was in progress. As early as February 1864 Dr. Brett, a retired surgeon of the Bengal Medical Staff, laid before the Director-General of the Army Medical Department a plan of this kind, and the Director-General approved of it.* In May of the same year this gentleman was sent officially to Turkey under the authority of the General commanding-in-chief, and with the sanction of the Secretary of War, for the purpose, among others, of organizing a Turkish Hospital Corps of dhooley-bearers. In July 1854, at Varna, Dr. Brett submitted to Lord Raglan a plan of organization and estimate of expense of the proposed corps. It was to consist of 800 Armenians, raised through the medium of the Turkish authorities, with petty officers

* The dhoolies which Dr. Brett proposed for use in the Crimea, though constructed on the same principles as the Indian dhoolies, had india-rubber cushions and pillows which were inflateable at pleasure. They were thus rendered light and portable. The construction also admitted of their being readily separated into detached parts to facilitate package.

Conveyances

NAME	Troop or Company	Date of Crime

End of Madras Dhooley.

No. 2.—Interior View.

a a a a. Cross pieces of wood supporting the canvass.

b. Iron bar within the frame by which the pole is fastened to the end of the dhooley. The bar extends to the lower horizontal part of the frame into which it is inserted and secured by the screw and nut indicated at *b*.

No. 1.—External View.

z. The pole.

y y. Two outer iron stays.

x. Middle iron stay, supporting the pole, and secured at *b*, by the same fastening which secures the bar shown in No. 1.

Bombay dhooley.

The Bombay dhooley resembles the Madras dhooley in construction, with the exception that it has the side canvas curtains differently arranged. Instead of a partial opening in the middle, the whole side curtain can be raised together, and by this means a patient can be carried on a mattress and easily laid on the cane-work bottom without any change of posture. This gives it a superiority over the Madras dhooley.

SECTION II.—ON THE PROPOSED EMPLOYMENT OF DHOOLIES IN EUROPEAN ARMIES, AND ON THEIR USE IN INDIA.

Proposed introduction of dhoolies for army use in Europe.

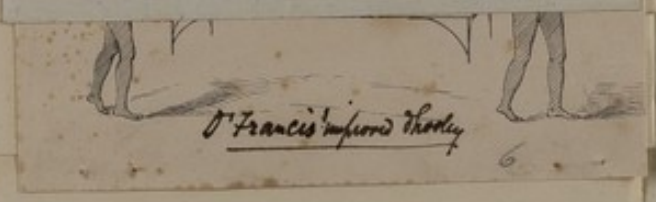
Advocated for employment in the Crimean campaign.

Dr. Brett's dhoolies.

Dr. Brett sent to Turkey to organize a Turkish corps of dhooley-bearers.

The introduction of dhoolies into European use has been not unfrequently advocated. A proposal to organize an establishment of dhooley-bearers for service in the Crimean war was made to the Government some time before the campaign opened, and was urged several times while it was in progress. As early as February 1864 Dr. Brett, a retired surgeon of the Bengal Medical Staff, laid before the Director-General of the Army Medical Department a plan of this kind, and the Director-General approved of it.* In May of the same year this gentleman was sent officially to Turkey under the authority of the General commanding-in-chief, and with the sanction of the Secretary of War, for the purpose, among others, of organizing a Turkish Hospital Corps of dhooley-bearers. In July 1854, at Varna, Dr. Brett submitted to Lord Raglan a plan of organization and estimate of expense of the proposed corps. It was to consist of 800 Armenians, raised through the medium of the Turkish authorities, with petty officers

* The dhoolies which Dr. Brett proposed for use in the Crimea, though constructed on the same principles as the Indian dhoolies, had india-rubber cushions and pillows which were inflateable at pleasure. They were thus rendered light and portable. The construction also admitted of their being readily separated into detached parts to facilitate package.



Dr Francis improved Dhooley

Borne by Men.

NAME	Troop or Company	Date of Crime	Crime	By whom Reported	Punish-ment	By whom Ordered	REMARKS

Conveyances

NAME	Troop or Company	Date of Crime	Crime	By whom Reported	Punish-ment	By whom Ordered	REMARKS

Borne by Men.

Punish-ment	By whom Ordered	REMARKS

CHAP. V.

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CHAP. V.

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CHAP. V.

Advantages of

The dhooley possesses another useful quality. It admits of the easy application of mechanical means for suspending limbs that

CHAP. V.

Dr. Brett's scheme not approved by Lord Raglan.

acquainted with English. Lord Raglan did not, however, approve of the project; chiefly because he had no expectation that Dr. Brett would be able to raise an hospital corps of Turkish subjects which could be relied on for service in the field, as well as from the difficulty there would be in finding natives who could communicate intelligibly with the English troops.* The scheme was consequently abandoned. In July 1855 Dr. Brett renewed his proposal, but, other hospital attendants and ambulance conveyances having been then formed, it was not entertained. The use of dhoolies, to be carried by Turkish porters, was urged by gentlemen from several other quarters. To one of these gentlemen, in a letter bearing date 14th February 1855, the Director-General replied:—"It has been found impracticable to get the porters of "Constantinople to venture on the field during or immediately "after a battle. I am aware dhoolies are very good, and they "would no doubt be used, could we secure the number of bearers "which it is easy to obtain in India."

Objections to the employment of Turkish dhooley bearers.

Dr. Williamson's views on dhoolies for European field-equipment.

In 1859 Staff-Surgeon Dr. Williamson urged in his work entitled "Notes on the Wounded from the Mutiny in India,"† the importance of having dhoolies as a regular part of the field equipment for armies in Europe, from considering them to be more perfectly adapted to the conveyance of sick and especially wounded men than any other conveyances. This officer recommended that a suitable supply of dhoolies should be procured from India and kept in store until required for use, and that, on war breaking out, bearers should be immediately called for from India for duty. Independently, however, of the difficulties which would be met with in the employment of natives of India—on account of the diseases and mortality which would certainly prevail to a great extent among them in a northern climate, their religious prejudices and peculiar habits, and the number that would be required, not only for ordinary service but also as supernumeraries to replace those who fell sick—other insurmountable difficulties have arisen to prevent such a scheme from being carried into execution. These difficulties will be noticed presently.

Objections to employing East Indians in Europe.

Universal praise of the dhooley as a conveyance.

The Indian dhooley has always been praised as one of the most easy, if not the most easy and serviceable kind of conveyance ever designed for the carriage of sick and wounded men. It has been held in equal estimation by military and by medical officers. Its universal employment by the natives in all parts of India as a vehicle both for short circuits in cities on the ordinary purposes of business and visiting, as well as for long expeditions of many hundred miles in distance, sufficiently proves its adaptation to the general climate and habits of the people of the country. It is not to be wondered at, therefore, that some persons who have experienced its advantages in the East, judging from that expe-

* *See* Copies of Correspondence in a pamphlet entitled "Dr. Brett's Hospital Ambulances; with a letter to the Duke of Newcastle, respecting his mission to the "seat of war." Lond. 1854.

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CHAP. V.

Explanation of the great estimation in which dhoolies are held as sick conveyances.

rience only, should have advocated its introduction into countries in which it is at present unknown except by repute.

There is no difficulty in explaining the sources of the extremely high estimation in which the dhooley has always been held as a means of transporting sick by those who have been practically acquainted with it. The patient while carried along in a dhooley has all the comfort and advantages, before described, belonging to the horizontal position, which are so essentially necessary for ease and repose in an Indian climate; he can freely turn and move his limbs; in the day time he is protected by it from the sun, at the same time that he can admit any breeze that may be stirring; at night it is not only a bed, but a place of shelter also to protect him from dews and cold, in case no tent or bungalow is at hand. It admits of the carriage of beverages, food, medicine, or any small article that may be necessary for the patient's use during the transport. The well-trained, easy, and yielding tread of the native bearers obviates any jolting or unpleasant jerk, and simply conveys to the bamboo pole from which the dhooley is suspended the slightest undulatory movement in harmony with their step; so slight, indeed, that it is only just perceptible to the recumbent patient within when his attention is directed to the subject. In watching the progress, however fast, of a train of dhoolies, nothing can be more remarkable than to observe the extremely little motion which is manifest in each single conveyance itself. There is no swinging from side to side, or rocking; the bearers have no "high action;" their feet just clear the surface of the ground, and the idea is conveyed that they are rather *pushing along* the dhoolies than carrying them. An almost perfect level, so extremely important as regards the ease of a patient, is preserved by the peculiar broken step with which the four bearers march. The hardly noticeable elastic movements of the bearers, together with the monotonous chant which they usually maintain on the line of march, often prove to be a source of beneficial influence; for they not unfrequently serve to soothe into sleep the invalids to whom the blessing would be denied in a hospital on an ordinary bed. Contrast these advantages with the usual sensations experienced in the other conveyances for the sick in use in India—the various kinds of carts, the conveyances borne by elephants and camels—and all surprise at the very great partiality expressed for the dhooley will cease.*

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* The dhooley-bearers of India have been noted for being a most willing and laborious class of men, exhibiting bodily endurance indeed to a surprising extent, and almost always well behaved and faithful when treated with due consideration and a little kindness. During the Indian Mutiny the dhooley-bearers attached to the European regiments were generally faithful, and frequently exposed their lives on the field of action, although at this time, on account of the great and widely-extended demand for these men, labourers were sometimes hired and employed who had not been regularly trained for the occupation. The late Duke of Wellington showed his appreciation of their services in the Mahratta war, in 1803, by issuing a general order in which he desired that "in consequence of the great labour of dhooley-bearers in "the public service, and the important services they have rendered in removing the "wounded men to the hospitals after the late battles of Assaye and in the plains of

CHAP. V.

Advantages of dhoolies for the carriage of men with fractured limbs.

The dhooley possesses another useful quality. It admits of the easy application of mechanical means for suspending limbs that have been fractured by gunshot. A broken leg or thigh, after being supported temporarily by splints, plaster of Paris bandage, or other means of protection, can be further materially protected against the effects of the least shaking or movement during the transport by being slung from the cross-pieces of the framework of the roof of a dhooley. During the Indian mutiny this was done in many instances. Not only great pain to the patient was prevented, but the chances of the surgeon having to resort to amputation were lessened by the plan, especially when the transport had to be continued for several days before a permanent hospital could be reached. This important advantage cannot be obtained when any of the roofless conveyances, such as stretchers or mule-litters, are employed. Neither are slinging appliances so easily adaptable, as a general rule, even to covered wheeled vehicles, owing to the usual distance of the roof from the bed on which the patient lies in them. Thus the combination of the many good qualities possessed by the dhooley renders it the most perfect kind of conveyance that has ever been constructed, or is perhaps capable of construction, for the removal of men suffering from fractures, whether simple or compound, of the lower limbs.

Present difficulties of obtaining dhooley-bearers.

But admitting the existence of all the peculiar and valuable advantages just described, circumstances have occurred materially to interfere with the employment of dhoolies, even in India. A change has taken place, during the last eight or ten years in the habits of the native population of such a nature that the class of people from which the dhooley-bearers were principally obtained is now lessened to an extent that renders it impossible to obtain the requisite numbers for service. At one time, in any of the principal cities of India, a thousand bearers could be obtained without any difficulty at a day's notice; now, in the same places, a hundred could scarcely be obtained, notwithstanding the temptation of a greatly increased rate of pay. Formerly the prejudices of caste to a great extent prevented emigration; there were comparatively few public works demanding labourers in large numbers; the demands for the cultivation of the land were readily met by the ordinary agricultural population; and there were comparatively few wheeled carriages used, especially by natives, for purposes of travelling over the country. But of late years, emigration to

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"Argaum, a donation of two star pagodas be given to each maistry, and one star "pagoda to each dhooley-bearer in the public service in the Madras establishment."

I had the opportunity of observing the character and the habits of the Madrassee as compared with the Bangali dhooley bearers in 1858, when about 250 men of the former were attached to my regiment during a month's march and for some time afterwards; and in physical strength, as well as in respect to the order and discipline preserved among them, they exhibited a very favourable contrast with the Bengalis. But it is only fair to mention that so many of the regular bearers had been absorbed in providing for the wants of the armies in the field in Bengal and Oude at that time, that most of the Bengalis with me were little better than common coolies, while the Madrassees were men who followed the regular occupation of bearers. The regular palki and dhooley-bearers in lower Bengal belong to a distinct caste, and come chiefly from one province, the province of Orissa.

CHAP. V.

Demerara and other parts of the West Indies, to Mauritius, and elsewhere, has been systematically proceeding in a continued stream; railways have been in course of construction through various parts of India; tea, coffee, cotton, and other plantations have increased to a vast extent; and gharries, or wheeled vehicles, have been gradually displacing palkis for private use. Hence it is that the people of the bearer class have been disappearing, either from having left as emigrants, or from having found more constant and profitable occupation in other pursuits. The dearth of dhooley-bearers appears to have been first specially felt in the Madras Presidency. In October 1857, the Commissary General from whose department the supply of the dhooley-bearers for the public service is always obtained, wrote to the Military Secretary to Government, Fort St. George, as follows:—"I have the honour "to request you will be good enough to bring to the notice of "the Right Honourable the Governor in Council, that the "adequate supply of dhooley-bearers for the carriage of sick, "especially in the southern part of the presidency, has become "very difficult; the result is, that when unusually large bodies of "troops have to move, it is quite impossible to obtain the services "of a sufficient number of dhooley-bearers without sending a "great distance for them, such as to Berhampore, &c., in the "northern division, involving much expense and delay in their "collection."* Similar difficulties were experienced in other parts of India at this period, owing to the general demand for dhooley-bearers for service with the troops in the field. General Anson was detained fourteen days at Meerut at one of the most anxious periods of the Indian Mutiny, owing to the impossibility of procuring the necessary number of bearers.

Causes of the dearth of dhooley-bearers in India.

Official notice in 1857 of the growing difficulty of obtaining dhooley-bearers in the Madras Presidency.

Impossibility of obtaining the requisite number of dhooley-bearers in India during the Sepoy mutiny of 1856–58.

The great pressure at this time for dhooley-bearers, in order to meet the wants created by the measures adopted for defeating the native troops who had mutinied, undoubtedly increased the difficulties of obtaining them in the requisite numbers; but, independently of the exceptional circumstances of that period, the gradual diminution, and present dearth of men of the bearer class in India are facts notorious to all who have been led to inquire into the subject†. The subject has been for some time past a matter of anxious consideration with the Indian government; has on several occasions led to consultations and experiments, some of which will be referred to hereafter, on kinds of conveyances best adapted to act as substitutes for the dhoolies; and at the present time forms the subject of one of the questions which is engaging the attention of the sanitary commissions at the three presidencies.

Deliberations on the best methods of counteracting the difficulties arising from the deficiency of dhooley-bearers in India.

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* Military Department. Proceedings of the Madras Government, No. 4450. Extract from the Minutes of Consultation, 8th December 1857.

† *See* a report on the improvement of the means of sick conveyance in the Madras army, by Inspector-General D. Macpherson, dated 6th November 1857, then acting Garrison Surgeon, Bangalore. *See also* the evidence of my colleague, Professor Maclean, on this subject before the Commissioners appointed to inquire into the sanitary state of the army in India.

Although, however, the deficiency in the available numbers of the bearer class, and the improvements in means of communication along the principal routes of India, will prevent dhoolies from ever again being used for purposes of sick transport in the proportion in which they were used previously to the last eight or ten years, it is not probable that they can ever be wholly dispensed with in field service in India. When troops are moving otherwise than by railway, so long as they are marching along grand trunk lines, and the roads are good, wheeled ambulance conveyances may be found to meet all the necessities of service. But when the troops are engaged in hill or jungle warfare, or are dispersed over the country in moveable columns, as they were throughout the period of the late Indian mutiny, marching across districts in the plains without any regular means of internal communication, without roads or bridges, and meeting impediments of all kinds to oppose their progress, wheeled transport would be little better than an incumbrance, and the dhooley will most probably still remain the only kind of carriage to be depended upon for the safe conveyance of those who fall sick or are wounded on the way. The habits of the people of India; the ease with which the men who form the class of bearers manage to provide for themselves under circumstances where great difficulty would be experienced in procuring the necessary forage for transport animals; the facility with which the difficulties interposed by the absence of regular means of communication are overcome by natives trained from infancy to meet them and to understand signs which are meaningless to strangers; these are all greatly in favour of the use of the native hand-litter, as compared with any other mode of conveyance, under the circumstances just described.

Dhoolies not likely to be wholly discarded from hospital use in India.

Circumstances under which dhoolies will probably form the only practicable means of sick transport in India.

Causes of the greater efficiency of dhoolies under the circumstances named.

The probable necessity for the continued employment of native conveyances in time of war in certain districts of India was pointed out by Sir Patrick Grant, when Commander-in-Chief of the Madras Presidency in the summer of 1858. While acknowledging the need of an improved system of ambulance transport for the army, Sir P. Grant observes.* "But there are "still divisions where the practicability of bringing it into use is "more than questionable. Those who have shared in the campaigns in the Kimedy and Goomsoor jungles are aware of the "utter hopelessness of attempting the use of any description of "sick carriage but the muncheel. The same may probably be "said of North Canara, and unfortunately, those engaged in this "jungle warfare generally need carriage more than the sharers "of any other campaign, for though there are fewer who suffer "from the hands of the enemy, there are few indeed who do not "succumb to the deadly influence of the climate, &c."

Remarks by General Sir Patrick Grant on the probable continued need of sick conveyances of this class under certain conditions of warfare in India.

General Sir William Mansfield has also strongly argued against changing the system of employing dhooley conveyances for ambu-

* Remarks by the Commander in-Chief, Sir Patrick Grant, transmitted by letter from the Quartermaster-General of the army, Head Quarters, Ootacamund, 30th July 1858, No. 170, to the Secretary to Government, Military Department.

CHAP. V.

Disuse of Dhoolies in India impracticable.

lance purposes in India. He has objected even to reducing the numbers of the dhoolies and dhooley-bearers ordinarily entertained by Government. And not only has Sir William Mansfield advised that these means of sick conveyance should be maintained to their full complement, but that dhooley-bearers should be specially nurtured and supported by the Government to prevent them from decreasing in numbers and perhaps becoming, as a race, almost extinct. In a report upon the comparative utility of wheeled ambulance conveyances and dhoolies for field service written in 1860, when the subject was under discussion at the instance of the Military Finance Department, Sir William wrote as follows:* "Ambulances (carts and wagons for carrying sick) "are admirable as long as there are metalled roads. As in "Europe metalled roads appear in every direction, and as, besides, "bearers are not to be had, there are no other means of carrying "sick and wounded than carts and wagons. In India, on the contrary, directly a general moves from the line of a trunk road his "carts and wagons become almost useless. He is sure the Finance Commission would allow this if they had an opportunity of "seeing the rearmost carts of such a small thing as a division of "5,000 men trailing in at the end of a column after a march of "10 miles across country. These carts, including ambulance "carts, arrive eight or ten hours after the troops, perhaps even "not till the middle of the next night. Lord Clyde had good "experience of this in his Oude campaign, in which he was "obliged to move across the common country roads. The "medical authorities were under the absolute necessity of abandoning their ambulance carts, or otherwise their sick men would "have been day after day exposed to the weather. There is "nothing, therefore, in Sir W. Mansfield's opinion so much to "be deprecated as reducing our old system of dhoolies and "dhooley-bearers. On the whole he would rather see the "number of combatants diminished than that of the dhooley-bearers. His experience is founded on observation of the "campaigns of Lord Gough in the Punjab, which were altogether "carried on away from metalled roads, on tedious operations in "the Peshawur valley where there were no roads at all, and "again in all the recent affairs. As regards moveable columns, "it may be held as a certainty that they will always have to "operate away from metalled roads. It should be borne in mind "that dhooley-bearers should be kept up in India very much as "if they were a breed of draught animals. The Finance Commission is possibly not aware that there is already a great "falling off in this description of labour in consequence of great "posting roads having been opened of late years. It may "be assumed that, as the railway system becomes more and "more developed, the dhooley-bearers will forget their craft,

* Quoted from a printed Report by the officiating President of the Sanitary Commission for Bengal to the Secretary to the Government of India, Military Department, dated Calcutta, January 1865.

Disuse of Dhoolies in India impracticable.

" and devote themselves altogether to other labour. Now it is " absolutely necessary for the efficiency of the army that they " should be maintained like gun bullocks or cavalry horses. It " would, therefore, seem to be a very bad economy to reduce " them numerically. It may be instanced that during the recent " campaigns, owing to causes above-mentioned, commissariat " officers had far more difficulty than formerly in supplying the " required dhooley-bearers."

Sir H. Rose, when Commander-in-Chief in India, entirely coincided in the views expressed by Sir W. Mansfield. Sir H. Rose wrote: "There can be no doubt that for the requirements " of India no system can be introduced more effectual than the " dhoolies or dandies as heretofore employed, by which means " wounded men could be transported from the hill side, broken " ground, or other locality, where they were struck down, to " their respective hospitals, and that too, over ground of any " nature."

"With reference to ambulance wagons, they are convenient and comfortable for traversing made roads, but totally inapplicable for use with troops operating in districts off the main lines of communication, and therefore cannot be applied for general use in India, where operations necessarily require a transport suitable for cross country purposes. Ambulance wagons have been used for some time past in the Peshawur division, and the result of their adoption has been to prove that, while extremely useful on the trunk road, they are subject to constant breakdowns, even on such a fair cross country road as from Peshawur to Talozail at the foot of the Cherat Hill; and, moreover, their general adoption, in lieu of dhoolies, is impracticable from the impossibility of employing them in mountains, or difficult raviny country."

Supplies of Dhoolies advised by Bengal San. Commission.

The recommendations of the Bengal Sanitary Commission in the report of January 1865 already cited, so far as the question of the number of dhoolies to be issued for the service of British troops in India, irrespective of any wheeled ambulance conveyances which might be added to them, is concerned, were the following:—That the two dhoolies allowed by regulations to regiments in cantonments should continue to be issued as before. That each battery of artillery should be allowed one dhooley to itself, instead of one dhooley to two batteries, where two batteries are brigaded together. That on an ordinary line of march the proportion which dhoolies should bear to other kinds of sick transport, such as ambulance wagons, is one-half. Taking, therefore, the average number of sick for whom transport is necessary at 5 per cent. of strength, 25 dhoolies would be the complement for a regiment 1,000 strong. Lastly, the Commission recommended that the number of dhoolies allowed by regulations for troops on field service should not be reduced, as no wheeled ambulance conveyances could be safely and advantageously substituted for them.

CHAP. V.

SECTION III. — CONCLUSIONS RESPECTING THE ESSENTIAL QUALITIES OF DHOOLIES AS ARTICLES OF AMBULANCE EQUIPMENT.

From the opinions expressed and the reasons given by the eminent authorities just quoted, as well as from the weight which must be attached to the recommendations of the Bengal Sanitary Commission, the conclusion seems inevitable that for a long period to come the dhooley will continue to form part of the hospital field equipment in India. If, therefore, further improvements can be devised in their construction, if, for example, their weight can be diminished consistently with preserving their fitness for service in all other respects, their cost lessened, their capability of stowage in respect to economy of space be increased, such matters are well worthy of attention, both from being calculated to improve their efficiency in fulfilling the purposes for which they are intended to be employed, and from lessening the difficulties arising from the want of trained bearers for their carriage. Whatever suggestions may be advanced in these respects, in considering them it is essential that the following, which are the chief points to be looked for in a good dhooley, should be always kept in view, viz.:—

Essential qualities of a perfect dhooley.

1st. Construction to afford the greatest amount of ease, fitness as regards position, and proper support for wounded and sick men. Facility of placing a badly wounded or very infirm patient within the dhooley while he is lying in a horizontal position.

2nd. Lightness, consistent with strength and durability, bearing in mind the usage to which dhoolies are usually subjected on service in campaigning.

3rd. Simplicity of design, with a view to capability of easy repair by means ordinarily available in the districts where dhoolies are liable to be employed.

4th. Such a connexion between the several parts of which the conveyance is composed that the risk of the whole machine being rendered useless by the casual absence of any one or more of them may be obviated.

5th. Adaptability for carriage in accordance with the habits of the bearers.

6th. Adaptability for package and stowage on board ship, on land conveyances, and in store.

7th. Means of protecting patients against rain, sun, dust, &c., with sufficient space within the cover and curtains for free aeration.

8th. Capability of use in the field as a substitute for a hospital bedstead.

To provide a frame into line

Of all the dhoolies which have been described in this chapter the Bengal dhooley meets the eight requisites above named, taken as a whole, most fully; but in certain particulars, especially as to lightness and adaptability for package and stowage on board ship,

it offers much room for improvement. The alterations suggested by Inspector-General Taylor, C.B., already described, would obviate the latter defect, and, to a certain extent, it is believed, the former also, and they seem to be well worthy of practical trial. The plan advocated by Surgeon-Major Francis deserves also a full and complete trial.

SECTION IV.—ON SOME OTHER FORMS OF EASTERN CONVEYANCES.

Palkis.

The Palki.—The description previously given of the Madras dhooley answers very nearly for that of the ordinary palki, which is usually known among English persons by the name of *palanqueen*. Its general arrangement is the same, but its construction has a more solid and permanent character. The entrance is effected by a double wooden door in the side. Each panel of the door is made capable of sliding in a groove up to the end of the conveyance; thus affording a wider opening for getting in and out, at the same time that both panels are under the control of the person within the conveyance for aperture or closure. Palkis sometimes have panes of glass inserted in the end panels, and, being chiefly intended for civil life, are often fitted with drawers and other conveniences inside, and are highly ornamented.

Muncheels.

Muncheels.—These differ from dhoolies in being unprovided with a fixed framework above the cot. Instead, the cot is suspended by cords, chains, or other means of a flexible kind from a pole, over which a curtain is thrown and extended to the sides of the cot, so as to screen the person within from the glare of the sun, or from damp. The flexible nature of the ends by which the muncheel is carried renders the conveyance far more portable than any of the ordinary kinds of dhoolies, especially the Madras dhooley; and hence, on Madras troops being ordered to Burmah and other places requiring transport by water, the hospitals are usually supplied with conveyances of the muncheel kind for the service. The chief inconveniences connected with them is the absence of the fixed support for the pole. The result of this is that when the muncheel is placed on the ground the ends sink, and care has to be taken that both they and the pole are placed outside the cot part of the muncheel to prevent them from sinking and pressing upon the patient. When thus at rest, the patient is necessarily deprived of the protection of the cover and sides, which are of such great advantage in the several forms of dhoolies, especially at night, by rendering them competent to act as substitutes even for the shelter of a tent or hospital of a more permanent kind. At all times the curtains of the muncheel fall comparatively closely upon the patient who is carried in it, owing to the triangular form assumed by the pole and ends over which they are placed. The inconvenience here described is one which attaches to some of the models of suggested improvements for dhoolies in the Museum of Military Surgery at Netley, in which ends of pliable leather straps and other such materials have been proposed for use for the

Their construction.

Their defects.

CHAP. V.

purpose of giving to the conveyances greater facility of package. Muncheels are much employed by the natives in some parts of India, but seem to be ill suited for the military purposes of sick transport. They closely approach in their nature to conveyances of the hammock kind when carried from poles, the chief diistinction being only the more substantial cot possessed by the muncheel.

Ton-jons.

Ton-jons.—These closely resemble the muncheel class of conveyances, the only difference being that the person is carried in a sitting instead of a recumbent posture. They are never systematically used for military purposes, and in no respect require any particular remark.

Jhampans.

Jhampans.—These are conveyances which are seldom, if ever, met with in the plains of India. They are modes of transport ordinarily employed in the hill countries, and are specially contrived for the easy carriage of persons up the steep roads, as well as down the abrupt descents, which have to be traversed in travelling through mountainous districts. Dhoolies could not be employed under such circumstances, owing to the litter being suspended so far below the points of support. If carried up a mountain path in the usual way on the shoulders of the bearers, the inclination given to the part on which the patient is placed would be such as to cause considerable distress to him, while the greater part of the weight would be thrown upon the two bearers who happened to be at the end of lower level; and if, in order to preserve a horizontal position, ~~attempted~~ to be carried on the shoulders at one end but in the hands of the bearers at the other end, the feet of the dhooley in the latter direction would be brought into contact with the ground. The jhampans are so contrived that the part of the conveyance on which the person carried is reclining or sitting may be kept level without any part of it being brought into collision with the road, or with the detached pieces of rock which are usually scattered over its surface—for the beds of winter watercourses not unfrequently form the roads which are travelled over at other seasons in the hill countries—at the same time that the weight is evenly distributed between the front and rear bearers, whatever may be the inclination of the road over which they are travelling. These purposes are accomplished by having the poles or points of suspension placed nearly in the same plane with the part on which the person is supported, and by having the shoulder supports moveable. With this arrangement, when the inclination is great, the bearers at one end can lower the part of the jhampan which they are carrying to the degree which is necessary for keeping it level with the rest of the conveyance, and thus avoid any impediment to their progress, at the same time that the pole still maintains a position at right angles to the shoulders of the bearers. The native jhampan in ordinary use is not unlike an ordinary couch, and is provided with a cover and side curtains. The couch itself is secured between two side rails made of wood. These side pieces are connected at each end by strong cross-bands of leather, or flexible traverses, and in the middle of each band, at

Peculiar to hill countries.

Special design.

Their construction.

Ordinary form of jhampan in which the natives of India are carried.

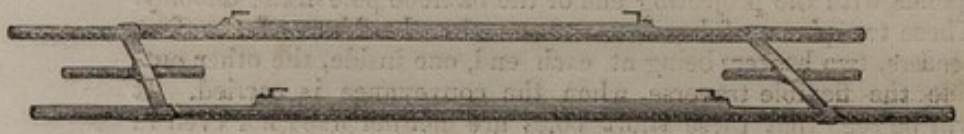
right angles to it, is secured a short piece of bamboo, which corresponds with the projecting end of the bamboo pole in the dhooley. These two pieces of bamboo rest on the shoulders of the four bearers, two bearers being at each end, one inside, the other outside the flexible traverse, when the conveyance is carried. It will be seen that these short poles are neither fixed nor even in contact with the body of the jhampan. They are only connected at the middle with the bands before mentioned, so that both their ends are left loose; and the partial freedom of motion which is thus left to them enables the level of either end of the conveyance to be altered according to circumstances with greater facility, without changing the relative position of the short poles to the men who are supporting them.

Surgeon Porter's dhooley adapted for carriage on the jampan system, to fit it for use in hilly districts.

It has been already mentioned that dhoolies constructed in the ordinary way are not suitable for use in mountainous districts, because, with a fixed pole, they cannot be kept in a horizontal position when the bearers are carrying them either up or down prolonged declivities, and because, from the mode of suspension, the cot part drops too near to the surface of the ground, so that patients transported by them would continually be subjected to much inconvenience. It has also been mentioned elsewhere that, instead of dhoolies, the Government of India issues the ordinary dandies for field service in the hills, and for the carriage of the sick to and from hill stations to which there is no access by made roads; but that these, being little better than hammocks, are ill suited for the conveyance of weak or badly injured men. Surgeon Porter, of the 97th regiment, has designed a conveyance with the view of affording sick and wounded patients all the advantages of a dhooley, and at the same time of removing all difficulties as to its carriage by the bearers. As will be seen by the sketches, it consists of a cot, with hood and cover, which is prepared for being hooked upon two long side poles. These poles are connected by cross straps at both ends, and each strap carries a short moveable yoke fixed to it midway between the two poles. The essential feature of the jhampan is thus adapted to the dhooley, and its carriage is effected in precisely the same manner as the carriage of a jhampan. Surgeon Porter claims for this form of conveyance advantages over all others that have been used for carrying patients in the hill districts of India: that the recumbent position can be maintained throughout the march: that on the line of march a patient need never be shifted: that the cot answers the purpose of a bed at night: and that a less number of natives is required for its carriage than for any other form of conveyance admitting of a recumbent position. There is no doubt that it possesses the qualities Surgeon Porter has ascribed to it.* The weight of Surgeon Porter's hill-dhooley is as follows:—Weight of dhooley without bedding, 50 lbs.; weight of poles and carrying straps, 56 lbs.; total, 106 lbs. It could probably be made lighter.

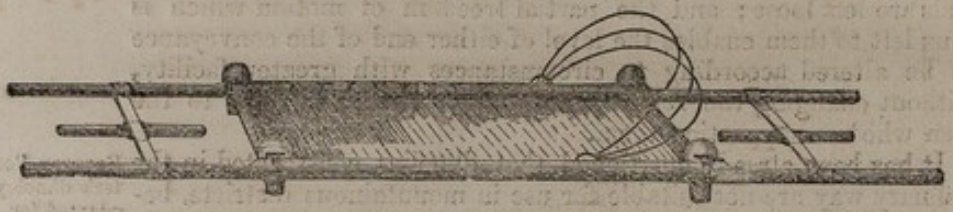
* A model of this conveyance is in the Mil. Surg. Museum at Netley, Spec. No. 1,245.

Fig. LXXI.—No. 1.



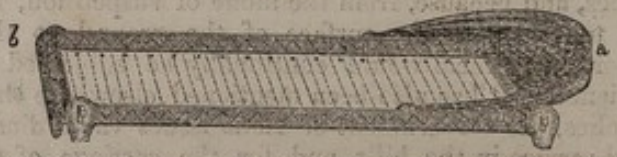
Jhampan frame of Surgeon Porter's Hill-dhooley.

No. 2.



Sketch showing the manner in which the Cot is hooked upon the Jhampan Frame.

No. 3.



Surgeon Porter's Hill-dhooley as a Hospital Cot, the Jhampan Frame being removed, the Hood *a* lowered, and the Cover *b* rolled at the Foot of the Cot.

Fig. LXXII.—No. 4.

Surgeon Porter's Hill-dhooley complete.

Use of the jhampan system in China.

A modification of the jhampan system is in use in China. When the Chinese palanqueen is carried by two bearers the side-poles are made to rest directly on their shoulders; when carried by four bearers the jhampan shoulder-pole is used, as shown in the illustration. But the shoulder-poles and side-poles are kept rather more distant from each other than they are in India; the latter are suspended from the former by cords of greater length and the conveyance is brought proportionally nearer to the ground. Ingress

Chinese Palanquin.

and egress from the carriage when it is laid down are facilitated by this arrangement, greater security is afforded during the progress of the bearers, and at the same time the conveyance is raised sufficiently high to be free from risk of striking against ordinary obstructions in the roads over which it has to pass.

Fig. LXXIII.—Chinese Palanqueen, carried Jhampan fashion.

Staff-Surgeon Guthrie's application of the jhampan system of carriage to stretchers.

Staff-Surgeon Guthrie, in 1863, when in medical charge of Lohoo-Ghàt station, applied to the ordinary field stretcher the same principles, and nearly the same mechanical arrangements as those already explained with regard to Surgeon Porter's hill-dhooley. The only difference was that, instead of having a detached frame, Surgeon Guthrie had the cross-straps and moveable yokes for the support of the stretcher attached to the side poles of the stretcher itself. The bearers, while supporting the yokes on their shoulders, were, therefore, placed, two between the rigid traverses of the stretcher and the leathern straps or flexible traverses, and two outside the latter. Dr. Guthrie sent a model of his jhampan stretcher to the Inspector-General's Office at Calcutta,* and at the same time mentioned that a party of invalids, several of whom were suffering from hepatic abscess, had been carried under his direction seven days' march, from Lohoo-ghàt to Nynee-tal, through a very broken and mountainous district, without difficulty in stretchers of the kind indicated, and with as little an amount of inconvenience as persons in their condition were capable of experiencing on such a journey. Dr. Guthrie's stretcher had no hood or cover, but they were stated not to be required on this occasion, it being the dry and cool season. They would obviously be required if patients had to be transported during the hot or rainy seasons. On comparing Surgeon Guthrie's mode of attaching the yoke-straps to the side-poles of the stretcher itself with Surgeon Porter's plan of attaching them to detached side-poles, it is obvious that although the inconvenience of a separate framework is got rid of, and the weight is lessened, the length of the cot or stretcher is unavoidably so much increased as to destroy its fitness for use as a bed at night in an hospital tent or ordinary hospital building. The opportunity of keeping a patient during his transport on the same cot, of using it as his carriage by day and his bed at night, is an advantage of great weight in favour of Surgeon Porter's hill-dhooley, an advantage which it has in common with the dhoolies used in the plains.

* This model is now in the Museum of Mil. Surg. at Netley, Spec. No. 1,242.

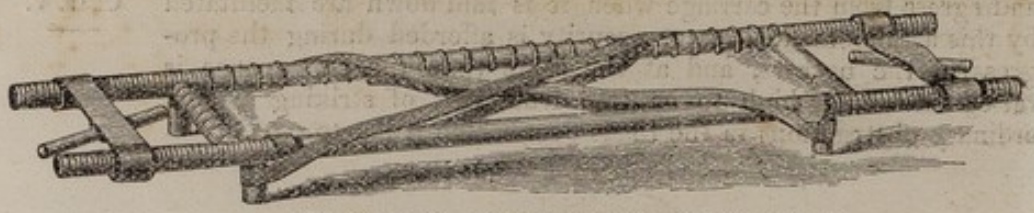


Fig. LXXIV.—Jhampan System applied to a Stretcher.

D.—Swinging Litters.

Introductory Remarks on Swinging Litters.

The fourth sub-division of the first class of conveyances, viz., Swinging Litters, remains to be noticed. The examples of this sub-division are comparatively limited in number, and the remarks upon them will be proportionately brief.

Essential principles of swinging litters.

Swinging Litters.—In the year 1805 Lieutenant-Colonel Crichton proposed the use of a litter for conveying sick and wounded troops resembling the conveyances previously described of this class in respect to the cot or horizontal part, and also in being provided with a complete frame, but differing widely in the mode of its suspension. This litter, the construction of which will presently be described in detail, will serve to illustrate the main principles of all such conveyances. Instead of being sustained by supports from a single pole, Colonel Crichton's litter was suspended by cords from a square elastic frame, so that it admitted of horizontal movement by swinging, and at the same time of a certain amount of vertical movement owing to the elasticity of the frame to which the ropes were attached. A form of stretcher reposing upon elastic bands and suspended from two poles, called a *sommier brancard*, and others swung within frames, have been manufactured in Germany, identical in principle, though differing in details, with the swinging litter just referred to.* These swinging litters essentially correspond in their nature with that of a slung cot on board ship.

Remarks by Sir G. Ballingall on Col. Crichton's litter.

Colonel Crichton's litter was used at the Royal Infirmary of Edinburgh, at Dundee, and in other parts of Scotland, but has never been employed on field service. Sir George Ballingall, referring to this conveyance, writes:—"I have upon two or three "occasions employed this litter in conveying patients to or from "the infirmary, and have reason to consider it a very comfortable "conveyance. It is, however, obviously the production of a man "who had the Edinburgh chairmen in his eye as bearers, and "from its cumbrous and unwieldy form it is quite unfit for the "service of the field."† There can be no doubt that this was a just verdict as regards its unfitness for the general purposes of field use. It does not appear, however, that Colonel Crichton

Col. Crichton's litters not designed as substitutes for field stretchers.

* Made by Frédéric Fischer and Co., Heidelberg, Baden.

† "Outlines of Military Surgery," 2nd edit., Edinburgh, 1838, p. 90. It is evident that this remark was not intended to imply that there was any peculiarity in the mode of carrying adopted by the Edinburgh chairmen, but sprung from the fact that, at the time Sir George Ballingall wrote, sedan chairs were still greatly in vogue in the Scotch capital, although they had been almost wholly displaced by wheeled conveyances in other parts of the kingdom.

ever intended his litters to act as substitutes for the ordinary field stretchers. He regarded them as means of conveying sick or wounded men only for short distances, but especially suited for being placed on the floor of an ordinary cart without springs, or baggage wagon. Two or three of the swinging cars could be placed in a wagon of ordinary size, and the vehicle would then proceed with its convoy of sick or wounded to their destination.

Their special design.

The contrivance was designed to prevent the jolting and shocks to which wounded men are so frequently subjected in campaigning by conveyance on ordinary carts without springs.* It was also intended to obviate the painful effects of taking the patients out of the carts, placing them on stretchers for carriage into the hospitals, and again removing them to put them in bed. By Colonel Crichton's plan, on the arrival of the cart at the hospital, the swinging litter was to be taken out, and, without disturbing the patient lying on it, was to be carried to the bedstead on which the patient was destined to lie. If the litter were not further required it could be simply unhooked at the foot and then at the head, the frame taken away, and the patient remain in it altogether undisturbed. These were the objects of this contrivance according to Colonel Crichton's published explanation, and he evidently did not contemplate their use, either as field stretchers, or when regular ambulance wagons fitted with springs were available.

Swinging litters applied to railway carriages.

Several examples of conveyances on similar principles, and not unlike Colonel Crichton's in form in one instance, were exhibited at Paris in 1867, for the carriage of patients on the floors of goods' wagons and trucks in common use on railways. This subject will be considered in the chapter on railway ambulance conveyances, but it will be convenient briefly to describe in this place the construction of the two particular swinging litters, the names of which have been already mentioned. Were it not for the prospect of some modification of this species of conveyance being hereafter employed on field service, the particular examples referred to might almost be dismissed without further remark, owing to their evident unfitness for use as ordinary conveyances for the transport of sick and wounded in campaigning.

DESCRIPTION OF PARTICULAR FORMS OF SWINGING LITTERS.

Construction of Col. Crichton's swinging-car.

Crichton's Swinging car.—Colonel Crichton's litter consisted of a horizontal lower frame made of ash or elm, seven feet long by five feet four inches broad, upon which were placed two strong pillars of wood supporting an upper frame. This frame was furnished with four handles. The pieces of the upper frame were made of ash, and the sides, being thick in the middle but tapering toward the ends, had a certain amount of elasticity

* It is a curious fact that at the Universal Exposition of Paris in 1867 the application of a system of suspension and elasticity to litters for carrying sick and wounded troops, more especially for the purpose of permitting them to be utilized with the carts, boats, or other ordinary means of transport of the country in which an army might be operating, was supposed to be entirely new, and great credit was given to the inventor of a litter constructed on these principles, for the *originality* of his idea. The merit of the inventor was not lessened by the fact of the idea having been developed so many years previously, as he was not, of course, aware of the existence of Col. Crichton's litter.

CHAP. V.

imparted to them. Connected with the cross pieces of the upper frame were four iron hooks from which the cot, in which the patient had to lie, was suspended. The cot consisted of sacking attached to a light wooden frame, opened out by being stretched upon five cross-bars of wood, and was somewhat less in length as well as width than the frame just described. Ropes* were attached to the ends of the cot of a convenient length for connecting them with the hooks on the upper portion of the outer frame. The whole machine was protected from rain by a cover supported on four hoops, which were fixed to the upper part of the frame. The elasticity of the frame was brought into action by the weight of the patient directly he was placed in the canvas cot, and this elasticity, combined with the swinging of the litter under the movements of the bearers in carrying it, prevented any concussions that might accidentally occur, from doing harm to the patient lying inside.

Directions for the mode of using this litter.

The directions given by Colonel Crichton for placing a sick or wounded person in the conveyance were the following:—The cot part was to be first laid on the ground by itself, and then the sick or wounded person to be lifted into it. As soon as the patient was settled, the frame was to be lifted over the cot, the ropes of the latter were to be hooked up, and then the frame, with its suspended litter, was ready to be carried away by two or four bearers to a cart or baggage wagon for removal. If more convenient, two hammocks for two patients might be substituted for the single cot within the frame.

The following sketch, which is copied from Colonel Crichton's description of his contrivance in the Edinburgh Medical Journal, will explain at a glance the manner in which the communication of sudden shocks or jolting to the patient were sought to be avoided by the swinging and elastic connexions above referred to.

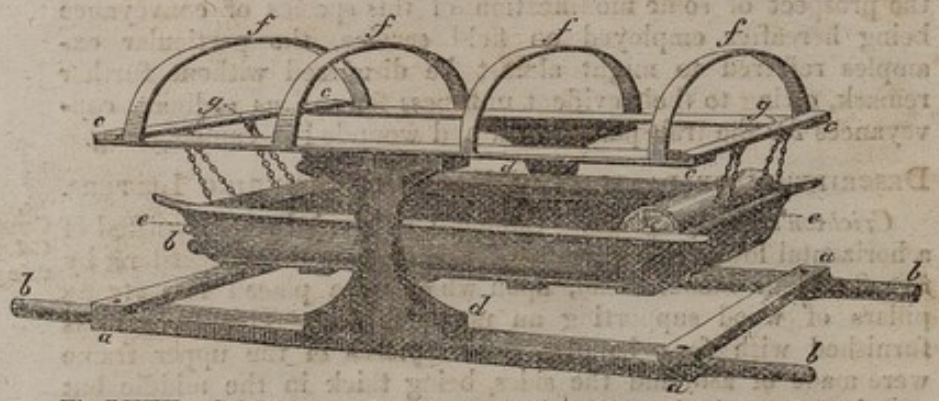


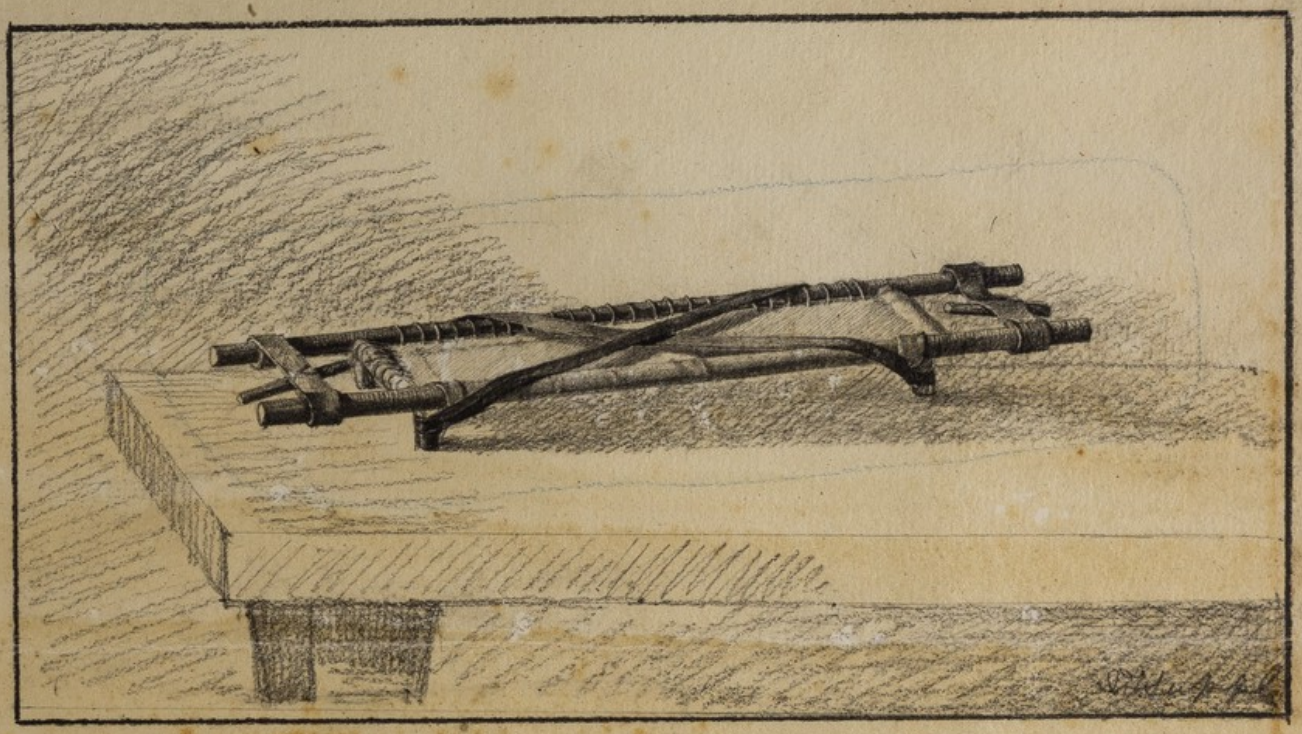
Fig. LXXV.—Col. Crichton's Swinging Car. *a a a.* Lower frame. *b b b b.* Handles. *c c c c.* Upper elastic frame. *d d.* Pillars supporting the upper frame. *e e.* The cot. *g g.* Four iron hooks from which the cot is suspended. *f f f f.* Four hoops for supporting a cover.

Sommier-brancard.

Sommier-brancard.—This conveyance consists simply, as shown in the following sketch, of a stretcher suspended by elastic bands

* The ropes here mentioned have been represented as chains in the drawing of Col. Crichton's swinging car. The fore-shortening causes also an inadequate idea of the length of the conveyance to be given, but the measurements are stated in the text.

A JAPANESE LITTER.



Tanspan system applied to a stretcher.

from two poles. The stretcher is fitted with a support for the head, which can be raised or lowered at pleasure, but this is no essential part of the conveyance. The peculiar qualities of this form of stretcher depend upon, firstly, its swinging horizontally from two independent poles, instead of being carried directly by its own side poles; and, secondly, upon its being endowed with considerable capacity of yielding with facility to pressure made in a vertical direction, owing partly to the elastic qualities of the bands within which the stretcher is sustained, and partly to the elasticity of the poles to which the ends of the bands are fixed. Under these circumstances it is obvious that neither the ordinary movements of the bearers, nor the accident of an awkward step or stumble on the part of any one of them, would be likely to communicate an abrupt shock to the patient, but that the recoil would be evenly distributed and gradually dissipated over the whole conveyance. A cover thrown over the two poles serves to protect the patient from inclement weather. Such a conveyance could only be carried by being supported on the shoulders of the bearers without striking the ground, and so far it more nearly approaches the character of a dhooley or jhampan than the swinging conveyance of Colonel Crichton last described.

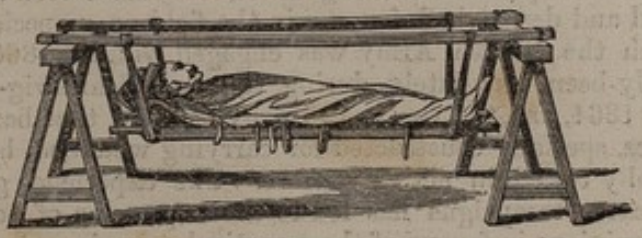


Fig. LXXVI.–The Sommier-brancard or swinging stretcher. The stretcher is suspended by elastic bands from two poles.

Stretchers slung within carts and wagons.

Swinging litters are sometimes suspended from the roofs of carts and wagons. One of the forms of carts which accompanied the troops for service in the early part of the Crimean war, viz., that designed by the late Mr. Guthrie, had a stretcher within the cart slung from the top. It was intended for a severely wounded man. As the cart itself was supported on strong springs, and horizontal movement was permitted to the suspended stretcher itself, it is obvious that to a certain extent it possessed the qualities of the sommier-brancard just described, although deriving its quality of springiness from different mechanical adaptations. Having only two fixed points of support, however, this stretcher more closely resembled an ordinary swinging cot on board ship, or one of the muncheel order of conveyances already described. Swinging litters have been on several occasions applied to the interior of ambulance carts and wagons, but they have never yet met with success. The motion has been objectionable as regards the patient supported, and the position of the weight has tended to throw the centre of gravity beyond the limits of the wheels when the vehicle has had to pass over uneven roads. Their employment is still advocated, however, by some inventors.

Carrying the Sick in Japan.

Conveyances

NAME	Troop or Company	Da of Cri	KS

CHAP. V.

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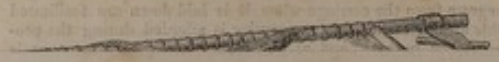
Fig. LXXI.—No. 1.



CHAP. V.

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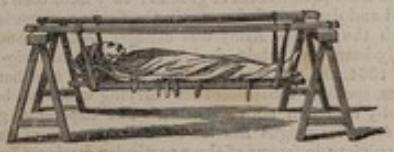
Directions for the mode of using this litter.

The directions given by Colonel Crichton for placing a sick or wounded person in the conveyance were the following:—The cot

Borne by Men.

Punish-ment	By whom Ordered	REMARKS

from two poles. The stretcher is fitted with a support for the head, which can be raised or lowered at pleasure, but this is no essential part of the conveyance. The peculiar qualities of this form of stretcher depend upon, firstly, its swinging horizontally from two independent poles, instead of being carried directly by its own side poles; and, secondly, upon its being endowed with considerable capacity of yielding with facility to pressure made in a vertical direction, owing partly to the elastic qualities of the bands within which the stretcher is sustained, and partly to the elasticity of the poles to which the ends of the bands are fixed. Under these circumstances it is obvious that neither the ordinary movements of the bearers, nor the accident of an awkward step or stumble on the part of any one of them, would be likely to communicate an abrupt shock to the patient, but that the recoil would be evenly distributed and gradually dissipated over the whole conveyance. A cover thrown over the two poles serves to protect the patient from inclement weather. Such a conveyance could only be carried by being supported on the shoulders of the bearers without striking the ground, and so far it more nearly approaches the character of a dhooley or jhampan than the swinging conveyance of Colonel Crichton last described.



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Stretcher slung within carts and wagons.

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Carrying the Sick in Japan.

Conveyances

NAME	Troop or Company	Date of Crime	Crime	By whom Reported	Punish-ment	By whom Ordered	REMARKS

A Number of Blank Pages Follow, which have not been Photographed.

Borne by Men.

NAME	Troop or Company	Date of Crime	Crime	By whom Reported	Punish-ment	By whom Ordered	REMARKS

CLASS II.—CONVEYANCES WHEELED BY MEN.*

General Observations.

Chap. V.

Conveyances intended to be wheeled by men, known under the name of wheeled stretchers, wheel-barrows, or hand-wheel litters, form a class of conveyances which has seldom been had recourse to for the systematic removal of sick and wounded of armies in time of war. The advantages of wheeled carriages moved by hand-labour for field service have not unfrequently been discussed of late years, but they have been very differently estimated; by some they have been condemned as fanciful and unpractical, while by others they have been strongly advocated as a serviceable and economical form of sick transport. These opinions have, however, been put forward without much experience of their qualities or suitableness for use in campaigning. Vehicles of this kind have been used from time to time under casual circumstances where other transport was not available, or where they formed an ordinary method of carriage of the country, owing to local peculiarities of ground; they have been even constructed and despatched for use in the field on a special service in which the British Army was engaged, viz, in 1860; but it has only been very lately, during the late Schleswig-Holstein war of 1864, and the war in Germany of 1866, that hand-wheel carriages, specially constructed for carrying wounded, have been practically tested in active warfare. The experience gained in these latter campaigns has led to the expression of some very strong opinions in favour of these particular carriages by eminent surgeons, who regard their introduction as likely to form a new era in the arrangements of ambulance transport.

Wheeled stretchers only recently introduced.

Objects aimed at by their use.

The principal objects intended to be obtained by the construction of these hand-wheel litters are:—First, a more rapid removal of the wounded from the scene of conflict to the rear than can be obtained by the use of ordinary stretchers; second, to compensate for the deficiency in the number of bearers usually available for transporting the wounded by lessening the fatiguing nature of the work; and third, to avoid the necessity for increasing the number of animals employed in bearing cacolets and litières, in armies where these form part of the matériel used for the transport service of the field hospitals. They are not usually advocated for adoption with the view of using them as substitutes for primary stretchers, but rather as auxiliaries to them. Neither are they designed to take the place of ambulance carts or wagons on long journeys, as in transporting wounded from the field hospitals to general hospitals at a distance in rear, although they can be employed to supplement these more bulky and sub-

* The remarks on some of the conveyances of this class have been previously published by me among the Army Medical Reports.

Wheeled by Men.

By whom Ordered	REMARKS

Ordnance ambulance barrows.—In October 1856 two forms of ambulance barrows, one barrow having only one wheel, the other being two-wheeled, were sent from the War Department for examination and report by a Committee of Military Medical

CHAP. V. — Ordnance ambulance barrows.

for carrying provisions and merchandise. Every private person had several of these vehicles. All the road from Bautzen to

CHAP. V.

stantial conveyances when necessary; but they are recommended in preference to other conveyances for travelling over the space comprehended between the immediate rear of the spot where the fighting is in progress, or first line of surgical aid, and the second line; or between the field of battle itself after an action is over, when the surface is favourable for the movement of such vehicles, and the first and second lines of surgical assistance. It is also believed that, when an engagement takes place at no great distance from a railway, wheeled stretchers form the most easy and expeditious means of transferring the wounded, after their wounds have been dressed, to the trains for further removal to the rear.

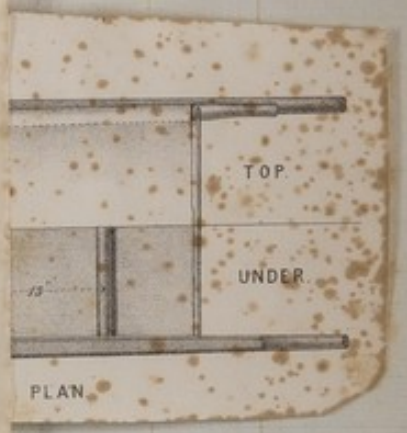
CHAP. V.

The first object, rapidity of removal, is gained by the use of wheels, generally high wheels, by means of which the conveyance can be caused, at the cost of slight expenditure of labour, to pass speedily over rough fields as well as over regular roads; at the same time that the whole litter is made so light that if great obstructions are met with, such as interfere with the employment of the wheels, it can then be readily carried by a couple of bearers over them.

Rapid removal of wounded.

The second object is also gained by the wheeled construction of the litter. Experience has always shown, in cases of engagements attended with many wounded, that the number of bearers falls far short of the number required for the regular and rapid removal of the sufferers. This deficiency is made the more manifest by the length of time occupied by the bearers in the removal of a single man on a stretcher, if the distance from the first to the second line of surgical assistance be considerable. Under these circumstances the two bearers, especially if the wounded soldier whom they are carrying is heavy, have either to halt and deposit the stretcher on the ground while they temporarily rest themselves, or have to be relieved for a certain distance by two other bearers. The fatigue of the usual limited number of bearers is also increased by the continuous nature of their work; by repeated journeys for transporting the wounded between the field and the field dressing stations without intermission, since so long as any wounded remain on the ground they cannot be allowed to stop from their duties for repose. The plan of the hand-wheel litter obviates in a great degree these sources of fatigue, by the weight of the conveyance being transmitted through the medium of the wheels to the surface of the ground instead of through the medium of the bearers; and, at the same time, by the circumstance that the slight effort which is required to set it in motion on ordinary ground can be varied, either by the act of pushing or by that of drawing the machine. One attendant is sufficient for the transportation of a patient lying on a well-made wheeled litter if the ground be favourable; and the rapidity with which it can be made to perform the transport from the dressing-station, or from the field of action itself, to the ambulance is still further calculated to lessen the evils arising from a deficiency in the number of hospital bearers, by the quickness of its return for the removal of other wounded who are requiring

To meet the want of bearers.



labour in either case. Any conveyance in which the patients can

CLASS II.—CONVEYANCES WHEELED BY MEN.*

General Observations.

Chap. V.

Conveyances intended to be wheeled by men, known under the name of wheeled stretchers, wheel-barrows, or hand-wheel litters, form a class of conveyances which has seldom been had recourse to for the systematic removal of sick and wounded of armies in time of war. The advantages of wheeled carriages moved by hand-labour for field service have not unfrequently been discussed of late years, but they have been very differently estimated; by some they have been condemned as fanciful and unpractical, while by others they have been strongly advocated as a serviceable and economical form of sick transport. These opinions have, however, been put forward without much experience of their qualities or suitableness for use in campaigning. Vehicles of this kind have been used from time to time under casual circumstances where other transport was not available, or where they formed an ordinary method of carriage of the country, owing to local peculiarities of ground; they have been even constructed and despatched for use in the field on a special service in which the British Army was engaged, viz, in 1860; but it has only been very lately, during the late Schleswig-Holstein war of 1864, and the war in Germany of 1866, that hand-wheel carriages, specially constructed for carrying wounded, have been practically tested in active warfare. The experience gained in these latter campaigns has led to the expression of some very strong opinions in favour of these particular carriages by eminent surgeons, who regard their introduction as likely to form a new era in the arrangements of ambulance transport.

Wheeled stretchers only recently introduced.

Objects aimed at by their use.

The principal objects intended to be obtained by the construction of these hand-wheel litters are:—First, a more rapid removal of the wounded from the scene of conflict to the rear than can be obtained by the use of ordinary stretchers; second, to compensate for the deficiency in the number of bearers usually available for transporting the wounded by lessening the fatiguing nature of the work; and third, to avoid the necessity for increasing the number of animals employed in bearing cacolets and litières, in armies where these form part of the matériel used for the transport service of the field hospitals. They are not usually advocated for adoption with the view of using them as substitutes for primary stretchers, but rather as auxiliaries to them. Neither are they designed to take the place of ambulance carts or wagons on long journeys, as in transporting wounded from the field hospitals to general hospitals at a distance in rear, although they can be employed to supplement these more bulky and sub-

* The remarks on some of the conveyances of this class have been previously published by me among the Army Medical Reports.

stantial conveyances when necessary; but they are recommended in preference to other conveyances for travelling over the space comprehended between the immediate rear of the spot where the fighting is in progress, or first line of surgical aid, and the second line; or between the field of battle itself after an action is over, when the surface is favourable for the movement of such vehicles, and the first and second lines of surgical assistance. It is also believed that, when an engagement takes place at no great distance from a railway, wheeled stretchers form the most easy and expeditious means of transferring the wounded, after their wounds have been dressed, to the trains for further removal to the rear.

Rapid removal of wounded.

The first object, rapidity of removal, is gained by the use of wheels, generally high wheels, by means of which the conveyance can be caused, at the cost of slight expenditure of labour, to pass speedily over rough fields as well as over regular roads; at the same time that the whole litter is made so light that if great obstructions are met with, such as interfere with the employment of the wheels, it can then be readily carried by a couple of bearers over them.

To meet the want of bearers.

The second object is also gained by the wheeled construction of the litter. Experience has always shown, in cases of engagements attended with many wounded, that the number of bearers falls far short of the number required for the regular and rapid removal of the sufferers. This deficiency is made the more manifest by the length of time occupied by the bearers in the removal of a single man on a stretcher, if the distance from the first to the second line of surgical assistance be considerable. Under these circumstances the two bearers, especially if the wounded soldier whom they are carrying is heavy, have either to halt and deposit the stretcher on the ground while they temporarily rest themselves, or have to be relieved for a certain distance by two other bearers. The fatigue of the usual limited number of bearers is also increased by the continuous nature of their work; by repeated journeys for transporting the wounded between the field and the field dressing stations without intermission, since so long as any wounded remain on the ground they cannot be allowed to stop from their duties for repose. The plan of the hand-wheel litter obviates in a great degree these sources of fatigue, by the weight of the conveyance being transmitted through the medium of the wheels to the surface of the ground instead of through the medium of the bearers; and, at the same time, by the circumstance that the slight effort which is required to set it in motion on ordinary ground can be varied, either by the act of pushing or by that of drawing the machine. One attendant is sufficient for the transportation of a patient lying on a well-made wheeled litter if the ground be favourable; and the rapidity with which it can be made to perform the transport from the dressing-station, or from the field of action itself, to the ambulance is still further calculated to lessen the evils arising from a deficiency in the number of hospital bearers, by the quickness of its return for the removal of other wounded who are requiring

assistance. It has been calculated that one bearer with a wheeled stretcher can do as much work as four bearers with ordinary stretchers in a given time, thus effecting an economy of seventy-five per cent. in attendants.

To act as substitutes for mule transport.

The third object is also important. The disadvantages attending the collection of a large number of transport animals are sufficiently obvious, not only as regards their first cost, the rations consumed by them, and the attendants required for their constant care, but also on account of the unhygienic conditions which they tend to promote when they are placed among bodies of troops. If, therefore, a litter can be fashioned calculated to lessen the necessity for employing a large number of transport animals, and there be no important objections to it in other respects, an undoubted improvement will be effected in the system of ambulance transport. Two bearers with two wheeled stretchers are able to do the work of a mule and its conductor with a pair of litters, with more ease and safety to the patients and with more speed. Neither wheeled litters nor conveyances borne by animals are suitable means for being brought among the ranks of fighting men while an action is going on; under such circumstances they can only be brought to convenient places in the neighbourhood, and from thence assist in the removal of the wounded. The two classes of conveyance are so far analogous. They can each also be employed in clearing a field of action after the fighting is over, and can each travel over farther distances than bearers could march with wounded men, due regard being given to efficiency and economy. The essential difference in quality between them is that the application of wheels to litters limits to a certain extent the kind of ground on which they can be employed, whereas the use of mule litters is not subjected to such restrictions. Mules are capable of service in rugged and mountainous places where no wheeled conveyances could be used.

SECTION I.—DESCRIPTION OF PARTICULAR FORMS OF HAND-WHEEL LITTERS.

Before describing the particular hand-wheel litters used during recent campaigns on the Continent, it will be useful to refer to the several examples of this class of conveyances which have either been used or proposed for use at previous periods. I will refer to them in the order in which they have been successively brought to notice.

Bautzen wheel-barrows.

Bautzen wheel-barrows (*brouettes*).—Baron Larrey mentions in his account of the Russian campaign,* that after the battle of Bautzen, in Saxony, which was fought in the summer of 1813, two-thirds of the wounded were transported to Dresden by the inhabitants, at his suggestion and advice, in a very convenient kind of wheel-barrow which was in general use in that country

* Mémoires de Chirurgie Militaire et Campagnes du Baron D. J. Larrey, Paris, 1817, tom. iv. p. 168.

for carrying provisions and merchandise. Every private person had several of these vehicles. All the road from Bautzen to Dresden, distant about thirty miles, had more or less inclination, so that the movement of these barrows met with no obstacle in the way. Baron Larrey relates that he had seen as many as one hundred and fifty filing along the road, one after another; and that, from observation of them, he was convinced no kind of transport could be more favourable or more expeditious for the country. I am informed that these barrows, which are in general use in the south of Germany, are usually so curved and inclined that a person lying upon one of them would find his position very much more easy than he would upon another of which the floor is straight, such as the floor of an English wheel-barrow, which requires to be tilted up considerably when put in motion. They are lower, and are also much longer than these latter barrows, being readily able to sustain a person lying at full length, with the head and shoulders slightly raised. There is only one wheel, but this is broad, and from the general width and construction of the barrow, together with the aid of two short supports near the fore part of the conveyance, they are with difficulty overturned. It is, moreover, a light vehicle, and is not fitted with sides above the shafts, so that wounded or weak persons can be readily laid upon or removed from it. It is frequently in use in this part of Germany for the removal of persons who have met with accidents in civil life.

Evans' hand-wheel litter.

[illegible] *litter.*—During the period of the Crimean [illegible] in London, Mr. G. [illegible] he had

CHAP. V.

Alleged advantages of Evans' hand-wheel litter.

dages, sponges, set of metal splints, paddings and tapes, a hand lantern, can of oil and cotton, &c., and lucifer matches. In addition one or more pairs of crutches can be slung underneath the litter.

(*e.*) The litter can also be used in the field as an operating table; and the chair, removed from the litter, can be used for operations in the upper extremities.

(*f.*) After the wounded are removed these litters can be usefully employed in collecting muskets, accoutrements, &c. scattered about the field.

(*g.*) The wheels being removed, this litter forms an excellent bedstead for the hospital; where the chair will be scarcely less useful to the wounded.

(*h.*) Any number of them attached to a regiment can be made most useful, when not needed for field or hospital purposes, in removing provisions, stores, clean or foul linen, from one point to another.

(*i.*) The litter can be made with shafts sufficiently long to admit of a mule drawing it, either with wounded on it or loaded with five or six cwt. of stores; or so loaded it can be attached to the rear of a baggage wagon on a line of march.

(*k.*) Though weighing, with its wheels and springs, only about 80 lbs., this litter is nevertheless remarkably strong in its construction; and by simply unscrewing the springs and wheels it becomes capable of easy and close stowage on board ship, and is as promptly put together again immedi[illegible]

Evans' litter not approved on examination.

In April 1855 [illegible] Board [illegible]

Ordnance ambulance barrows.

Ordnance ambulance barrows.—In October 1856 two forms of ambulance barrows, one barrow having only one wheel, the other being two-wheeled, were sent from the War Department for examination and report by a Committee of Military Medical Officers. I have not met with an account of the particular construction of these barrows, but neither of them were approved of for field purposes. The special reasons for which the conveyances were condemned by the Committee are not stated in their proceedings, but the general principles of all such conveyances were disapproved of by these officers, so that they were induced to remark that "no hand carriage with wheels is adapted to field service."

Ambulance wheelbarrows sent to China in 1860.

China ambulance barrows.—In the year 1860 a considerable number of ambulance barrows with two wheels were despatched from this country to assist in meeting the requirements of the British forces then assembling in China. These conveyances have been since generally spoken of as "China barrows." When, in consequence of the disastrous affair which occurred at the mouth of the Peiho river in the summer of 1859, it was determined to force a way to Pekin, it was found that the nature of the country, and the means of transport that could be obtained on the route from the place of landing to the Chinese capital, could not be ascertained with any degree of certainty. The immense distance of the scene of hostilities from England precluded many arrangements being made which might otherwise have been resorted to. The state of the roads that would have to be travelled over was unknown, and it seemed not impossible that all the ordinary transport animals of the country would be removed by the Chinese. It was determined, therefore, to send means of sick-carriage adapted for meeting every kind of emergency. Improved ambulance carts, as well as litières and cacolets, were provided in case horse or mule labour might prove to be available; in addition to the ordinary stretchers, dhoolies were sent on from India for native bearers; and the barrow which is now under consideration was also forwarded, under the idea that it might be advantageously employed, both for commissariat and sick-transport purposes, with the aid of Chinese labourers collected in the [illegible] The extensive and easy means of [illegible] almost up to [illegible] eyances, [illegible] from [illegible]

Origin of these conveyances.

CHAP. V.

Adaptation of the China barrow for carriage of a patient.

is first taken out, and the two sides, which are hinged, and of a height exactly to meet each other when lowered, are then made to fold down on the body of the cart. The hind board is next laid across in front and secured. Two iron uprights, each fitted at its upper extremity with a strong india-rubber spring and broad hook, are now inserted in iron collars, one at each side near the hind part of the body of the cart. The hooks connected with the springs are for the purpose of receiving and supporting the ends of the two poles of a regulation stretcher; the other ends of the poles of the stretcher are supported by two iron crutches which are made to screw into the shafts of the cart near their handles. If a bearer now places himself between the shafts he can lay hold both of the shafts and of the ends of the stretcher poles; and when the shafts are raised to a convenient height for the man to draw the cart the stretcher is brought into a horizontal position clear of contact with the wheels, or any other part of the barrow (*see* Fig. No. 4). The stretcher could be used without the sides of the barrow being turned down, but by no means so conveniently, because when they are left upright the poles of the stretcher are brought into contact with them owing to the movements of the vehicle.

79/ 2.

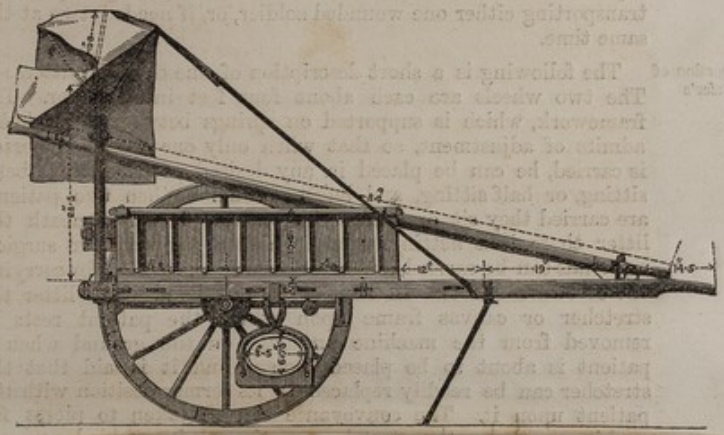
The transport is rendered easy to the patient by the action of the springs which assist in supporting the stretcher upon which he is lying. Ropes are supplied with means of hooking them to projections from the axles, for attaching an additional bearer to add to the traction if necessary, as in ascending a steep slope. A keg for water is suspended from the under part of the barrow. A hood for protecting a patient against the effects of sun and rain is also supplied with it.

A pattern of the China barrow, complete for ambulance purposes, including the stretcher, has been carefully weighed at Netley.* The weight was found to be 234 lbs. 9 oz. The conveyance was never therefore intended to be itself carried by hand, any more than the other patterns were which have been previously described.

AMBULANCE BARROW.

(China Pattern.)

Fig. 1. Ambulance Barrow (China pattern), with the Stretcher ready for carrying a Patient, but without the Hood.



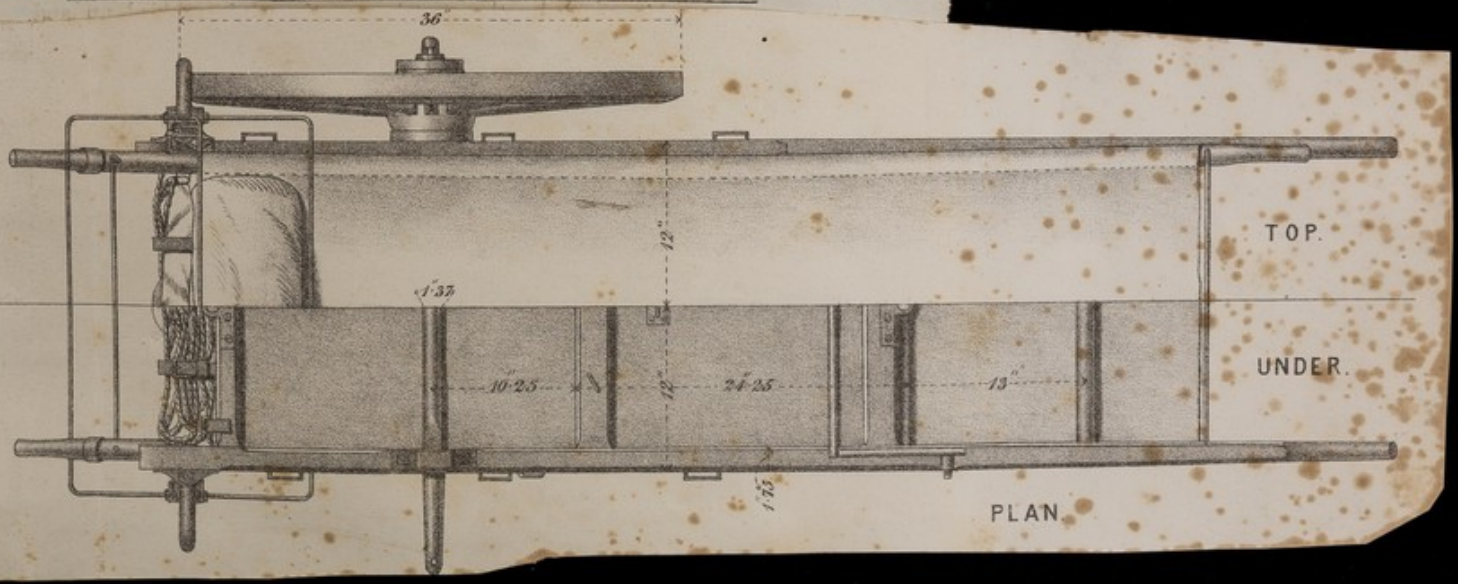


Fig. 8 . A

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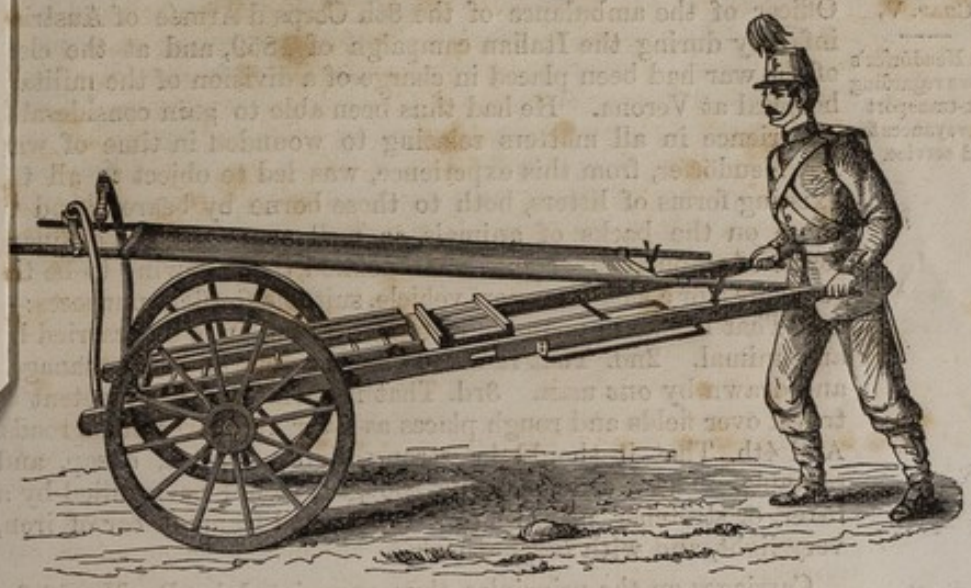

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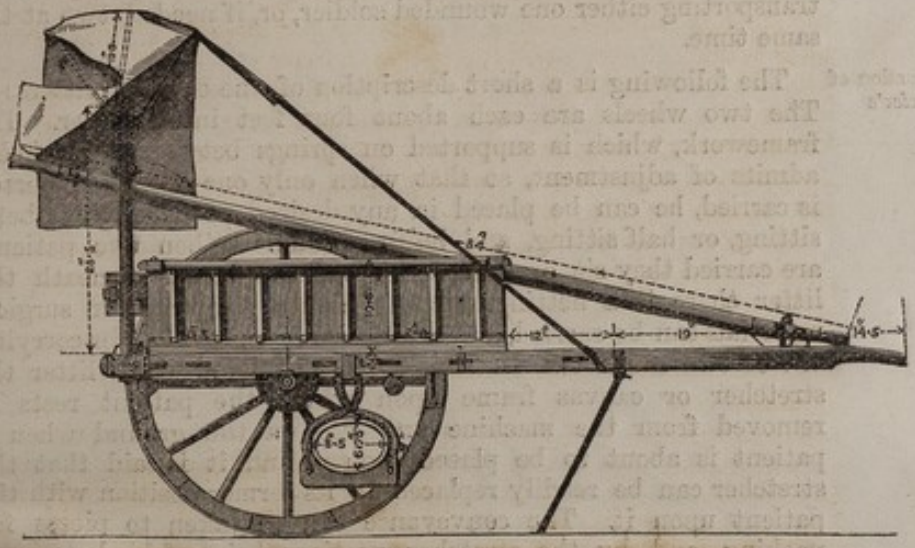

Fig. 1. Side Elevation of Ambulance Barrow (China pattern), with Measurements.

Neudörfer's Hand-wheel Litter.—Early in the year 1864, the war with Denmark commenced, Dr. J. Neudörfer, an ian military surgeon, and Professor of Surgery in the rsity of Prague, published the first part of a handbook on y surgery.* Dr. Neudörfer had acted as Principal Medical

Neudörfer's hand-wheel litter.

* andbuch der Kriegs-Chirurgie, ein Vade-Mecum für Feldärzte, nach eigenen gen bearbeitet," von Dr. J. Neudörfer, etc., etc., Erste Hälfte. Leipzig,

CHAP. V.

Dr. Neudörfer's views regarding sick-transport conveyances for field service.

Officer of the ambulance of the 8th Corps d'Armée of Austrian infantry during the Italian campaign of 1859, and at the close of the war had been placed in charge of a division of the military hospital at Verona. He had thus been able to gain considerable experience in all matters relating to wounded in time of war. Dr. Neudörfer, from this experience, was led to object to all the existing forms of litters, both to those borne by bearers, and to those on the backs of animals, as well as to all the ordinary forms of ambulance wagons. He defined the following to be the requisites for a sick-transport vehicle, suitable for field purposes:—1st. That it should not require to be drawn, or to be carried by any animal. 2nd. That it should be capable of being managed and drawn by *one* man. 3rd. That it should be as competent to travel over fields and rough places as over regularly made roads. And 4th. That it should be strong, light, durable, cheap, and portable. These conditions, he thought, would be fulfilled by a litter, or stretcher, placed on a two-wheeled frame or car of iron, very light, and with *large* wheels.

Carriages on the principles thus enunciated by Dr. Neudörfer were constructed by Messrs. Fischer of Heidelberg. These conveyances were made with a view to their being capable of transporting either one wounded soldier, or, if needed, two at the same time.

Construction of Neudörfer's litters.

The following is a short description of one of these litters:—The two wheels are each about four feet in diameter. The framework, which is supported on springs between the wheels, admits of adjustment, so that when only one wounded person is carried, he can be placed in any desired position, recumbent, sitting, or half sitting, and half reclining. When two patients are carried they sit or half recline back to back. Beneath the litter there is a netting, within which a knapsack or surgical materials can be carried, and means are also provided for carrying one or two muskets. In Dr. Neudörfer's hand-wheel litter the stretcher or canvas frame upon which the patient rests is removed from the machine and laid on the ground when a patient is about to be placed upon it, and it is said that the stretcher can be readily replaced in its former position with the patient upon it. The conveyance can be taken to pieces for packing, and by the stretcher portions being folded up and placed between the two wheels, which are then brought near to each other, the whole machine can be reduced to occupy a space having its sides equal in length to the circumference of the wheels by seven inches in width. I am not aware that any conveyances made precisely in accordance with the description above given have been actually used in military service.

81/ 82/ The illustrations numbered ^ and ^ have been copied from photographs furnished by ~~Messrs. Fischer~~ of some of these carriages which they have manufactured in accordance with Dr. Neudörfer's designs.

Fig. 1.—Neudörfer's Two-wheeled Litter, for the transport of one, or two, wounded soldiers.

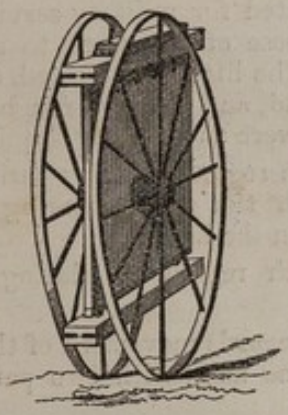

Fig. 1.—Neudörfer's Litter folded up and packed for carriage.

Pirogoff's two-wheeled hand-litter.—This litter on two high wheels, after the design of Dr. N. Pirogoff was, like the former, manufactured by Messrs. Fischer and Co. of Heidelberg. Its advantages are stated to be that a single bearer can easily transport two patients by its means, even along narrow paths, and that the litter can be taken in pieces for package. Pirogoff's wheeled litter.

Pirogoff's litter so very closely resembles Neudörfer's litter in design and appearance, and in the manner in which its parts when taken asunder are placed for package, that the illustrations of the one will equally serve to give a general idea of the other. The chief difference is that Pirogoff's litter has no springs, but the two folding stretchers are suspended by means of short straps

CHAP. V.

with iron hooks and eyes from the inner surfaces of the two side poles. The stretchers are therefore within certain limits moveable, and are lower, especially the one near the bearer, than they are in Neudörfer's, in fact, both patients when placed on the stretchers are slung within and between the side poles of the litter.

Pirogoff's litter when dismounted consists of 12 detached parts, viz., (*a*) two wheels and two screw caps; (*b*) two jointed shafts; (*c*) one axletree; (*d*) two folding stretchers; (*e*) one hood; (*f*) one iron screw bolt and turn screw combined; and (*g*) one canvas-bearing seat. When placed together for package they occupy a circular space nearly four feet in diameter, corresponding with that of the wheels, and about one foot in depth, and the appearance is very similar to that of Neudörfer's when packed. (See illustration, No. 24.)

Trials of Pirogoff's litter at Netley.

The nature, construction, and dimensions of these several parts may be found fully described in the sixth volume of the Army Medical Reports, and there seems to be no advantage in repeating them here. But as very careful trials were made with Pirogoff's litter at Netley, and as several of the results of these trials will probably be found equally applicable to all litters similarly designed to carry two patients and to be wheeled by one bearer, rendering them unsuited for military service, it will obviously be useful for the purpose of this work to mention these experiments rather fully. The litter was tested on paved ground, on newly gravelled ground, and on very rough and uneven ground. The following points were particularly inquired into:—

1. Convenience with regard to lifting patients from the ground and carrying them on the canvas-bearing seat preparatory to their being placed upon the litter.

2. Convenience with regard to placing patients upon the folding stretchers.

3. Convenience as regards movement of the carriage, either by draft or pushing, by one man, with two patients reclining upon the litter.

4. Convenience as regards movement by one man when only one patient is carried.

5. Convenience as regards movement of the carriage by two men when two patients are carried.

6. Effects as regards concussion of the patients from the substitution of the system of slinging the folding litters instead of placing them on springs.

7. Amount of protection afforded by the hood.

Results of the trials at Netley.

The following were the results of the inquiries above mentioned:—

1. The bearing seat, simple as it is, was found to answer its purpose exceedingly well. There was no difficulty in slipping it under a man lying or sitting on the ground, and when once

slipped beneath him, the man was easily raised into a sitting position, and so carried by two bearers.*

2. Although the practicability of placing the patients from the bearing seats upon the folding stretchers was established, at the same time it was apparent that care and practice were required to accomplish this with ease and celerity.

Owing to the suspension of the stretchers within and below the level of the shafts, it was found advisable, with regard to the foremost stretcher, to open the cross-piece in front of it, in order that the patient might be carried between the shafts and lowered down upon the folding stretcher. This plan obviated the necessity of lifting him over the shafts for the purpose of placing him on the stretcher, a proceeding which on trial was found extremely troublesome and inconvenient.†

With reference to the rear stretcher, no cross-piece being attached to it, and the shafts being shorter than the stretcher itself, no inconvenience was experienced in placing the patient on it.

As there are no upright supports or other means of sustaining the shafts in a horizontal position, the necessity arises for their being securely held by a third attendant, while the two bearers are engaged in placing a patient on one of the litters. Likewise, if the same two bearers who brought the first patient have to return to fetch the second patient, the carriage must equally be held in the interval in a horizontal position by a third attendant.

The bearing seat on which the patient has been carried remains under him after he has been placed on the folding stretcher; it is, therefore, available for lifting him again off the carriage, and the two bearing seats will accordingly never be completely separated from the carriage to which they belong.

3. Two patients having been placed into the litter to be conveyed, either by draught or pushing by one man, it was found that—

(*a.*) There was no difficulty in wheeling the carriage along on a pavement;

(*b.*) On a newly gravelled road, although on a level, it was very difficult to move the carriage, either by drawing or pushing, and an amount of exertion was necessary sufficient to quickly fatigue a strong man;

(*c.*) On rough and broken ground, but sufficiently hard to prevent the wheels from cutting into it, it was found scarcely possible to wheel the carriage even for a very short distance.

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* For a description of this bearing seat, see p. 111.

† Pirogoff's litter was tried at the International Conferences of the Sociétés de Secours aux Blessés Militaires at Paris, in May 1867, and was chiefly objected to on account of the great difficulty of placing patients upon, and taking them off it. But the trial-committee do not appear to have used the bearing-seats intended to be employed with it. They also objected to the absence of feet to the litter, and of means for protecting the arms of patients against the action of the wheels.

CHAP. V.

Results of trials made at Netley of Pirogoff's wheeled litter.

4. When only one patient was occupying the litter, and one man was employed to wheel it, considerable exertion was found to be requisite to move the conveyance.

There was not much appreciable difference in the amount of exertion demanded and difficulty experienced whichever of the two folding stretchers, the front or rear one, was selected to place the patient upon.

When the patient was put into the front stretcher, his weight came to lie between the fulcrum, or axle, and the sustaining power, or bearer, and was, moreover, not balanced by any counterweight on the rear stretcher. The bearer had, therefore, to exert himself to sustain the carriage in order to keep the patient in proper position, in addition to the expense of power necessary to wheel the carriage.

On placing the patient upon the rear stretcher, although the weight was more favourably situated with regard to the bearer in front, yet still a good deal of exertion was found necessary to maintain the equilibrium, and to press down the handle so as to keep the shafts in a horizontal position, independent of the exertion requisite to move the vehicle. Irregularities of the ground moreover, were found to cause sudden violent jerking of the handle upwards, and, under these circumstances, the bearer had to take special care to prevent the remote end, where the patient lay, from touching the ground.

On the whole, there appeared to be nearly as much difficulty for one bearer to wheel the carriage with only one patient in it, as with two, the advantage afforded by the establishment of an equilibrium in the latter case being so considerable.

5. When two bearers were employed to wheel the carriage with two patients upon it, no practicable difficulty was found on any of the kinds of ground before mentioned.

6. The position of the patient in each stretcher was found to be sufficiently easy and secure, and the amount of concussion over any kind of ground moderate. Caution was necessary to slacken the pace and movement, when the vehicle was pushed or drawn over very rough ground, both to avoid sudden jerks in the hanging litters, and to prevent the arms or sides of the patients from coming into collision with the shafts. Their legs and feet were sufficiently protected against injury by being fastened within the belts provided for this purpose.

7. The hood was found to be inconvenient when not expanded, from not being provided with means of maintaining itself in an upright position. It was liable to fall down on either side so as to annoy the patients. It was also evident that the hood would have chiefly to be carried folded up, as the patients, under ordinary circumstances, would rather suffer slight inconvenience from weather than undergo the exclusion of view and lessened freedom of breathing caused by having their faces completely enveloped by it. The hood would only be of use in heavy rain or under a very scorching sun, while it offers no protection against the dust which may rise from the ground over which the conveyance is wheeled.

Conclusions arrived at regarding Pirogoff's wheeled litter.

The results of the experiments under these several heads having thus been noticed, the following remarks suggest themselves:—

(*a.*) On a comparison of the alleged advantages of Pirogoff's wheel-litter with other wheeled conveyances; and,

(*b.*) On the advisability, or otherwise, of its introduction among the matériel of ambulance transport.

(*a.*) The chief advantages of Pirogoff's litter, as compared with other wheeled conveyances, are stated to be:—

(1.) Saving of labour by its permitting the carriage of two patients by one man, while other litters are only capable of carrying one patient each under any circumstances.

(2.) Its capability of being folded up and packed for stowage, occupying, as a package, only a small space.

With respect to these differences and alleged advantages compared with other wheeled vehicles, the experiments made here have shown:—

1st. That the labour of wheeling two patients by one man over ordinary ground is so great as to render its continued exercise impracticable. Pirogoff's conveyance does not, therefore, possess the superiority mentioned under the heading (1).

2nd. Pirogoff's conveyance professes to admit of being packed up into a circular space of four feet in diameter by one foot in depth; but on examination it was found that no means were provided of connecting the several parts of the conveyance in such a manner as to keep them together within the space mentioned. The two wheels are held together by the iron screw bolt, and the other parts have then to be placed separately and loosely in the interval left between the two wheels. It becomes necessary, therefore, to place the whole into a packing case, and to take steps to prevent the several parts from injuring each other by collision among themselves during the movements attendant upon transportation. The packing case in which the conveyance was forwarded from Heidelberg, consisted of a square deal box, the dimensions of which were 4½ feet square, by over 1 foot in depth, and the weight about 130 lbs.

This very considerably lessens the advantage alleged to exist under the heading (2).

(*b.*) In considering the advisability of the introduction of Pirogoff's hand-wheel litter among the hospital transport matériel of an army, the following points occur to notice:—

1st. The want, or the possession in only a very modified degree, of the advantages enumerated under the heads *a* (1) and *a* (2), deprives this conveyance of its special features of supposed superiority over other wheeled conveyances moved by hand labour.

2nd. Although capable of being readily wheeled by two men with two patients upon it, it is, when thus employed, less useful than other wheel-litters which admit of the easy transport of one patient by one bearer. Two patients can be wheeled on two separate litters by two men, and there is, therefore, no saving of labour in either case. Any conveyance in which the patients can

CHAP. V.

Conclusions arrived at regarding Pirogoff's litter.

be carried in a fully recumbent position is preferable to one only fitted for the reception of certain special injuries. All cases of injury, however severe, and in whatever part of the body the wound may be situated, can be carried in wheeled litters made for the carriage of single patients; while Pirogoff's conveyance is only adapted for such patients whose wounds allow of their being carried in a sitting or semi-recumbent position. The length would be excessive and impracticable if the stretchers were prepared for two patients fully recumbent.

3rd. So long as the several parts composing Pirogoff's litter are separable as at present, and without any definite place for their reception when the conveyance is taken in pieces for package, so long will there be a liability to one or more parts being mislaid by oversight or neglect, and the absence of almost any one part will render the whole conveyance useless.

4th. The want of protection of the patient from dust arising from the road, and the instability of the hood, when not required to keep off rain or strong sun, are objectionable circumstances.

For these reasons, the conclusion is inevitable, that Pirogoff's two-wheel litter is not suited for the general purposes of military medical transport, nor does it appear likely that any hand-wheel litters arranged for carrying two patients together will ever prove sufficiently serviceable under the ordinary circumstances of campaigning, so as to cause them to be preferred to hand-wheel litters for the carriage of single patients.

Neuss's wheeled litter.

Neuss's Two-wheeled litter.—Early in the course of the war of 1864, between Germany and Denmark, the Russian Johanniter Orden (Knights of St. John)* had some two-wheeled hand-litters constructed at the factory of the Messrs. Neuss, Government carriage builders at Berlin. These carriages were constantly employed in the service of the Prussian wounded throughout the war; but their practical advantages were particularly noticed at the time of the storming of the forts of Düppel. As this was the first occasion on which wheeled carriages, moved by hand labour, were systematically employed during the active operations of warfare, a special interest is attached to them.

Construction of Neuss's wheeled litter.

Neuss's conveyance consists of a litter partly made of wood and partly of canvas, stretched between two side-poles and placed upon springs; these springs being again made to rest upon an iron axle connecting the two wheels upon which the weight of the whole machine, when in motion, is supported. The side-poles are provided with handles at both ends. A single man, on grasping two of the handles at either end, can wheel the machine either by pushing it from behind or by drawing it from the front; or two men, one in front and one behind, can

* This charitable order established an ambulance at Nübel, at a distance of three miles from the heights of Düppel, and near the road leading both to the forts and to Sonderburg. They also established, by permission of the Government, other field hospitals at the seat of war. In the campaign of 1866 the Knights of St. John equally furnished hospital aid to the Prussian Government.

CHAP. V.

Dr. Neudörfer's views regarding sick-transport conveyances for

Officer of the ambulance of the 8th Corps d'Armée of Austrian infantry during the Italian campaign of 1859, and at the close of the war had been placed in charge of a division of the military hospital at Verona. He had thus been able to gain considerable

CHAP. V.

with iron hooks and eyes from the inner surfaces of the two side poles. The stretchers are therefore within certain limits

CHAP. V.

4. When only one patient was occupying the litter, and one

CHAP. V.

Conclusions arrived at regarding Pirogoff's litter.

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Wheeled by Men.

NAME	Troop or Company	Date of Crime	Crime	By whom Reported	Punish-ment	By whom Ordered	REMARKS

NAME	Troop or Company	Date of Crime	Crime	By whom Reported	Punish-ment	By whom Ordered	REMARKS

Wheeled by Men.

only be ascertained by actual experience in field use, for the cost is not merely the first outlay, but should include the expenses of repairs, and, indeed, involves the whole question of strength and durability when a comparison between it and the other transport conveyances in this respect is instituted. CHAP. V.

In conclusion, on considering all the circumstances above stated, it does not appear that this two-wheeled litter, notwithstanding its alleged utility and success in the German war against Denmark, in the campaign of 1866, and in Mexico, is fitted for the motion of the conveyance. The springs prevent this. When the conveyance is wheeled over ploughed land, there is more jolting CHAP. V.

As already mentioned, very strong testimony has been given in favour of this form of litter by some of the surgeons who saw them in use in the late Schleswig-Holstein campaign. Dr. Gurlt CHAP. V. Dr. Gurlt's

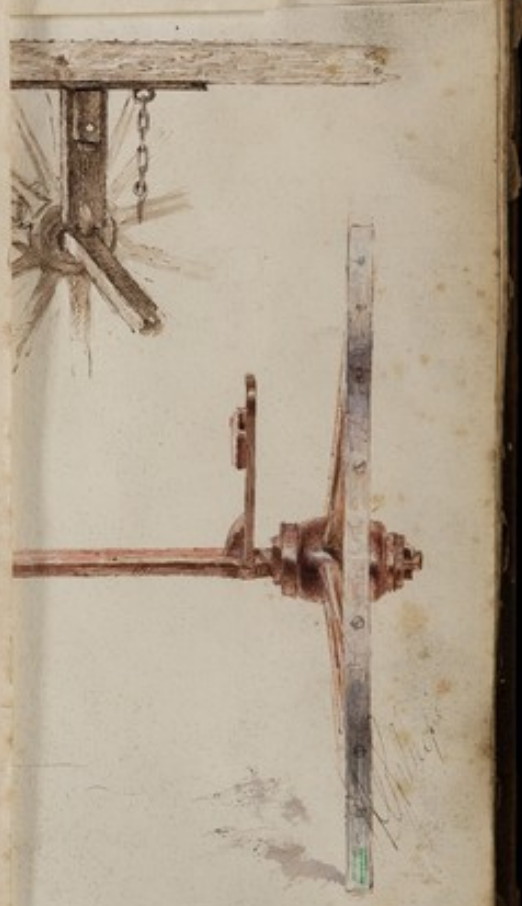
together push and draw it, or can carry the litter, if required, without the wheels being brought into contact with the ground. In order to combine lightness with solidity, the framework has been made of hickory wood. The wheels are also constructed on a peculiar plan, with a view to obtain the same ends; for each nave is of unusual length, and the spokes, twelve in number, radiating from it to the circumference are alternately inclined in opposite directions, so as to cross each other at very acute angles, and distribute support evenly from whatever side pressure may be principally exerted. CHAP. V.

Means are provided to support the litter firmly when at rest, and in the absence of an attendant. These means consist of two pairs of strong, well connected props, one in front and one behind. The hinder prop alone, in conjunction with the wheels, forms a sufficiently stable support for the conveyance. Each prop is so joined to the framework that, when the two together are resting on the ground, they stretch out at obtuse angles with the middle portion of the litter in opposite directions, and thus ensure perfect stability of the whole. By a simple arrangement, a man pushing this litter from behind, can, without moving from his place, either raise or lower, as well as fix in position at pleasure, both the front and hind supports. The hind support consists of a single piece, but the front support is jointed, so that, when shortened, the litter resting on the wheels and upon this shortened front support has such an inclination given to it, from the head downwards towards the foot, that the ingress or egress of a patient is greatly facilitated.

Position of patient on Neuss's litter.

Considerable attention has been paid in the design of this litter to secure an easy and steady position for a patient while being transported in it. The patient does not lie in a completely horizontal posture; his head and back are somewhat raised, and inclined at an angle with the pelvis and thighs, and these again form an angle with the legs. The head of the patient rests upon a pillow covered with glazed cloth or leather; the back, pelvis, and thighs upon a flexible support of sailcloth, while the part for supporting the legs and feet consists entirely of wood. There are two padded supports for the arms and elbows of the patient. A folding sailcloth hood is fixed to the upper end of the carriage, and can be drawn over the head and shoulders of the patient, so as to form a sun-shade or protection against rain, without interfering with the free access of air. A cover of sailcloth is also rolled up and fastened by two straps at the foot of the litter. This covering, when unrolled, can be drawn up so as to lie under the upper edge of the expanded hood, and be fastened to the upper part of the framework. By these means the patient, during transport, can be protected against dust or inclement weather on every side.

Under the part which is made to support the head and shoulders of the patient there is a space, enclosed within two wooden sides and a floor of strong sacking, capable of carrying refreshments, bandages, or other parcels to the front, or of re-



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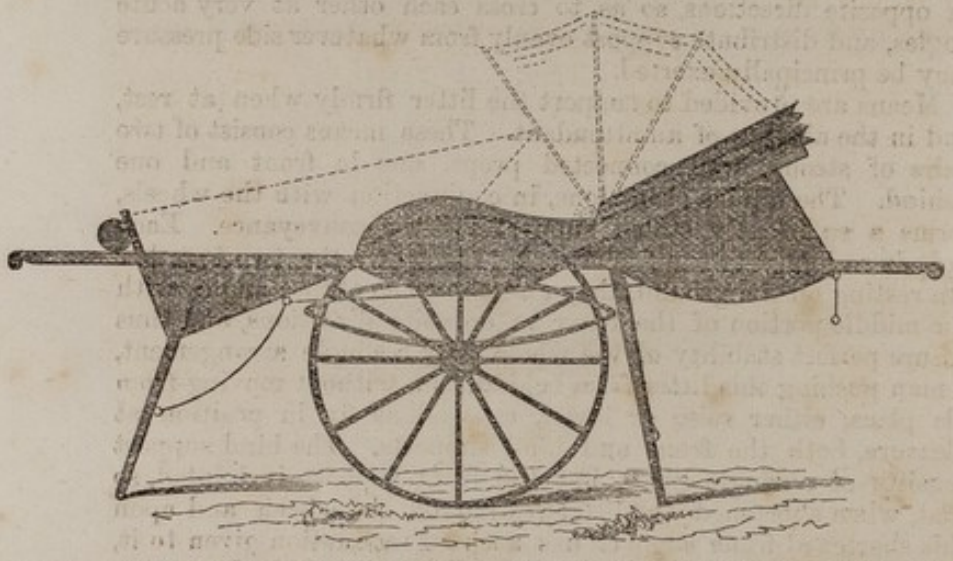
CHAP. V.

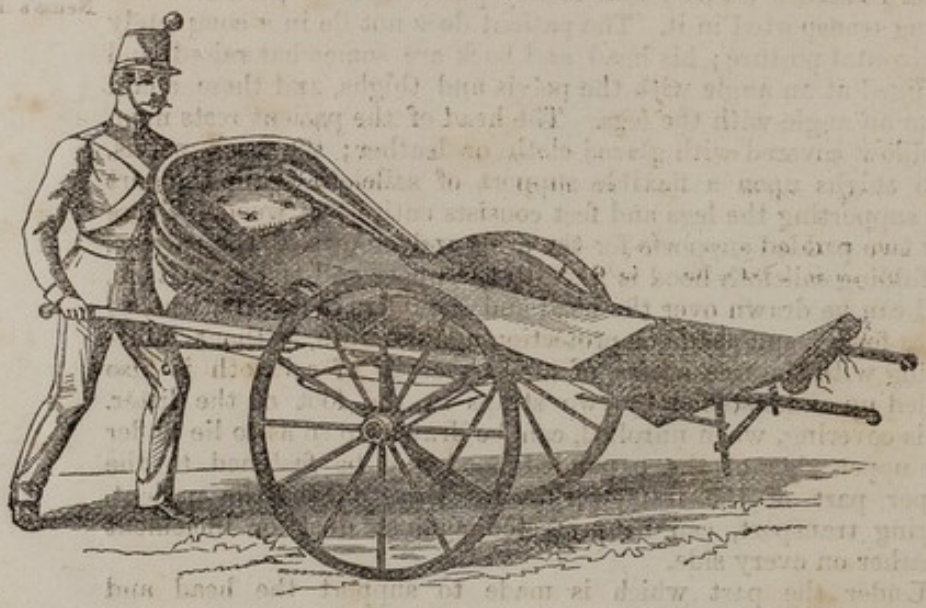
ceiving the knapsack or accoutrements of a wounded man who may have to be transported to the rear. This space is covered behind with a canvas flap secured by a button.

The weight of the litter complete as thus described, on weighing it at the Royal Victoria Hospital, has been found to be 109 lbs. 13 oz. avoirdupois.*



83/

Fig. A.—Side view of Neuss's Two-wheeled Litter. (Scale of ½ inch to 1 foot.) Copied from Dr. Gurlt's pamphlet before quoted. The dotted lines indicate the manner in which the sailcloth hood and cover are used when required to protect a patient from rain or sun.



84/

Fig. A.—Neuss's Two-wheeled Litter, as seen in perspective.

* Spec. No. 1,263 in the Museum of Mil. Surg. at Netley.

Dr. Gurlt's experience of Neuss's litters.

As already mentioned, very strong testimony has been given in favour of this form of litter by some of the surgeons who saw them in use in the late Schleswig-Holstein campaign. Dr. Gurlt, Professor of Surgery in the Royal Prussian University at Berlin, thus writes of it from his own practical experience* :—" If I am asked how this litter answers, I can guarantee its excellence from my own observation. The circumstances under which these litters were employed before and after the storming of the forts of Düppel were particularly favourable, because good roads, as the high road to Sonderburg, could be used in moving the wounded from the front to the rear, and thence to the hospital. But I have also seen them answer well on uneven ground, ploughed fields, and the like. Even obstacles of a formidable nature which could never be passed by an ordinary wagon, are easily overcome by these two-wheeled litters; for, with two men only with them, they can be easily lifted over such impediments, like the ordinary hand-litters, without any interference from the wheels, on account of their extreme lightness.

" Besides this, on exceedingly uneven ground, jolts and rough movements can be spared the wounded man by attentive porters; for, as soon as the litter must pass over hillocks and through ditches, all jolting of the vehicle can be prevented by lifting one or both wheels from the ground. On even roads, one man is able to convey this litter long distances without fatigue, alternately pushing or pulling, according as he places himself behind or in front of the conveyance.

" On the march these litters are either pushed or pulled by the men, and they can be used, as I have often seen them, for holding their knapsacks: or two or more of them can be fastened behind each other to the rear of a wagon; or, lastly, by removing the wheels, they can be easily packed upon wagons."

Dr. Neudörfer's experience of Neuss's litters.

Dr. Neudörfer, the Austrian military surgeon whose name has been before mentioned, has also borne strong testimony to the success of these two-wheeled conveyances in the late campaign against Denmark. He writes, in the course of an official report on the wounded in Schleswig, as follows, respecting them† :—" Although, from the very nature of war, it is impossible to pro-" vide completely for the requirements of the wounded, yet it " would be impossible to shut our eyes to the immense improve-" ment that these wheeled carriages present over all former " means of transport. It was proved beyond doubt that in " wheeled barrows severely wounded men could be transported " with even less injury than in other carriages, both over rough " ground and high roads; that they, moreover required fewer " men than other conveyances, and that these men, being less " fatigued, could continue at their work for longer periods " together." He has since borne equally favourable testimony

* " Militär-Chirurgische Fragmente, von Dr. E. Gurlt, Berlin, 1864," p. 7, &c.

† " Aus dem feld-ärztlichen Berichte über die Verwundeten in Schleswig, von Dr. J. Neudörfer. Berlin, 1864," pp. 7, &c.

CHAP. V.

with regard to the results of their use in Mexico, where he states they were preferred to the litters carried by mules.

The opinions expressed by these eminent and experienced surgeons are entitled to great respect; and, after careful examination and trial of the two-wheeled litter, I am led to agree with much that has been advanced by them in favour of this field conveyance. But, although believing it likely that wheeled hand-litters may be destined hereafter to take an important part in the transport of wounded in time of war, especially on the continent, I cannot concur in the opinion that they are calculated to supplant the existing means of conveyance borne by men and animals. Neither do my observations lead me to believe that any such wheeled litter as Neuss's can be adapted to the *general* requirements of transport conveyances for the British military service, although, in certain situations, and under special circumstances already before adverted to, I think it may constitute a form of conveyance preferable to any other for removing wounded between the first and second lines of surgical assistance.

I will briefly explain the grounds on which the views I have just expressed have been based, and define the limitations which it appears to me the circumstances of the British service will cause the use of wheeled litters in general to be subjected to, in case they are introduced among the number of its conveyances for sick and wounded soldiers.

Qualities of Neuss's litter.

Firstly, as to the fitness of Neuss's litter in regard to the ease afforded by it to a wounded man during the act of transportation. All the requirements in this respect are met as far as practicable. It is superior, as regards ease of position, to either the plain stretcher or to the mule-litter. This fact is owing to the soft, and at the same time firm, nature of the support, as well as to the respective degrees of inclination given to the head, shoulders, and thighs of the patient. It is the easiest position in which a patient could be placed who is faint from loss of blood or from the effects of injury, while, in whatever region of the body the wound may have been received, the injured part may be as carefully protected from additional hurt during the conveyance as on an ordinary stretcher, and more so than on either the cacolet or mule-litter. The only conveyance, perhaps, which offers equal advantages in regard to securing ease of position for the patient is the Indian dhooley. The back of the conveyance is not adapted for being raised or lowered, as in Evans' hand-wheel litter; but it can rarely happen that such a change is necessary during the first transport of wounded, for which the litter is chiefly designed, and firmness is gained by the absence of the mechanical contrivances which would be necessary for such an adaptation. At the same time the head and shoulders of the patient can be readily raised, if necessary, as in ordinary stretchers, by placing articles of clothing beneath them.

When the ground is level, over a gravel road, or over pasture, for instance, the patient is not subjected to jolting from the

motion of the conveyance. The springs prevent this. When the conveyance is wheeled over ploughed land, there is more jolting than there is when a patient is carried upon an ordinary stretcher by well-trained bearers. This jolting can be prevented, in the same way that it is in the stretcher, by two bearers carrying the wheeled litter. It is, however, a heavier load for the bearers.

If the road be favourable, the patient can be much more rapidly conveyed to the place of surgical assistance than he can be by the ordinary stretcher, or even by the mule-litters; for the animals carrying these latter conveyances have to be restricted to a walking pace. An objection to the use of Neuss's wheel litter has been noticed by Colonel Beauchamp Walker, C.B., military attaché at Berlin.* It is, that though they answer admirably over favourable ground, such as a country where there are no fences, they cannot be lifted over even a low wall without an amount of hand labour not to be spared during an action. This objection applies to all wheeled stretchers. The same difficulty, though not quite to the same extent, is met with in lifting the ordinary stretcher without wheels over fences and walls; it is so great indeed, that it is an established rule never to attempt to lift a wounded man on a stretcher over a wall if it can possibly be avoided. When an opening in the fence cannot be made, or a portion of the wall be thrown down, sufficient for the stretcher to pass through, the safety of the patient requires that the bearers should traverse even a longer distance, if, by so doing, the impediment can be avoided, and a readier way of access to the open ground or road be obtained.

Secondly, as regards advantage in saving of labour. If the ground be favourable, one man can easily transport a patient by means of this conveyance to any usually required distance, and with very little fatigue, because the muscular exertion is moderate, is well distributed, and is capable of being varied. Under these circumstances there is very considerable saving of labour, both from one man being able to do the usual work of two or more men, from his being able to accomplish it more speedily, and from his being less fatigued at its conclusion, and, therefore, the sooner available for other duty.

If, however, the ground be unfavourable, two men are required for the transport of a patient; and there does not appear to be any reason for concluding that the two-wheeled litter would, so far as labour is concerned, be then more advantageous than an ordinary stretcher, or so advantageous as the mule transport of two men under the guidance of a single soldier.

Thirdly, as to its portability. The Berlin litter can be readily transported when ordinary roads, or moderately even ground, are available by being moved on its own wheels. These litters have been usually moved in this way in Prussia. One or more of them have been attached to the rear of a wagon on the

* Appendix, No. XXXV., p. 503, Report of Committee on Transport, &c., 1867.

line of march, and have thus been drawn along either empty or carrying patients. Or it can be transported as a package by its wheels being removed and stowed away with the litter. But, under these latter circumstances, the package is a large one, and not calculated to resist with impunity any rough usage.

Unfitness of Neuss's litters for general use in the British service.

It is not fitted for transport by sea. It cannot be taken in pieces, so as to be put together into a compact package. Although the wheels are removed it is still bulky, and there remain many projecting parts, and these of comparatively little power of resistance, which will be constantly exposed to injury in the movements of a transport vessel in bad weather. This defect would quite unfit it, in its present state, for the general requirements of the British service. Necessity, arising from the insular nature of Great Britain, obliges such conveyances to be simple in construction, easily taken asunder and packed, to be fully capable of resisting the shocks to which they are liable during a sea-voyage, and to be fitted for being readily put together again on landing at the conclusion of the voyage. These qualities are not found in the Berlin two-wheeled litter.*

Fourthly, as to its capability of repair. Independently of the inconveniences which would arise from its bulk if it had to be transported in its complete state, the nature of the construction of the conveyance would cause it to be easily injured if subjected to undue violence, whether on shipboard or elsewhere. If the wheels or springs were injured, they could not be repaired under ordinary circumstances in the field. Spare wheels would be required to be taken for supplementing those which might be damaged, as is done in ordinary ordnance carriages. This objection would not hold good if the means of repairing such defects were at hand, as they probably were in Germany.

Fifthly, as to the cost. Dr. Neudörfer has made a calculation of the probable cost of an equipment of these litters, when made according to his designs, for an Austrian army of forty brigades, supposing that all other forms of sick transport conveyances be abandoned. He remarks as follows:—"I find that my vehicles "can be made, strong and fit for service, for about 100 florins "each (10*l.*); so that, for each infantry brigade, 5,000 florins "(500*l.*), and for an army of forty brigades, 200,000 florins "(20,000*l.*) will be the cost. This sum is large, but, as every "nation must necessarily improve its artillery and keep progress "with the times, so must it similarly improve the means of "transport for its wounded, unless it wishes to be left behind in "the race both of military science and of philanthropy."† The cost of Neuss's two-wheeled litter sent to the Army Medical School was 15*l.*, irrespective of the expenses of its carriage from Berlin to England. But the real cost of these conveyances can

* Even in the passage from Hamburg to Southampton on a steamer, and carefully packed, Neuss's conveyance obtained for the Army Medical School had one handle broken off, and was defective from the loss of two or three minor parts which had to be replaced before it could be fitted for use.

† Op. cit., p. 10.

only be ascertained by actual experience in field use, for the cost is not merely the first outlay, but should include the expenses of repairs, and, indeed, involves the whole question of strength and durability when a comparison between it and the other transport conveyances in this respect is instituted.

In conclusion, on considering all the circumstances above stated, it does not appear that this two-wheeled litter, notwithstanding its alleged utility and success in the German war against Denmark, in the campaign of 1866, and in Mexico, is fitted for the *general* service of the British army for the transport of wounded in time of war. Its want of portability for stowage on board ship, its liability to injury, and the absence of facilities for repair, counterbalance its advantages. It would certainly be unwise to recommend it as a substitute for transport conveyances, the superior merits of which in respect to those qualities in which it is defective, and which are so important in the British service, have been practically tested and established, before it has received a more extended trial than it has hitherto been subjected to in field operations.

Fitness for use of Neuss's litters if required in England.

On the other hand, the superior advantages of these litters over other conveyances in the exceedingly easy position afforded by them to sick or wounded soldiers, in the little injury the patients are liable to be subjected to from shocks or from jolting during the transport, in the rapidity of their movement, the economy of labour, the ease with which they can be caused to travel long distances, together with the fact that they possess sufficient strength for all ordinary legitimate uses, render them not only appropriate, but, perhaps, the most appropriate transport conveyances that can be devised for use under certain special circumstances. Among a civilised community, with good roads, so that the ground between the scene of action and the lines of surgical assistance is likely to be tolerably regular and level, and where no necessity exists for transport by sea, or close package of the vehicles themselves, they seem to offer every advantage that can be expected to be found in any ambulance carriage.* To fit them for transportation by sea, and for use under the circumstances in which British armies have to act in foreign expeditions, they would require many modifications in order to free them from the objections which have been already described. Attempts have not been wanting to remove these objections, and they will be presently noticed.

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* One of these litters has been frequently used for removing invalids requiring a recumbent position from the landing place at Netley to the Royal Victoria Hospital. The first part of the road from the beach has a very steep incline, the remainder has only a gentle slope. The regulation stretcher, Russell's spring dhooley or stretcher, Hopper's invalid chair, the China ambulance barrow, have been also employed for the same purpose. Preference has been universally given to Neuss's two-wheeled litter, on account of the several advantageous qualities above enumerated. On arriving at the entrance of the hospital, no difficulty has been experienced in carrying the litter with the patient upon it up the six steps leading into the corridor, or, if the wheels be shifted, to the upper stories of the building.

CHAP. V.

Advantages of Neuss's litters under certain conditions.

Two other advantages, not enumerated in the foregoing *résumé*, may be noticed. With the hand-wheel litter it is not necessary to disturb the patient during the transport, in case of the conductor wishing to halt for a time, as must be done, to a certain extent, where the bearers of a stretcher place it on the ground in order to give themselves rest. Neither does it require any training to be able to conduct the movements of the wheeled litter, but only common care and attention; whereas, with the ordinary stretcher, a certain amount of previous practice is necessary to enable the bearers to carry a wounded man in such a way as not to aggravate his suffering by jolting or uneven movement. With mule ambulance transport also, quietness of the animals and other qualities, with special training of the conductors, are necessary to ensure ease to the patients; and with ambulance carts and wagons considerable skill is required for driving properly. Nothing can be simpler than the management of two-wheeled litters.

If an enemy were to attack the shores of this island, and a conflict occurred, I cannot imagine a more efficient hand-conveyance than such wheeled litters would afford. The wounded could be rapidly transferred by their means from the places of action to the stations for the first dressings, and from these latter to appointed hospitals; or, if a railway were near at hand, could be carried to stations for removal to longer distances with the greatest amount of ease that the particular conditions of each wounded man would render admissible. The circumstances under which they seem to have been so successfully employed after the assault on the forts of Düppel in the war between Germany and Denmark, and in the campaign in Bohemia, appear, from the descriptions, to have been of a nature, in many respects, similar to those I have just contemplated, and these are the conditions for which careful examination of Neuss's hand-wheel litters would have led me to conclude them to be particularly well adapted, even without the practical proofs of their advantages which those campaigns are stated to have afforded.

Gablenz's wheeled litter.— This is a wheeled litter constructed for the removal of a single recumbent patient. It is the first example of an attempt to combine the advantages of a primary stretcher with the power of assisting its movement at pleasure by the aid of a light pair of wheels and axle, the whole machine being designed for ambulance purposes.

In the foregoing examples the litter has been either a constituent part of the conveyance itself; or, though separable, has been placed on a heavy small cart, as the China barrow; or not fitted for the purposes of a primary stretcher, as in the contrivance of Dr. Pirogoff.

Gablenz's litter was exhibited in the international collection at the Universal Exposition of Paris in 1857 by the Baden Committee, and it was stated that it had been adopted in the

Baden army and had proved serviceable during the campaign of 1866.*

Fig. .—Gablenz's wheeled Litter.

Messrs. Fischer and Co., of Heidelberg, were the manufacturers of this conveyance, and they thus describe its merits:—

Advantages attributed to Gablenz's wheeled litter.

"Besides its easy stowage and portability, Gablenz's litter has the great advantage of offering the patient a secure position, even if rapidly moved down hills, owing to the angle formed by the two parts of the stretcher on which the chief weight of the patient is placed.

"The stretcher is light, and, when required, is quickly and easily separated from the wheels and axle, and can be used separately.

"If a patient is to be conveyed on this litter, either the stretcher may be taken off the wheels and put on the ground to place the patient on it, and without removing the patient, re-fixed on the axle; or the lower and heavier end may be brought down close to the patient's back, and the patient drawn upon it in a sitting posture.

"By the application of a very simple contrivance this carriage may be converted into a sledge."

One of these litters † was very carefully experimented upon over ground of various descriptions at Netley. The results of these trials will be mentioned after an explanation of its construction has been given.

Gablenz's litter consists of two principal parts: a folding stretcher, and two low wheels connected by an axle.

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* "La Médecine à l'Exposition Universelle de 1867, Guide Catalogue publié par la Société Allemande de Paris," p. 65.

† Spec. No. 1,246 in the Museum of Mil. Surg. at Netley.

CHAP. V.

These are separable into four detached portions, viz., the folding stretcher, the axle, and the two wheels. The weight of the stretcher is 48 lbs., that of the wheel and axle is 39 lbs.

When these portions are arranged for transportation, they are packed in the following way:—

The stretcher is folded up, one half lying within the other half. The two wheels are laid one behind the other upon the folded stretcher, and the axle is laid by the side of the whole. A package is thus formed 5 feet in length, 2½ feet in width, and about 10 inches in depth.

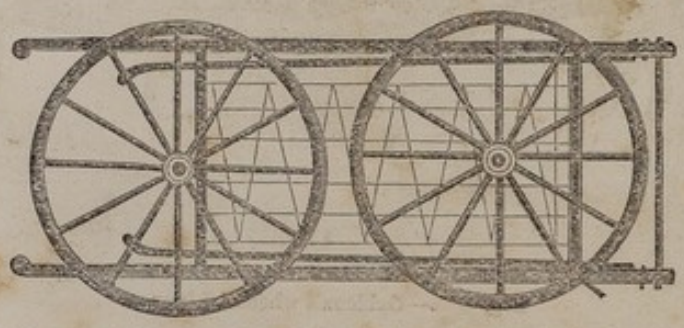

Fig. .—Gablenz's Litter, separated and arranged for packing.

86/

There is, as in the case of Pirogoff's litter, no arrangement for securing the several parts together, and they, therefore, also require, both for preventing their separation from one another as well as for protection from injury, to be put into a packing-case when they have to be carried on shipboard or on transport wagons.

Construction of Gablenz's wheeled litter.

The *stretcher* is jointed near its middle, and thus consists of an upper and a lower half. These parts are so hinged as to fold closely together when necessary. The sides, or poles, of the upper half of the stretcher, that on which the head of the patient would be placed, are made of wood and connected by a wooden traverse at the end near the handles, and by a bent iron traverse beneath. The poles of the lower half of the stretcher are made of one solid piece of iron bent in the middle at right angles so as to form a third side or traverse, and together to constitute three sides of an oblong frame. The fourth, or open side of this frame, which is near the place of junction of the two halves of the stretcher, is connected by an independent iron traverse, placed at a lower level than the frame itself. The two ends of the side poles of the iron frame are curved so as to be attached to this traverse, which is thus prevented from being brought into contact with the sacking, or from hurting a patient lying on it.

The breadth of the wooden frame portion of the stretcher inside the poles is twenty-six inches, that of the iron frame portion is twenty-two inches. This difference enables the stretcher

a hand-litter is effected by the following means :—

A small bent piece of iron is attached by strong rivets to the curved end of each of the two iron poles and the connected traverse before described, and these pieces, together with the ends of the poles themselves, form openings capable of receiving within them the axle connecting the two wheels. These openings are rectangular, to correspond with the square shape of the axle, and are spoken of as the "knees of the stretcher hinges." A short iron chain, with a spring hook at the end, is suspended from each of the curved pieces of iron which help to form the knees just mentioned. (See Fig. No. 1.) When the stretcher is placed upon the wheels, all that has to be attended to is that the rectangular openings fall properly upon and embrace the square parts of the axle. They are then fixed in position by winding round both the axle and the adjoining traverse of the stretcher the iron chain, which is then secured by being hooked to one of the ropes of the corded bottom of the stretcher.

For removing the stretcher, the chain has only to be unhooked from the netting, and to be unwound from the axle and traverse. The stretcher can then be lifted off the axle and wheels.

The *wheels* correspond in general features with the wheels of Pirogoff's litter already described, and differ only in size. The diameter of each wheel is 2½ feet.

Q. 87

[illegible] and it is, therefore, not necessary to lift him [illegible] up from the ground for the purpose of carrying and placing him upon the stretcher, as is required when ordinary stretchers are employed.

2. In carrying a man upon the stretcher off the wheels he is not so much shaken as upon an ordinary stretcher. This is owing to the fact that the side poles are more rigid on account of their being composed of two pieces firmly joined in an angle midways, while in ordinary stretchers each pole, consisting only of one long piece, more or less elastic, sways up and down with the steps of the bearers.

3. The position of the patient upon the stretcher is easy, and the girths maintain him secure in that position.

4. The weight of the stretcher, when used off the wheels, causes fatigue to the bearers after a short time. With a heavy man upon the stretcher two bearers of ordinary strength would require to halt after about every two hundred yards of marching. But the stretcher can be placed temporarily on the ground so as to give the bearers rest, its weight being supported on the central iron traverse, without inconvenience to the patient.

5. By a certain amount of management the stretcher, with the patient upon it, can be easily and rapidly placed upon the axle connecting the wheels, and secured there. But it would be necessary to lay down rules defining the manner in which this

manœuvre is to be done, and some little practice is required to do it with celerity when a patient is on the stretcher.

6. One bearer was found to be able easily and rapidly to wheel the litter, with a patient lying upon it, over level roads covered with loose gravel, either by pushing or pulling the conveyance.

7. No more than a moderate and easily supportable amount of exertion was required to wheel the litter up a rather steeply-inclined and very rough road.

8. The men who were carried in the litter found their position easy, and stated they did not experience inconvenience from jolting even when the stretcher was wheeled rapidly over very rugged ground. This appeared to be chiefly due to the elastic nature of the bottom of the stretcher, and to its padded girths, there not being any springs to it.

Conclusions regarding Gablenz's wheeled litter.

As shown by the experiments referred to above, this form of hand-wheel conveyance appears to have several qualities to recommend it to favourable consideration. The moderate amount of labour, and the rapidity with which it can be wheeled even over rough ground, the comparative facility with which the stretcher can be transferred on and off the wheels, the easy and secure position of the patient upon it, the readiness with which the litter may be taken to pieces and folded for package, the moderate amount of space in which the separate parts can be stowed away, and the not excessive weight of the whole conveyance, viz., 87 lbs., are all qualities in its favour. To give Gablenz's litter a higher title to recommendation, the objectionable weight of the stretcher, which is strongly felt when it is used apart from the wheels, would have to be reduced; and for package and stowage, the wheels should admit of being placed within the same limits as those of the sides of the folded stretcher, while the whole should be arranged for being secured together without the necessity of the employment of a packing case. It ought also to have some means of protecting the patients carried upon it from rain and dust. It is questionable whether after continued use the bottom of the stretcher would not lose its elasticity, and then the absence of springs would certainly be very objectionable to any one carried upon it. There was not the opportunity of trying the litter along roads covered with deep mud or heavy sand at the time the experiments were made with it at Netley, and the question remains therefore how far such a condition of surface would render the conveyance impracticable in consequence of the lowness of its wheels, and, further, objectionable as regards the patient carried upon the stretcher on account of its nearness to the ground over which it was being wheeled. It seems probable that the circumstances just mentioned will always cause objections to be made, and rightly too, to the adoption of similarly low wheels for conveyances of this kind when intended for general use in campaigning.

Brancard roulant.—M. Henri Arrault, of Paris, who is well known from having designed numerous articles of field equipment for the medical service of armies, has invented a stretcher on

CHAP. V.

wheels, which he has called the *brancard roulant*, or rolling stretcher. It consists of (A) a stretcher closely resembling the ordinary stretcher of the French service, adapted to (B) light wheels, so that it can be either rolled over the ground or carried by the hands of bearers at pleasure.

As in Gablenz's litter, one of its peculiarities is the rigid connexion between the stretcher and the axle. It is destitute of springs, nor is it slung so as to move with a certain amount of freedom, as happens in Neudörfer's litter.

Construction of Arrault's brancard roulant.

(A). The stretcher consists of two side poles and two traverses made of wood (beech), and a canvas support stretched within them. The canvas is securely and permanently nailed to the two side poles, but is free at the head and foot borders. A canvas loop is attached to the middle of each of these free borders, and is intended for one of the wooden traverses to be passed through it. Each traverse, when employed to keep the canvas stretched out for use, is secured in its situation by two small iron bolts placed at its two ends, and arranged to pass into two small iron eyes at corresponding positions in the side poles. When thus put together the canvas and its framework form an ordinary hand-litter.

Near one end of each side pole, at about six inches from the handle, is an iron support or foot, which assists in supporting the stretcher when it is placed upon the wheels. These iron feet can be readily raised and secured within supports provided for them on the outer aspect of the two side poles. They then remain in close proximity with the side poles.

(B). The wheels are twenty-seven inches in diameter, and of ordinary construction. They are connected by an iron axle of sufficient length to admit of the stretcher being connected with it, and at the same time lying conveniently within the two wheels.

The connexion between (A) and (B) is thus obtained. Near the middle of the under surface of each side pole of the stretcher is a T-shaped piece of iron, or tenon, the cross part being firmly secured to the pole, the tongue part being left projecting. Near each end of the iron axle is a small elevated piece of iron furnished at its upper part with a square opening, or mortice, adapted for receiving the tongue of the T-shaped piece of iron just described. When the stretcher is placed on the wheels attention has to be given that the tongue on each side is inserted into its corresponding receptacle on the axle; the connexion is then secured by an iron pin being passed laterally through certain openings which exist both in the receptacle and the tongue at a corresponding level. When the stretcher is bolted by these means to the wheels and axle the whole appliance can be lifted off the ground together without any risk of the parts (A) and (B) becoming detached from each other.

The stretcher can thus either be employed as an ordinary stretcher without the wheels, or on being connected with the wheels can be either drawn or pushed as a wheeled conveyance.

The weight of each of the several parts, on being weighed at

Netley,* was found to be as follows: stretcher, 21 lbs. 14 oz.; the two wheels, 23 lbs.; the axle, 8 lbs. 11 oz. The weight of the whole is therefore 53 lbs. 9 oz.

The "brancard roulant" is simpler in construction than any of the hand-wheel conveyances which have been previously noticed, but was found to be defective in many particulars on being subjected to practical trials at Netley. It was also rejected by the examining committee in May 1857 at the Exposition in Paris, although at the same time it received praise for its simplicity and lightness.

The chief faults found at Netley were the following:—

Practical objections to Arrault's brancard roulant.

Firstly, it was very difficult to place a patient, while lying on the stretcher, upon the wheels. The chief source of the difficulty was the fact that the weight of the man upon the stretcher made the canvas bottom belly downwards, and in so doing caused the upper surfaces of the two side-poles, to which the canvas is nailed, to turn inwards towards each other. When the upper surfaces were thus turned inwards it followed, as a necessary result, that the under surfaces were proportionably turned outwards, and with them the T-shaped iron tenons attached to them. The tenons were therefore no longer in the straight line which was necessary for their easy insertion into the upright mortices made for their reception upon the axle, which of course remained in their perpendicular position. When, after much manœuvring, the ends of the tenons were got into the upper parts of the openings of the mortices, it was only by forcible exertion that the remainder of the tenons could be pressed down into them. The drag on the side poles arising from the weight of the man had to be counteracted by force being applied to each side of the stretcher. There was considerable shaking necessarily communicated by these efforts to the stretcher, and no little inconvenience would have been the result to any wounded man lying upon it. For reasons arising from the same cause it was found difficult to take a patient lying on the stretcher from off the wheels.

Secondly, it was found to be anything but an easy mode of conveyance for the persons carried upon it. This fact arose (*a*) from the difficulties, already described, in placing the stretcher, with a patient lying upon it, on and off the wheels; (*b*) from the absence of springs, and (*c*) from the angle of inclination which the stretcher assumes when the appliance is wheeled by a bearer of ordinary height.

Practical objections to Arrault's brancard roulant.

The effect of the absence of springs is that every jolt which a wheel accidentally meets with is directly communicated, through the axle and through the unyielding iron uprights by which it is connected with the side poles of the stretcher, to the stretcher itself, and at the same time to the patient lying upon it. There is nothing to break the concussion; even the canvas bottom on which the patient lies is stretched so tightly by the manner in which its side poles, and indirectly its traverses, are connected

* Spec. No. 1,265 in the Mus. of Mil. Surg. at Netley.

CHAP. V.

with the axle, that the relief is not afforded which would be if it retained more flexibility.

The angle of inclination was found to be very considerable when a man of ordinary height was wheeling the stretcher. This was owing to the wheels and uprights upon the axles not being sufficiently high to keep the stretcher in a horizontal position relatively to the hands of the bearer by which the appliance was wheeled. The evils to a patient lying on the stretcher of such an inclined posture would be felt in all cases of wounds, but especially in those in which the bones of the leg or thigh were fractured, for, in these, the lower part of the broken limb would remain comparatively helpless and stationary, while the upper fragment would have a constant tendency to slide down and become displaced upon it.

Thirdly.—There were several faults in construction, so that the appliance was evidently not calculated to resist the shocks it would be liable to in campaigning.

The first error appears to be in the iron uprights containing the mortices on the axle. Their form and construction render them unable to resist the strains and shocks to which they are necessarily subjected. As already explained, when the weight of a man is placed on the stretcher, the iron tenons on the side-poles are made to turn outwards, so that they assume an oblique direction, and considerable force is required to bring them perpendicular to the mortices so that they may be inserted into them. This force throws a great strain on the iron uprights, and causes a liability to injury at the parts where they are connected with the axle. Moreover, any accidental blow at the upper part of one of these uprights, owing to the length of leverage and want of lateral support, is very likely either to bend or break it off at the same place. In either case, whether bent or broken, it would be rendered unfit for service. One of the uprights was thus broken at Netley from a man falling while carrying the stretcher.

The same circumstances which throw the strain just described on the lower ends of the uprights of the axle, together with the working of the stretcher when attempts are made to get the side-pole tenons to enter the mortices at their upper extremities, cause further a great force to be exerted on the traverses at their places of junction with the side-poles. It is in these situations that the traverses are weakest, from the nature of their construction, and the application of this force increases greatly the liability of their breakage. Owing to these causes, some of the iron bolts joining the traverses to the side-poles were either broken or bent on each occasion of trying the stretcher at Netley.

Unfitness of the brancard roulant for army use.

The conclusion with regard to the *brancard roulant* is, therefore, that—notwithstanding saving of labour during the transit, and notwithstanding the general simplicity of construction of the conveyance—the disadvantages from want of ease to the patients to be carried upon it, and from the liability of the appliance to be disabled by injury, are so great as to unfit it for employment in military service.

NAME	Troop or Company	Date of Crime

CHAP. V.

These are separable into four detached portions, viz., the folding stretcher, the axle, and the two wheels. The weight of the stretcher is 48 lbs., that of the wheel and axle is 39 lbs.

When these portions are arranged for transportation, they are packed in the following way:—

The stretcher is folded up, one half lying within the other half. The two wheels are laid one behind the other upon the folded stretcher, and the axle is laid by the side of the whole. A package is thus formed 5 feet in length, 2¼ feet in width, and about 10 inches in depth.

CHAP. V.

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CHAP. V.

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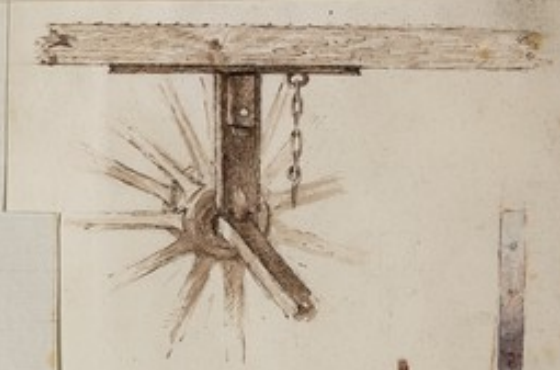
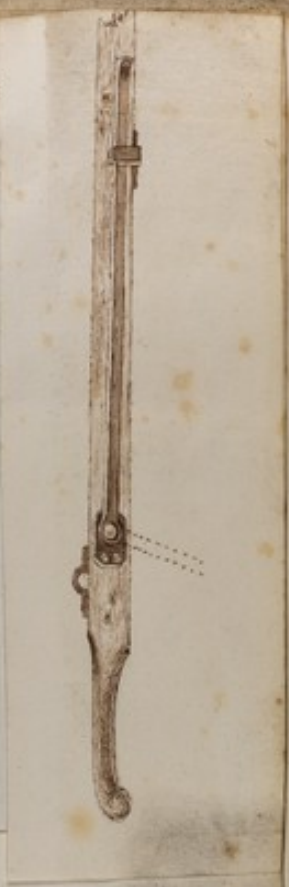
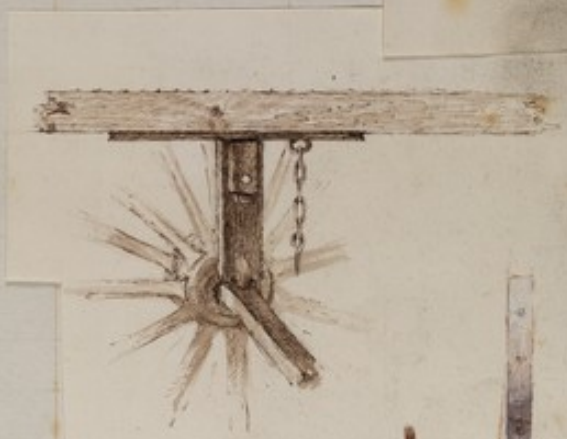
Wheeled by Men.



Wheeled by Men.

	Troop or Company	Date of Crime	Crime	By whom Reported	Punish-ment	By whom Ordered





NAME	Troop or Company	Date of Crime	Crime	By whom Reported	Punish-ment	By whom Ordered	REMARKS

Wheeled by Men.

The observations further lead to the belief that no hand-wheel litter without springs will answer for the carriage of wounded men, any more than a wheeled vehicle without springs drawn by horses.

Shortell's wheeled stretcher-support.

Shortell's wheeled stretcher-support on springs.—In the summer of 1866 Serjeant Shortell, Army Hospital Corps, who had assisted in conducting the trials of the several kinds of wheeled litters already described at Netley, himself constructed, according to a design of his own, and deposited in the Museum of Military Surgery at Netley,* a model of an appliance which he called a "wheeled stretcher-support on springs." This invention was adapted for wheeling the regulation stretcher of the British army, but at the same time was rendered capable of wheeling any other stretcher, irrespective of size. Shortly afterwards a full sized pattern of this appliance was made, but under some disadvantages in respect to workmanship, which will be alluded to hereafter. On the occasion of the Universal Exposition at Paris in 1867 Serjeant Shortell was sent on duty connected with the British section of the Exposition. He took his wheeled stretcher-support with him, and it was placed among the other articles forming the collection exhibited by the national societies for aid to wounded in time of war. When it was first deposited in this collection the only other patterns in the Exposition were some of those which have been previously described, and one of Dr. Gauvin's hereafter alluded to; but several other patterns were added subsequently. Most of these additions had some features in common with Shortell's contrivance. At the close of the Exhibition Serjeant Shortell received a silver medal for his invention from the International Committee representing the societies above mentioned.

As Shortell's wheeled stretcher-support offers more practical advantages for military use in the British service than any similar contrivance which has yet been examined, and as, with certain alterations which are required in some of the details of its construction, it is not unlikely to form the basis of construction for future wheeled stretcher-supports, it will be useful to describe the contrivance itself fully, and afterwards the results of various trials made with it for experimental purposes.

The advantages alleged by Serjeant Shortell to belong to this appliance are the following:—

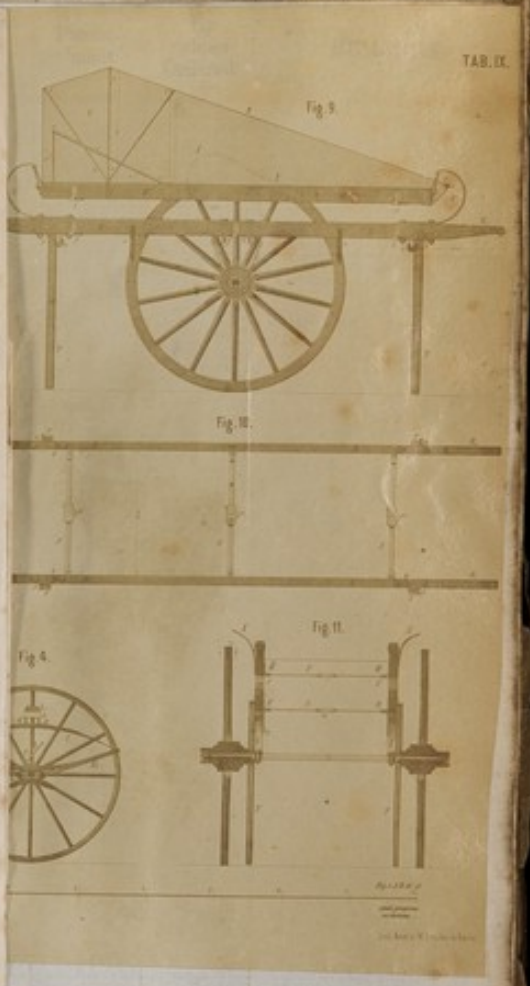
Advantages claimed for the contrivance.

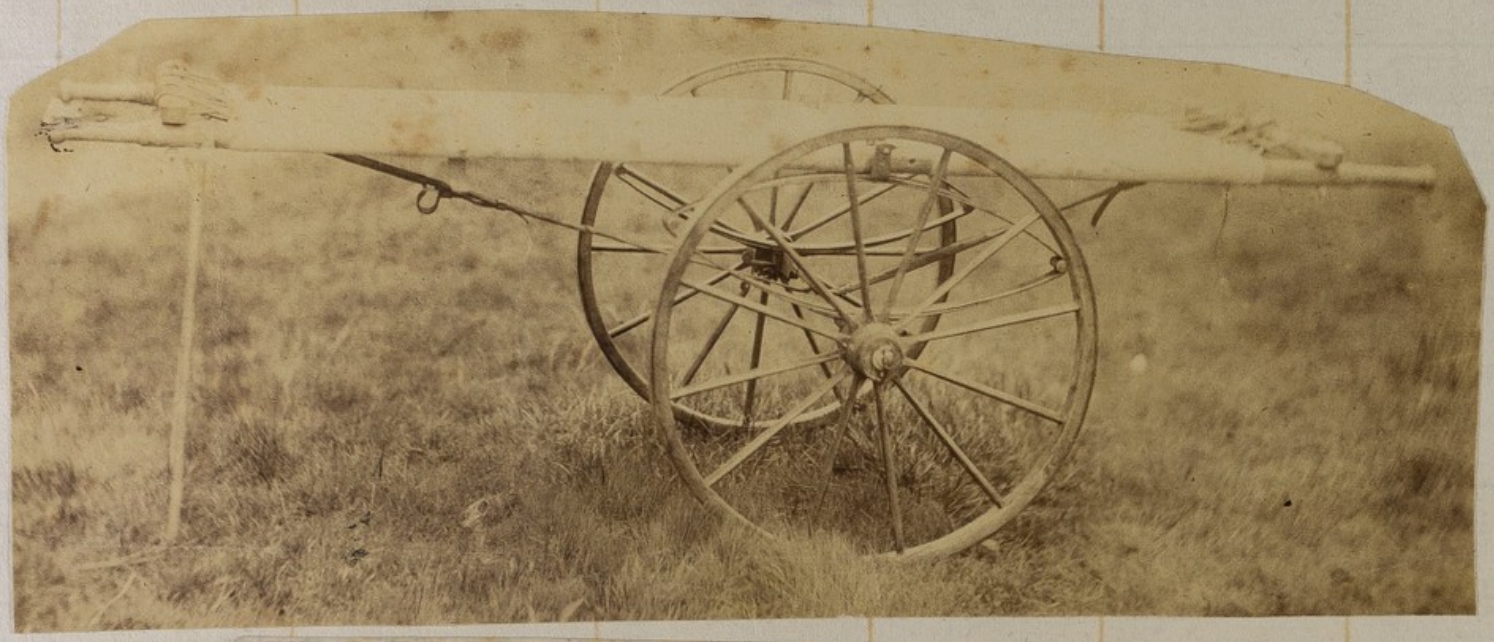
1st. The appliance can be used with the regulation or any other stretcher of ordinary construction, notwithstanding variations in width.

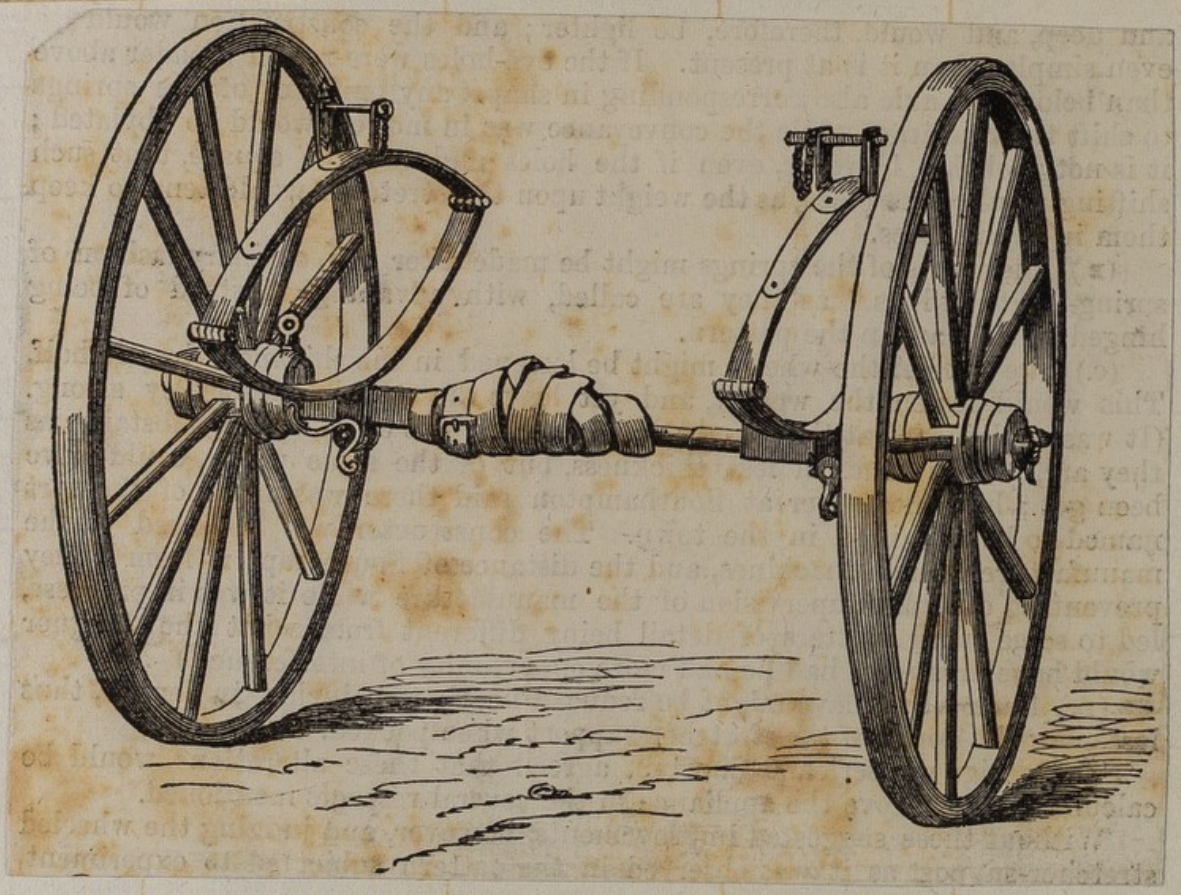
2nd. A stretcher placed upon the appliance affords as much ease to a patient carried upon it as can be obtained upon any form of wheeled stretcher.

3rd. The stretcher, with a patient lying upon it, is easily placed on or taken off the appliance by two bearers. A peculiar contrivance fixes the appliance in position, and obviates the necessity of its being held by a third bearer while the two bearers are placing the stretcher upon it.

* Spec., No. 1







The observations further lead to the belief that no hand-wheel litter without springs will answer for the carriage of wounded men, any more than a wheeled vehicle without springs drawn by horses.

Shortell's wheeled stretcher-support.

Shortell's wheeled stretcher-support on springs.—In the summer of 1866 Serjeant Shortell, Army Hospital Corps, who had assisted in conducting the trials of the several kinds of wheeled litters already described at Netley, himself constructed, according to a design of his own, and deposited in the Museum of Military Surgery at Netley,* a model of an appliance which he called a "wheeled stretcher-support on springs." This invention was adapted for wheeling the regulation stretcher of the British army, but at the same time was rendered capable of wheeling any other stretcher, irrespective of size. Shortly afterwards a full sized pattern of this appliance was made, but under some disadvantages in respect to workmanship, which will be alluded to hereafter. On the occasion of the Universal Exposition at Paris in 1867 Serjeant Shortell was sent on duty connected with the British section of the Exposition. He took his wheeled stretcher-support with him, and it was placed among the other articles forming the collection exhibited by the national societies for aid to wounded in time of war. When it was first deposited in this collection the only other patterns in the Exposition were some of those which have been previously described, and one of Dr. Gauvin's hereafter alluded to; but several other patterns were added subsequently. Most of these additions had some features in common with Shortell's contrivance. At the close of the Exhibition Serjeant Shortell received a silver medal for his invention from the International Committee representing the societies above mentioned.

As Shortell's wheeled stretcher-support offers more practical advantages for military use in the British service than any similar contrivance which has yet been examined, and as, with certain alterations which are required in some of the details of its construction, it is not unlikely to form the basis of construction for future wheeled stretcher-supports, it will be useful to describe the contrivance itself fully, and afterwards the results of various trials made with it for experimental purposes.

The advantages alleged by Serjeant Shortell to belong to this appliance are the following:—

Advantages claimed for the contrivance.

1st. The appliance can be used with the regulation or any other stretcher of ordinary construction, notwithstanding variations in width.

2nd. A stretcher placed upon the appliance affords as much ease to a patient carried upon it as can be obtained upon any form of wheeled stretcher.

3rd. The stretcher, with a patient lying upon it, is easily placed on or taken off the appliance by two bearers. A peculiar contrivance fixes the appliance in position, and obviates the necessity of its being held by a third bearer while the two bearers are placing the stretcher upon it.

* Spec., No.

1271.

CHAP. V.

Advantages of Shortell's wheeled stretcher-support.

4th. The stretcher is capable of being very firmly secured to the appliance when placed upon it.

5th. The appliance is composed of but few separate parts, and the construction of all of these parts individually, as well as their combination, is simple.

6th. The arrangement of the machine is such that it is hardly possible to lose any of its parts, unless in case of complete breakage.

7th. A patient lying on a stretcher and placed upon the appliance is easily wheeled over any ordinary ground by a single bearer.

8th. Its weight is so moderate that, if rendered necessary by a difficulty being met with on the way, such as a ditch, it can be easily carried over the obstacle by two men without disturbing the patient.

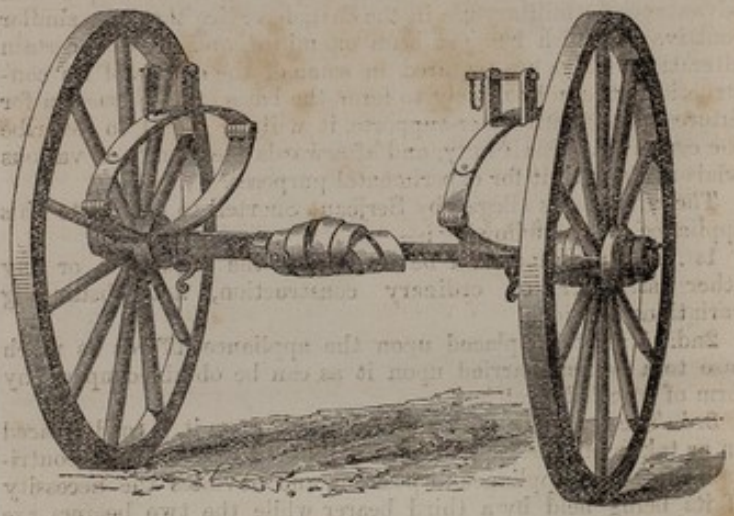
9th. It is of comparatively small cost.

10th. It is calculated to sustain without damage the ordinary risks of campaigning.

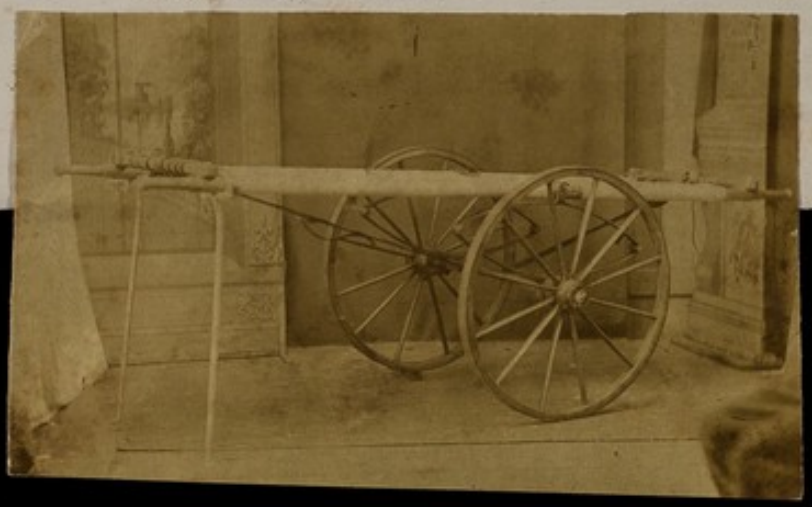
11th. It can be taken to pieces and packed for stowage without liability to damage or loss of parts by separation from each other, and at the same time without the necessity of being protected by a packing case.

12th. In the event of the regular stretcher having been broken, or not being forthcoming when wanted, temporary stretchers constructed in the field of the rudest manufacture, in fact any piece of cloth sufficiently strong secured to two poles, will form with this appliance a serviceable wheeled conveyance.

The two sketches which follow represent the stretcher support standing on its wheels and packed up.



88/ Fig. A .—Shortell's Wheeled Stretcher-Support.—The springs are fixed upright by the action of the clamping screw in the nave of the wheel, which appears on the left of the drawing. The crutch pins are in the crutches.



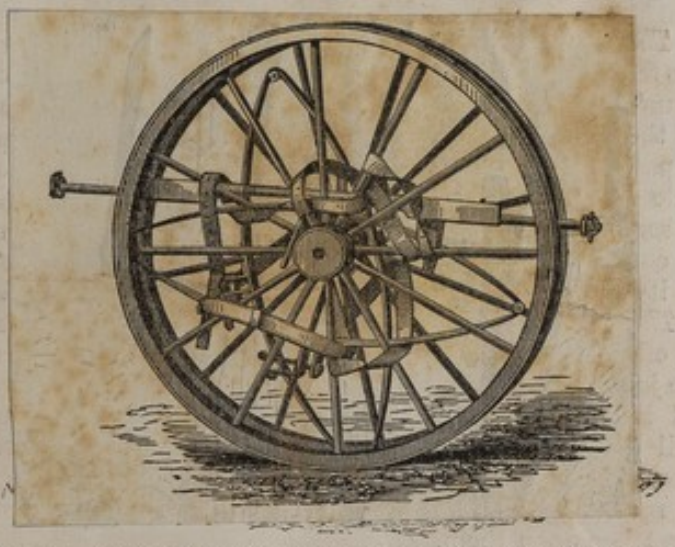


Fig. A.—Shortell's Wheeled Stretcher-Support packed for stowage.

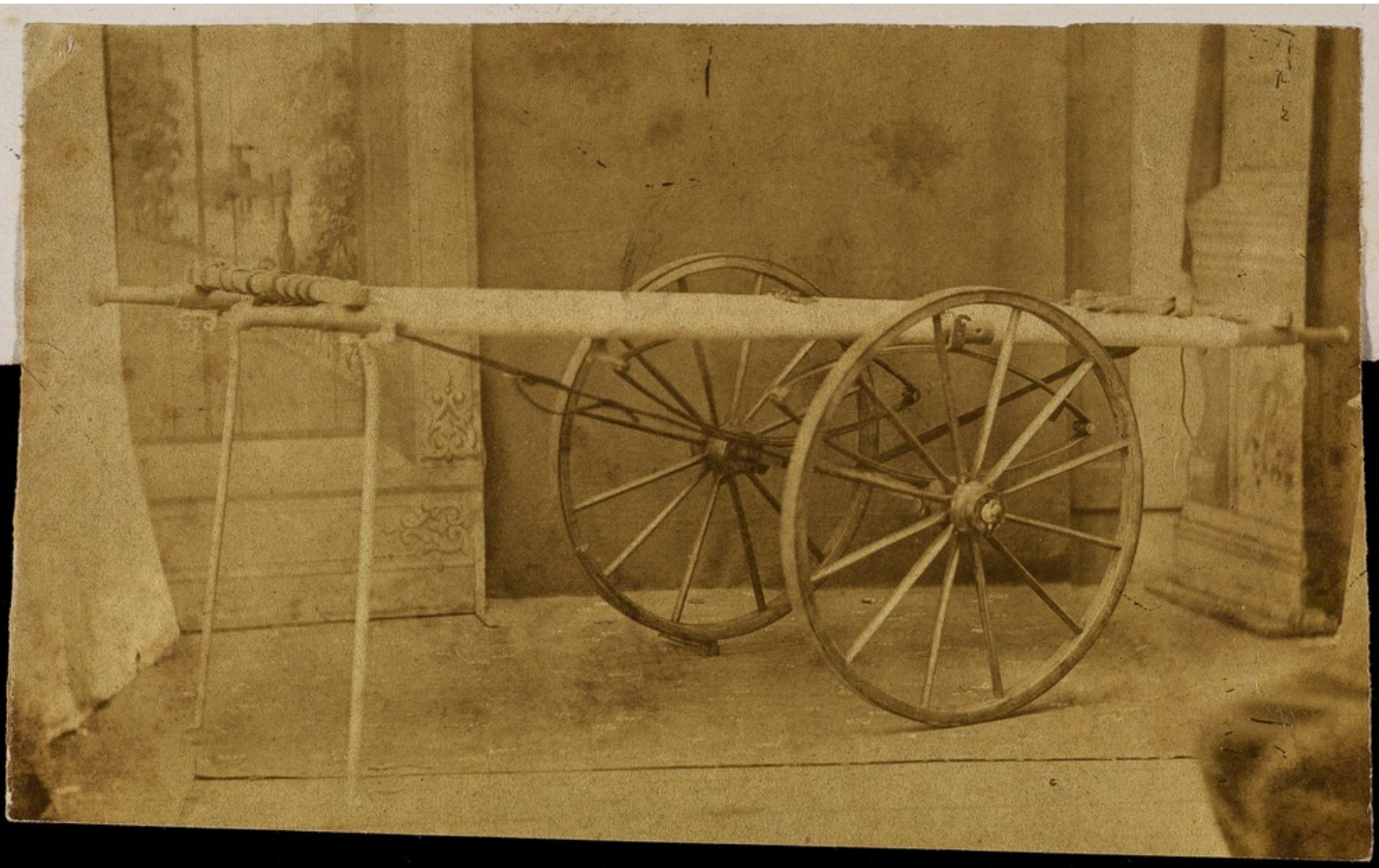
Before being put together this appliance consists of the following distinct parts:—two wheels, washers, and linch-pins, axle, two springs, four iron pins, two fly nuts, one clamping screw for the nave of one of the wheels, and two leathern straps with two buckles. These several portions are afterwards so fastened and secured together that when the appliance is ready for use only three separate portions remain, viz., (*a*) an axle, with a long strap of leather attached; (*b*) two wheels; and (*c*) two springs.

Constraction of Shortell's stretcher-support.

The following is a brief description of these three parts separately:—

(*a.*) *The axle, with leathern strap attached.*—The axle is made of iron, is 26 inches in length within the wheel-naves, is rounded for 12 inches in the centre, but quadrangular at each end for 7 inches within its corresponding wheel. The quadrangular portions of the axle, which are seven-eighths of an inch broad, by one and three-eighths of an inch deep, are intended to receive the springs; and the springs, as will be presently explained, are so fashioned that they can be shifted in position along these particular parts of the axle, and secured at any given point of their length with the utmost facility.

There are two small winged projections connected with, and, indeed, forming part of its axle, at the middle, and to each of these one of the leather straps is attached. These straps are permanently fixed to the axle by means of stitched loops, in the same way as a strap and buckle are usually secured together. Each strap is an ordinary strong leather strap about six feet six inches in length and an inch and a quarter in width, and has at its free end a buckle and several eyelet holes. The straps thus extend sufficiently beyond the axle on each side for them to be buckled respectively to the corresponding traverses of a stretcher when one is placed upon the appliance, and are also adapted for use in keeping the several parts of the appliance together when it is made up into a package.



CHAP. V.

Construction of the stretcher-support.

(*b.*) *The wheels* —These are of ordinary construction. They are two feet seven inches in diameter, are made with six felloes, and are bound by a tire one inch and a half in width. The nave of one of the wheels is fitted with a clamping screw, which pierces it and passes through into the opening along which the end of the axle is intended to pass. This screw works along a metal female screw fixed in the substance of the nave, and is furnished with a convenient handle. The length of the screw prevents any risk of its displacement from accidental causes.

(*c.*) *The springs.*—These are two in number. They consist of double elliptic steel springs, each being two feet four inches from joint to joint across the greater axis. Each spring supports above a small iron crutch for receiving one of the poles of a stretcher. A small chain and pin are connected with each of these two crutches, and through the sides of both of them there is an opening for receiving the pins when it is required to secure the poles of a stretcher upon them.

Opposite to the two crutches, on the under surfaces of the springs, are two projections of somewhat similar form, but longer, by means of which the springs are supported on the axle. Each spring is made to sit on the narrow face of the quadrangular part of the axle which is turned upwards, and are held in position by two lateral pieces of iron. These are of the same width as the spring itself, and are prolonged down each side of the axle. Through these side pieces a square iron pin is made to pass, under and close to the axle so that when in position the spring, the two side pieces, and the iron pin together form an oblong hole for the axle to pass through. One end of the pin is headed, the other is rounded, with a thread cut on it to receive a fly-nut, by which the spring can be clamped on any part of the axle. The fly-nut is prevented from being taken completely off the pin by the end of the pin being capped; thus the spring and its clamping part comprise but one piece, no portion being separable from the remainder.

When the spring is clamped to the axle half a turn of the clamping screw serves to slacken the grasp sufficiently for the spring to be shifted along, or to be withdrawn altogether from the axle.

When the stretcher-support is required for use the wheels and axle are connected, and the springs secured upon the axle, at distances corresponding with the width of the stretcher to be placed upon them, by means of the clamping screws. The clamping screw fixed to the nave of one of the wheels is then turned until pressure is exerted by it on the axle; this renders the axle immovable, and fixes the springs in an upright position ready to receive the stretcher. Two bearers then carry the stretcher over the appliance, and deposit it upon it by letting the side-poles rest within the crutches at the upper surfaces of the springs. As soon as the stretcher is placed on the appliance one of the bearers leaves the end he was carrying to take the necessary steps for fixing the stretcher. The stretcher in the meantime is

Mode of using the stretcher-support.

supported in part by the wheels of the appliance, and partly by the bearer who remains with it. The fixing is effected by passing the iron pins attached to the crutches either over or through the side-poles of the stretcher, as may be most convenient, and then by buckling the two ends of the straps to the respective traverses of the stretcher. As the poles in the regulation stretcher are passed through continuous loops in the canvas, so that there is no opening through which the *inner* arm of the crutch can be passed, it is necessary to cut a small opening two inches in length near the side-pole for it to pass through; and if it is thought desirable that the pin should be passed *through* the pole itself, instead of over it, a hole will have to be previously bored through it for the purpose. As soon as the pins are passed through and the straps buckled the stretcher is ready to be wheeled away by the bearer told off for the duty, the other bearer being then at liberty for other work. Should the stretcher be provided with long feet, as is the case in the one specially arranged for the purpose, and hereafter described, one of the bearers may leave as soon as the stretcher is deposited on the wheeled support, without waiting for it to be secured to it. The remaining bearer simply lets down the feet from the side-poles, and these feet, with the wheels, form a sufficient support for the stretcher while he inserts the fixing-pins and buckles the straps. These being secured he lays hold of the handles of the stretcher at the end near which the feet are placed, raises and secures each foot successively in its place, and is then ready to proceed with the patient.

Having thus described the construction of the wheeled stretcher-support and mode of handling it, it will be useful to notice the manner in which the twelve advantages enumerated at the commencement of the remarks are stated to result from its employment. **Sources of its advantages.**

1. *Adaptability to stretchers of any width.*—This quality is obtained by having the springs so placed on the axle that they can be moved along it to suit either a wide or narrow stretcher. This advantage would equally apply to the case of a stretcher with one or both of its side-poles warped out of the straight line.

2. *Ease to patients.*—This quality is secured by the action of the elliptic springs.

3. *Facility of placing a stretcher and patient upon the appliance without extra assistance.*—This facility is obtained by means of the clamping screw on the nave of the wheels. The action of this screw causes the axle to remain immovable; and so the springs, with the stretcher-pole receptacles upon them, are maintained in an upright position, ready for receiving the stretcher when laid upon them. Were it not for the clamping screw, the weight of the springs would cause them constantly to gravitate downwards, and a third person would be necessary to hold them up when a stretcher was about to be placed on them, as reported to be the case in the *brancard roulant*, previously described.

CHAP. V.

Sources of the advantages of Shortell's stretcher-support.

4. *Security of the stretcher upon the appliance.*—The stretcher is not only secured upon the appliance by the side-poles being pinned upon the crutches attached to the springs, but also additionally fastened by being strapped to the traverses at each end, and to the axle.

5. *Simplicity of construction.*—This quality is chiefly shown by the appliance being capable of being put together, or taken apart and packed, by hand alone; neither hammer nor wrench are required for this purpose. The wheels, axle, and springs are of ordinary construction, with the exception only of the easily manufactured additions necessary to fit them for their special purpose.

6. *Freedom from liability to loss of any of its parts.*—This is due to the manner in which the several parts are connected, as well as the manner in which they have to be combined, both when they are in use and when they are packed for carriage. As before mentioned, the minor parts, such as the clamping screws of the springs, the pins for securing the stretcher poles, are fixtures to the major parts to which they belong. So also the linchpins remain attached to the wheels. The axle clamping screws can only be removed by a deliberate and continued effort. None of the parts, therefore, can be mislaid or be lost by ordinary movement when the appliance is in use.

7. *Facility of movement with a patient lying upon it, by a single bearer.*—The moderate weight of the whole machine, and the fact of the principal part of the weight falling upon the wheels, contribute this quality to the appliance.

8. *Moderate weight.*—The weight of the appliance is 62 lbs. 7 ounces, the wheels being 36 lbs. 4 ounces, the axle and straps connected with them 8 lbs. 3 ounces, and the springs 18 lbs. The weight is greater than it need be, and greater than it was intended it should be. The material used in making the tires is double in thickness of what was required, but none of proper depth and width could at the time be obtained in Southampton, where the wheels were made. No spring wheeled conveyance can be constructed lighter than this may be constructed, for no such conveyance can be reduced to simpler parts than this, viz., an axle, two wheels, and two springs.

9. *Moderate cost.*—The simplicity of construction insures a moderate cost. The price ought not to exceed, or at any rate but very little, the price of an ordinary pair of wheels and axle, with the addition of springs sufficiently strong to bear the weight that is intended to be placed upon them. The pattern subjected to trial cost 4*l.*, but this was manufactured under exceptional circumstances.

10. *Durability under the circumstances of campaigning.*—It is not more liable to be injured by the circumstances of campaigning than any other wheeled vehicle, being proportioned in strength in all its parts to the shocks it is likely to meet with, whether in use or packed up during transport. When in use, the parts most likely to feel the force of any accidental concussion will be the adjustments by which the two springs are clamped to the axle, for these are rigid, and not able to yield, as the other

parts of the springs can, to any force impressed upon them. These are, therefore, made strong and resisting. When fastened up as a package for transport, the most fragile parts—viz., the two springs—are protected from injury by being placed within the two wheels.

11. *Capability of being easily and securely packed for stowage.*—The parts of the appliance are as easily taken asunder as they are put together. When taken asunder, one wheel is first laid on the ground; the two springs, which fit within the circumference of the felloes, and the axle are laid upon this wheel, and the second wheel is then laid over these. The two ends of the strap fastened to the axle are used to buckle the whole together. The two ends of the axle project beyond the wheels, and can be used as handles for the purpose of carrying the package if required.

12. *Capability of use with the most primitive description of stretcher.*—Temporary stretchers, made in the field, and consisting only of two poles cut from a tree, with a piece of sufficiently strong cloth or canvas nailed or otherwise secured to them, can be used with the appliance, by boring two small holes through the poles for the pins of the crutches on which the poles rest to pass through. The pinning of the two crutches to the poles will obviate shifting at the same time that the fixed positions of the springs will keep the poles apart, and thus act in the stead of traverses.

Serjeant Shortell constructed a special stretcher, with long jointed feet, for use with his stretcher-support, but as this stretcher is not an essential part of the appliance, which, as before named, is suited for any stretcher, it is not here described. When the stretcher-support was tried at Netley, the experiments were conducted both with Serjeant Shortell's stretcher and also with the regulation stretcher of the British service.

The trials were made in the same order as that in which the advantages claimed for this appliance have been already enumerated, and it will be convenient to refer to them in the same succession and under corresponding numbers.

The following were the results of the trials:—

Results of trials of Shortell's stretcher-support.

1. The appliance can be used with a regulation stretcher. The springs can be shifted to suit it to a stretcher of any width. The appliance can be used with the middle of the regulation stretcher, placed over the axle, thus throwing *all* the weight upon the wheels; this is not done with a stretcher furnished with long feet, or the feet would be rendered useless. The regulation stretcher requires to have a hole cut on each side in the canvas for it to be properly fastened by the pins of the crutches, but the application of the straps alone secures it sufficiently for temporary use. The appliance was tried with an ordinary regulation stretcher without holes being cut in the canvas, and when a person was wheeled upon it over broken ground the movement was found to be very easy. (The subsequent experimental trials were made with Serjeant Shortell's modified stretcher placed upon the stretcher-support.)

CHAP. V.

Results of trials of the stretcher-support.

2. The appliance was tried with Serjeant Shortell's modified stretcher over ground broken by holes, and the movement was pronounced by the men carried upon it to be very easy. I was myself wheeled over broken ground upon it, and found the movement as free from jolts as I believe it could be on any wheeled conveyance; such concussions as were felt were chiefly felt about the pelvis; the legs and upper parts of the body were very little shaken.

3. There was no difficulty in fixing the appliance, nor in either placing the stretcher upon it or taking the stretcher off. Two bearers only were required for the purpose. As soon as the stretcher was placed upon the appliance, one of the two bearers sufficed to secure it in position by the straps and crutch-pins; the other bearer being set free for any other duty.

4. The fastening of the stretcher to the appliance was perfectly secure. The appliance and stretcher could be lifted up and carried away together, by two men, without the least risk of separation or displacement.

5. The construction was found to be very simple. Every man understood, almost at a glance, how to put the appliance and stretcher together, or to take it to pieces for package.

6. All the parts of the machine appeared to be well guarded against the risk of accidental separation and loss.

7. One bearer could easily wheel the machine with a man lying upon it over any ground admitting the passage of a wheeled vehicle.

8. The weight is sufficiently moderate to allow of two bearers carrying the conveyance with a wounded man upon it for short distances. The experiment was tried of two bearers carrying the whole conveyance with a man upon it, first upon level ground, and afterwards across a gap ten feet in width and two and a half deep; no difficulty was experienced in either case. The wheels proved to be an advantage in the latter case, from acting as a support after the conveyance had been lowered into the gap and while the second bearer was descending into it, so that it was found to be easier to carry a man across this hollow way on the wheeled conveyance than on an ordinary stretcher.

9. The cost of the conveyance has been stated elsewhere; no doubt the cost would be less if made on the same conditions as Government wheeled conveyances are usually constructed.

10. It appeared to be well adapted to sustain the ordinary risks likely to be encountered on field service.

11. When the parts of the appliance were separated and put together for stowage in the manner elsewhere described, the whole was found to form a compact package, readily carried by either one or by two men, and sufficiently secure against damage or loss of parts, without the addition of a packing-case.

12. Although the alleged twelfth advantage was not tried, it was sufficiently manifest that any two poles, however roughly cut, with a piece of cloth stretched and fixed between them, could be adapted to the appliance and rendered capable of serving, as a

temporary measure, the main purposes fulfilled by the stretchers which had been used in making the experiments, the results of which have just been described.

In addition to the advantages just named, it was suggested that the modified stretcher when resting upon the appliance was sufficiently firm on its feet, and of a favourable height, to answer as a substitute for an operating table, in case of one not being at hand when required.

Suggested improvements.

At the same time that the wheeled stretcher-support was found, on trial, to have the advantages just enumerated, it was thought that these advantages might be increased by the following alterations in some of its details (marked A, B, C, D, E, and F), and that these alterations would not interfere in any way with the principles and main features of its construction.

(A.) Instead of the springs being secured to the axle by the clamps, &c., they might each have attached to them in the same situation an eye-hole, of a form adapted to fit and slide along the axle. The fly-nut and screw would thus be done away with; the strength of the spring attachment would be increased without the weight being increased; the axle need not be so broad and deep, and would, therefore, be lighter; and the construction would be even simpler than it is at present. If the eye-holes were rather broader above than below, the axle also corresponding in shape, any tendency of the springs to shift their position while the conveyance was in motion would be obviated; it is not probable, however, even if the holes and axle be square, that such shifting would take place, as the weight upon the stretcher would tend to keep them in their places.

(B.) The joints of the springs might be made after the ordinary fashion of spring-joints, "lugs," as they are called, with advantage, instead of being hinged as they are in the pattern.

(C.) The tires of the wheels might be lessened in the thickness by one-half. This would lessen the weight, and yet leave the wheels sufficiently strong. (It was explained that they would not have been put on of such a substance as they are if iron bands of less thickness but of the same width, could have been got; but the maker at Southampton said there was none of the sort named to be obtained in the town. The constructor was not used to the manufacture of such machines, and the distance of Southampton from Netley preventing constant supervision of the manufacture while it was in progress, led to some small matters of detail being different from what the designer would have arranged had he had more opportunity of interference.)

(D.) Each wheel-nave might be reduced nearly two inches in length, thus lessening the depth of the stretcher-support when packed.

(E.) It would be advantageous if the wheels were so far increased in diameter as to admit the axle within them when packed. The package would be facilitated, in a canvas bag for example, and this would be especially obvious in case of a number of these appliances being packed and sent away together.

CHAP. V.

(F.) It would be useful to substitute another plan for holding the stretcher-poles in the crutches upon the springs. Pins and chains are liable to be broken off, and though, in the present instance, easily replaced, this inconvenience may as well be obviated if practicable. Some means by which the stretcher-poles could be securely fixed within the crutches would perhaps answer best; the attachment of the stretcher to the wheels and axle would then be still more independent of the addition of the straps.

On the whole, however, there can be no doubt that the wheeled stretcher-support just described was the most practically serviceable invention of the kind at the time of its introduction. Its value has been shown by several features in its construction having been copied by subsequent designers of wheeled litters, and it seems not unlikely that, if conveyances of this class are ever regularly admitted as articles of field hospital equipment, the particular patterns adopted will be some modification of the simple stretcher-support designed by Serjeant Shortell, rather than any of the more complicated kinds which are occasionally recommended.

Dr. Gauvin's spring stretcher on wheels.

*Dr. Gauvin's spring stretcher on wheels.**—This is the wheeled stretcher which gained the competitive prize offered for the best example of its class on the occasion of the Universal Exposition at Paris in 1867. Some of its features have been already alluded to in general terms in the chapter on stretchers (page 160), but a particular account of its construction was reserved to be placed in the present chapter, for it was as a *wheeled stretcher* that the contrivance chiefly attracted attention at Paris. Moreover, it is only in this form that Dr. Gauvin's stretcher can be studied with completeness; for, although capable of use as a field-stretcher without the wheels, it is scarcely likely that in such a capacity alone it would have been recommended for adoption, for reasons already given in the remarks upon it among those on hand-litters.

Dr. Gauvin's wheeled stretcher has undergone several alterations in the details of its construction, and other adaptations have been added to it, since the date when it was first brought before the observation of the committee who adjudged to it the prize at Paris, but the essential features embodied in the contrivance remain the same. The following illustrations, which are copied from the second part of the report of the proceedings of the international meetings of the societies for aid to wounded troops held in Paris in August 1867, serve to give a fair idea of Dr. Gauvin's stretcher in its latest form, both on and off its wheels.

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* This stretcher was thus named at Paris. "*Brancard à roues et à bras. Brancard à ressorts, nouveau modèle, du Dr. Gauvin, conservant la suspension et l'élasticité avec ou sans ses roues.*" "Wheeled and hand-stretcher. Spring stretcher, new pattern of Dr. Gauvin, preserving suspension and elasticity without or with its wheels." It was also spoken of as Dr. Gauvin's "*Brancard-lit à ressorts,*" or "spring stretcher-bed."

Fig. ^. Dr. Gauvin's Spring-stretcher on Wheels.

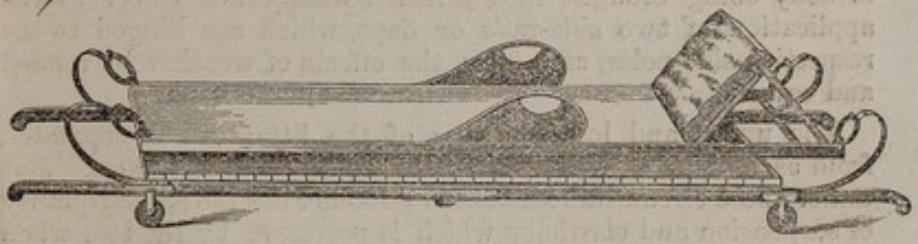


Fig. ^. Dr. Gauvin's Spring-stretcher removed from its Wheels. The small wheeled feet shown in the drawing are to facilitate its passage over the floor of a wagon.

Essential features of Dr. Gauvin's contrivance.

An examination of Figures Nos. ^ and ^ serves to show that the most striking feature in Dr. Gauvin's wheeled stretcher is the two-fold construction of the part upon which the patient is placed. Instead of a single stretcher, as is ordinarily used, Dr. Gauvin employs a double stretcher, the upper of the two stretchers being suspended by leather rings from four steel springs fixed to the four corners of the lower stretcher. The necessity for springs between the stretcher and the wheels and axle is thus got rid of, and, in the present instance, as may be noticed in Fig. ^, the union is established by the side-poles of the under stretcher being connected with rigid oblong pieces of iron approaching the letter V in shape, attached to and rising upward from the axle.

When the double stretcher is used without the wheels it is the lower of the two frames which is held in the hands of the bearers. It is furnished with handles for this purpose. The lower frame is a complete stretcher, the side-poles being fixed

CHAP. V.

Concluding remarks on Dr. Gauvin's contrivance.

from the wheels to the same extent as is possessed by it when upon the wheels. And hence it is that the stretcher is equally capable of use on carts or wagons, whether common country carts or railway wagons, without springs, as it is of being used on its own wheels and axle without springs. The weight of the stretcher is unavoidably increased to obtain this quality, and simplicity and singleness are necessarily done away with in its construction. The weight of the double stretcher, as before mentioned at page 161, really unfits it for the general purposes of a primary stretcher. It is true that it can be divided into two parts and each part separately used as a stretcher, but the distinguishing qualities of suspension and elasticity disappear from each the moment the separation is made. The upper and lower frames must be joined together in order to obtain the advantages of these qualities.

Discarding all idea, however, of using Dr. Gauvin's stretcher without its wheels as a *primary* field stretcher, the contrivance has many features to recommend it for use as a stretcher of the *secondary* kind, with adaptation for rapid movement on wheels when the terrain is such as to admit of their employment. One important question which has to be determined is, how far its construction will enable it to resist the shocks all such articles must be subjected to in campaigning, and this can alone be settled when sufficient experiments have been made on the subject.

Prussian army wheeled stretcher.

Wheeled stretcher under trial in the Prussian army.—The wheeled stretcher made by M. Neuss, of Berlin, and used by the Knights of St. John in the service of the Prussian army, has been already described. After the introduction of that conveyance the Prussian military authorities adapted the stretcher of one of the army regulation ambulance wagons, the "Transport Wagen für Schwernerwundete," for being moved upon wheels. The adaptation was arranged by an officer in the Prussian War Office, and the plan carried into execution by the Government contractor, Mr. Dittmary. This contrivance differs in many particulars from Neuss's litter.

The stretcher thus adapted is one of the secondary kind; it is not made capable of being folded up either transversely or lengthwise, but has been chiefly prepared for being carried in the ambulance wagon before named; although, at the same time, it can be carried by hand when required. A traverse made of wood near the head of the stretcher, and two iron rods slightly bent near its middle and foot-part, are used to keep the side-poles apart. These latter rest upon four short wooden feet. On the inferior surfaces of these feet are iron bands, and these bands are continued from them on each side, and cover nearly the whole length of the under surfaces of the side poles. The feet are thus strengthened, and the gliding of the stretcher along the floor of the wagon facilitated. The greater part of the bottom of the stretcher consists of canvas sacking, which is laced underneath, and admits of being removed for being cleaned, or of being slackened or tightened at pleasure. The part which supports

Construction of the stretcher.

the head and shoulder of the patient is moveable, being hinged at the lower end, and supported upon two racks which work within the side-poles. A pillow of glazed cloth is attached by three straps to the surface of this head-piece, and underneath the latter there is a small knapsack, also fastened by buckles and cords, for carrying articles of dressing, bottles, &c. A padded flap is hinged to the centre of each side-pole; these flaps protect the arms of a patient from coming into contact with the wheels.

Construction of the wheeled support.

The wheeled support made to receive this stretcher consists of two short wheels, each being about 2¼ feet in diameter, turning upon an iron axle which carries two elliptical springs. Props are connected with the joints at the four ends of these springs, and when these are let down the stretcher-support remains in position ready for the stretcher to be fixed to it.

The stretcher fixed upon its wheeled support is shown in the following drawing which is copied from Dr. E. Gurlt's descriptive plates of ambulance matériel.*

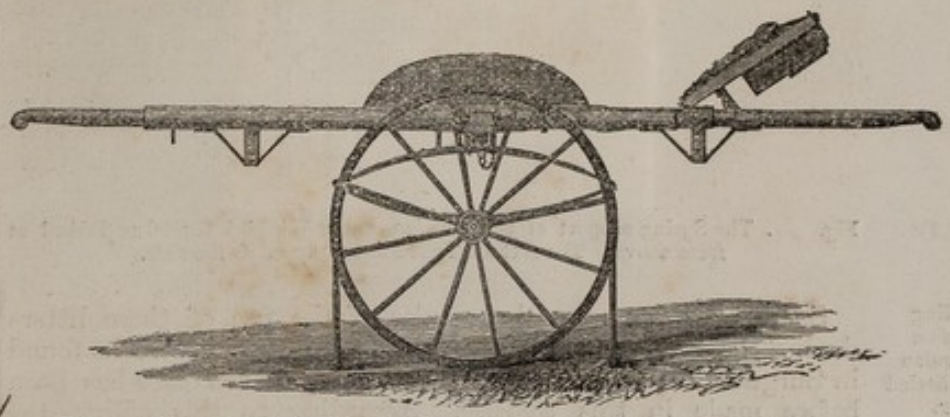


Fig. . Side-view of the Wheeled Stretcher in use in the Prussian army.

Connexion of the stretcher and wheels.

The mechanism by which the stretcher is fixed to the wheeled support is simple. Upon the top of each spring there are two small iron supports, and resting upon them a crutch of the same metal and of proper size for receiving one of the side poles. The inner side of the crutch is less in height than the outer side. The middle of the floor of the crutch is pierced by a rectangular opening. Beneath the middle of each side-pole of the stretcher is an iron tenon of a size fitted to enter this opening, and long enough to pass below it between the two crutch-supports. The lower part of the tenon is pierced by an opening in shape like the key-hole of a lock placed horizontally. When the poles of the stretcher have been placed in the crutches and the side-pole tenons have passed through their respective openings, they are each fixed in their place by the insertion of a small bolt adapted in shape for entering the horizontal key-hole before named. The bolts for this purpose are attached by small chains to the respective springs. When a half-turn is given to them after

* For a reference to this work see Appendix.

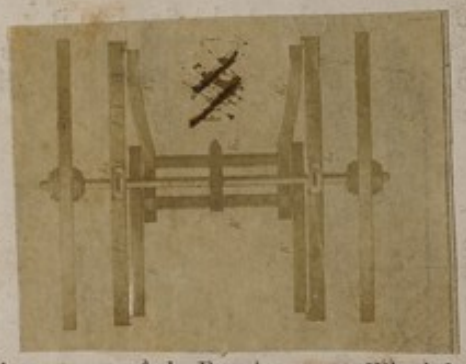
note 4.

CHAP. V.

their insertion their own weight maintains them in the position thus given, and they can only be withdrawn by again raising them a half-turn upwards.

The feet of the stretcher-support.

The four feet attached to the ends of the elliptical springs are not left to act singly, but are united into two couples by cross-pieces being joined to them. One of these couples is bent so as to be capable of folding within the other couple. When not employed as supports the two couples are turned upwards toward the axle, and here they are secured by a strap and buckle which is passed around them and the axle together. The shape of the feet and the manner in which they are folded up are shown in the following sketch :—



95

Fig. . The Spring-support of the Prussian army Wheeled Stretcher looked at from above. The feet are folded and strapped to the axle.

Concluding remarks on the Prussian army wheeled stretcher.

Some remarks upon the results of the use of these litters during the Prussian campaign of 1866 in Bohemia, will be found in Surgeon-Major Bostock's report, to which reference has been before made in this treatise. According to this officer, the opinion of the Prussian surgeons was not so much in their favour as might have been expected.* The chief objection seems to have been the jolting and rough movements caused when they were wheeled over stony and uneven ground. Over good roads, level turf, and some cultivated ground, the movement was rapid and easy, but this did not appear to compensate for the drawback above named. Dr. Gurlt has pointed out that the lowness of the wheeled support gives rise to a certain amount of inconvenience, for persons of middle height or upwards are compelled to bend themselves forward in order to keep the stretcher horizontal while wheeling it along. Higher wheels would moreover facilitate the passage of the conveyance over uneven ground.

Height suitable for wheeled stretchers.

It is questionable whether the wheels of any wheeled stretcher should be less than 3½ feet in diameter. The axle will then be 1 foot 9 inches from the ground, and allowing another 9 inches for the springs and stretcher receptacles upon them, the stretcher

* Army Medical Reports, vol. vii., p. 377.

Fig. 1.

Fig. 2.

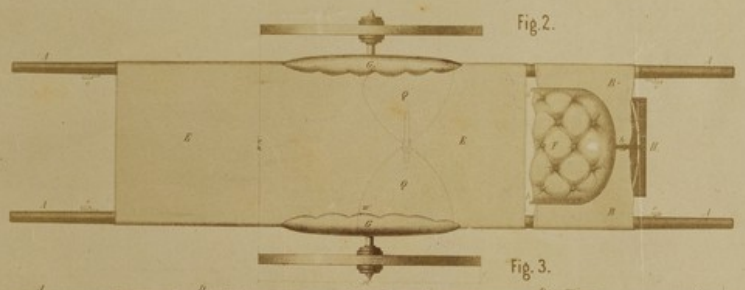


Fig. 3.

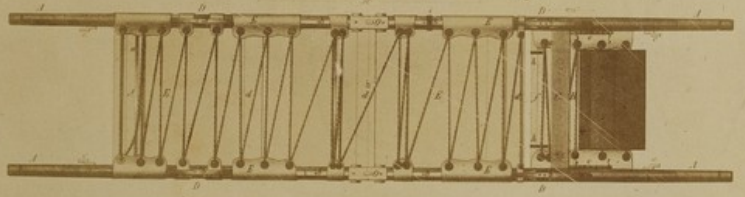
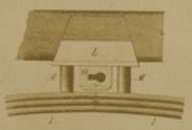


Fig. 6.



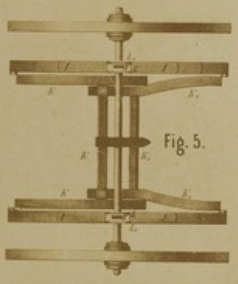


Fig. 5.

Fig. 8.

Fig. 7.

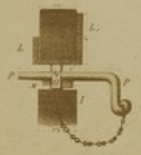


Fig. 9.

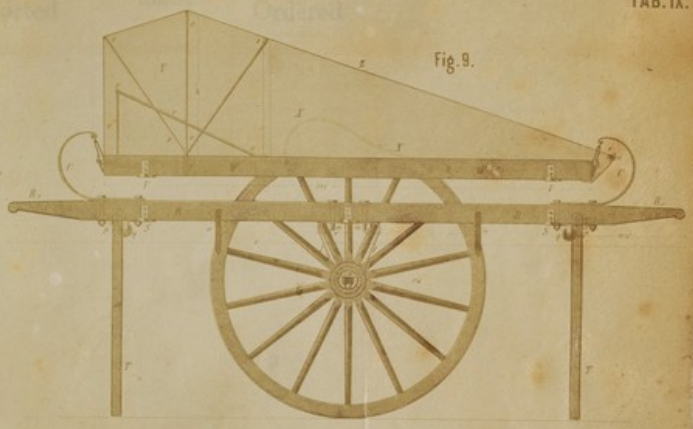


Fig. 10.

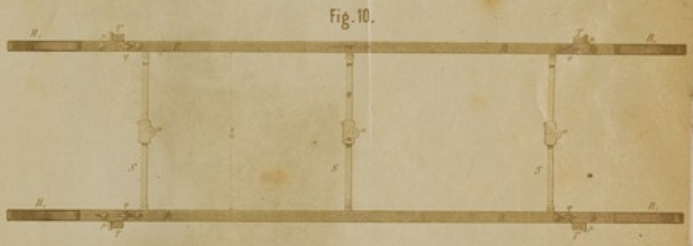
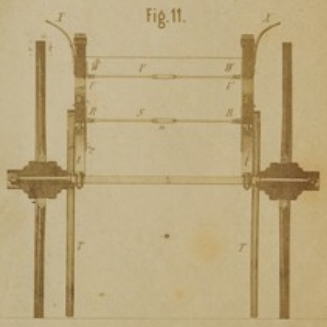


Fig. 4.

Fig. 11.



Verlag v. A. Easlin in Berlin.

Lith. Anst. v. W. Loeillot in Berlin.

NAME	Troop or Company	D... C...	D...	D...

CHAP. V.

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95/ Fig. ^. The Spring-support of the Prussian army Wheeled Stretcher looked at from above. The feet are folded and strapped to the axle.

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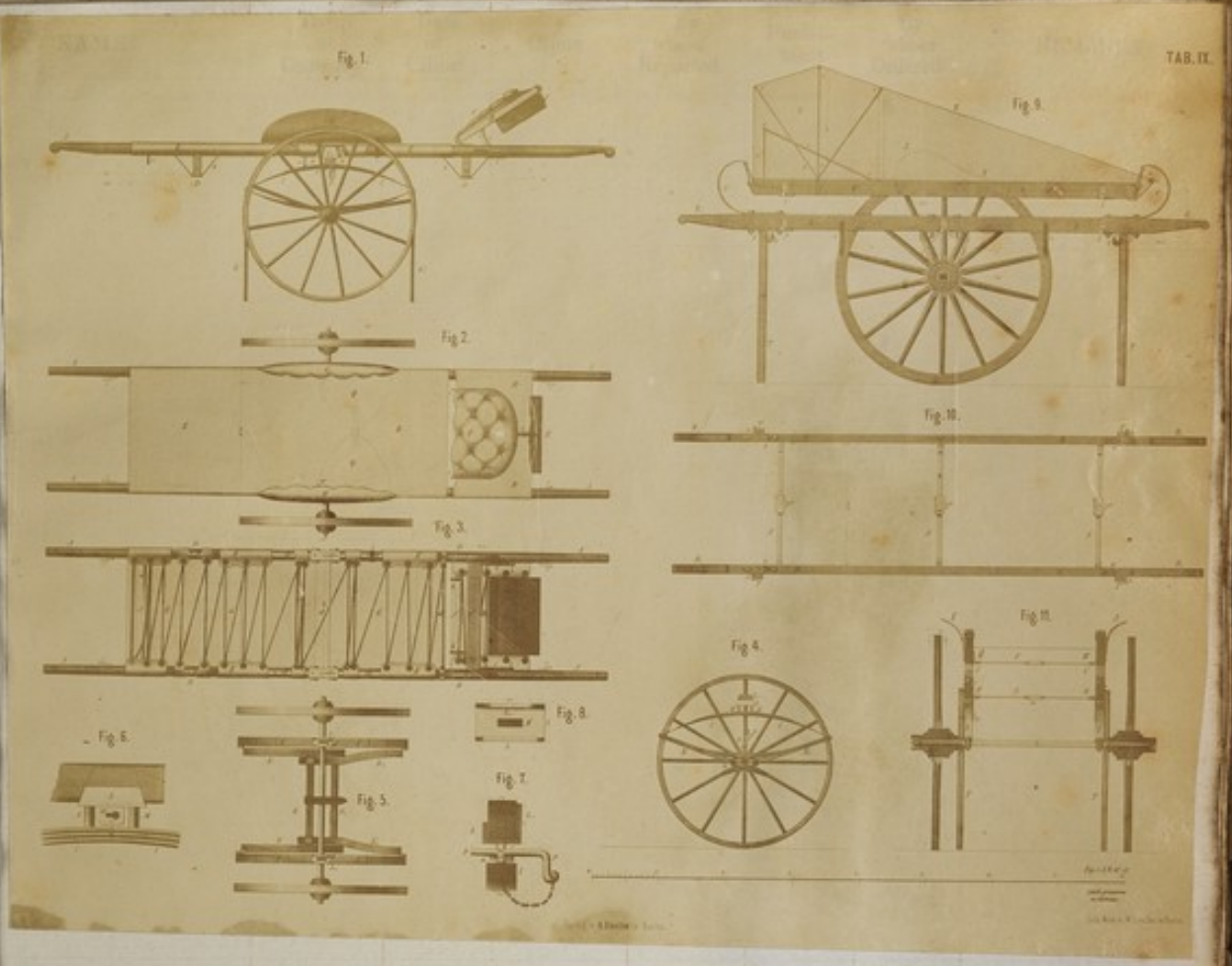
* Army Medical Report, vol. vii., p. 377.

Wheeled by Men.



NAME	Troop or Company	Date of Crime	Crime	By whom Reported	Punish-ment	By whom Ordered	REMARKS

Wheeled by Men.

By whom Ordered	REMARKS

itself, when horizontal, will be 2½ feet from the ground. This is the position at which a man of average height, one of 5 feet 8 inches for example, is found to be able to handle and push a wheeled stretcher kept level most easily, so far as the use of his arms and personal exertion are concerned.

CHAP. V.

Swiss wheeled stretchers. — Two forms of Swiss wheeled stretchers are figured in Dr. Gurlt's plates of ambulance matériel, one designated "brancard roulant Suisse," the other "brancard à roues Suisse, modèle de M. Ruepp."

Swiss wheeled stretcher.

Brancard roulant Suisse.—This stretcher has its two wheels applied to it at one of its extremities, and it is used in the same way as one of the Bautzen wheelbarrows before described. The stretcher is simple, consisting only of two poles and a canvas bottom with detached traverses. Each traverse is made of iron, has two feet in one and the same piece with itself, and is provided with circular openings so that it may be passed over the pole-handles. Only one of these traverses is employed when the stretcher is used as a wheeled conveyance, this traverse being at the end which is handled by the bearer. At the other end the two poles, for about six inches from their extremities, are covered with metal, and within these limits the poles are pierced by two openings passing completely through them and destined to receive the ends of the axle on which the wheels turn. The axle and wheels have to be inserted before the traverse is put on. The absence of the traverse enables the handles to be brought near each other, and in proportion causes the space between the other end of the side-poles to be widened, so as readily to allow the insertion of the axle into the openings provided for it. The wheels and axle being fixed, the traverse with its feet is put in position at the other end, and the wheeled stretcher is ready for use. It is obvious that such a contrivance may be very quickly put together. The wheels are only of moderate height, viz., 1 foot 8 inches in diameter, causing the part of the stretcher in which the axle is inserted to be about 10 inches above the surface of the ground. The iron feet attached to the traverse are 13 inches in height; so that there is a gradual slope from the handle of the stretcher toward the wheels when it is standing upon the ground. This slope is of course increased when the stretcher is being wheeled.

Its construction.

Several objections present themselves to a wheeled stretcher of this description. Not only the exertion of moving the conveyance, but a very large proportion of the weight of the vehicle and the patient upon it has also to be borne by the person pushing it along. The labour of rolling it up an inclined road would speedily cause great fatigue; in rolling it along a road with a downward inclination, the slope of the stretcher and the flatness of the canvas would give a constant tendency to the patient to glide downwards toward the wheels. There are no springs to the conveyance, and, as already pointed out in the description of Arrault's wheeled stretcher, this want would unfit it for use over any but the most level and smoothest roads. The

Remarks on this stretcher.

CHAP. V.

lowness of the wheels would increase greatly the difficulties arising from friction, especially if the conveyance had to pass along ground which admitted of the wheels sinking below its surface.

M. Ruepp's wheeled stretcher.

Brancard à roues Suisse, modèle De M. Ruepp.—This wheeled stretcher consists of a simple stretcher, without feet, placed upon a pair of wheels and springs having the general appearance of Shortell's stretcher-support. The chief points of difference are the manner in which the springs are fixed to the axle; the want of means for fixing them upright to receive the stretcher; and lastly, the absence of the straps connecting the axle and traverses, which act an important part in Shortell's contrivance, and consequently the necessity of fixing the side-poles more firmly in the grasp of the crutches than exists in that conveyance.

Mode of fixing the stretcher to its wheeled support.

In M. Ruepp's stretcher the springs each rest upon a small upright iron column, the end of which is caused to pass through an opening prepared for it in the corresponding end of the axle, where it is fixed by a small bolt attached to a chain. The crutch on the top of the spring is circular, but divides into two halves, the upper half being made to open outwards from the lower half by means of a double neck and connecting hinge-joint. When the upper half is turned over towards the wheel, the lower half is uncovered and ready to receive the stretcher pole. The pole being placed in it, the upper half is turned over again so as to cover the pole. It is then fixed in the crutch by a screw which, being turned through the double neck, binds the two halves of the crutch together with the pole between them. The wheels are two feet seven inches in diameter, and the stretcher when fixed upon the springs is nearly of the same height above the surface of the ground. The stretcher is not supported in the centre, but at a point such that three-fifths of its weight are on one side, and two-fifths on the other. It is supposed that the act of pushing is rendered easier by this arrangement; but this seems questionable, as, when the stretcher is evenly balanced upon the wheels, its weight is transmitted through them to the ground, and none of it falls upon the arms of the bearer. No means are provided for supporting the stretcher in a horizontal position in case of the bearer quitting his hold.

Col. Clerk's wheeled stretcher.

Colonel Clerk's field-stretcher adapted to wheels.—The field stretcher invented by Colonel Clerk has been already referred to, and descriptive drawings of it given, among the remarks on the second subdivision of hand-litters.* Colonel Clerk has adapted this stretcher for being supported on springs and moved on wheels. The wheels, axle, springs, and side supports weigh thirty-nine pounds, in addition to the weight of the stretcher. The chief feature in the adaptation is the ingenious construction of the wheels, which are wholly composed of metal. The tire is divisible into three portions, and each of the spokes, which are

* Pp. 123-125.

Construction of the wheels.

all tubular in form, is also separable both from the tire and the nave into which it is inserted. The two wheels can thus be taken to pieces, and, together with the springs, all packed in a small bag, of which the largest outline corresponds with one of the three sections of the circumference of the wheel. As the connexion of the several parts of the wheel is effected by a system of interchangeable screws, less time is required for mounting and dismounting the wheels than might be anticipated. Experience can alone show how far wheels so constructed will be able to withstand the strains of active service.

WHEELED STRETCHERS WITH VERY SMALL WHEELS.

Stretchers with low wheels.

Several conveyances of this class were shown at the Paris Universal Exposition of 1867, fitted with wheels considerably smaller than those belonging to any of the contrivances hitherto described. These low wheels were sometimes rather less and never more than one foot in diameter. Several advantages were claimed for these contrivances by their inventors, but their chief object seemed to be to keep each wheeled litter light enough to be carried by a bearer as easily as a hand-litter. In one or two instances a single central wheel only was provided, in others the conveyance was fitted with two side-wheels; in one or two instances the wheels could be either brought together so as to form a single central wheel, or separated and used as two wheels. It will be useful to describe a few of these contrivances.

Castiglioni's stretcher.

Castiglioni's wheelbarrow stretcher. (*Brancard-charrette du Dr. P. Castiglioni, de Florence.*)—This is a wheeled stretcher presenting several ingenious features; being adapted for being carried by hand, or for being wheeled along: for being wheeled by a single central wheel, or by two wheels, one at either side: for carrying a patient either sitting or in a recumbent position. When used with two wheels this conveyance presents in some respects the appearance of one of the low-wheeled barrows often employed at railway stations for moving luggage; and, indeed, Dr. Castiglioni mentioned to me that he first took his idea of the stretcher from observing the ease, quickness, and security with which packages are carried along on wheelbarrows of a similar construction at railways.

Its construction.

The stretcher is formed of two wooden side-poles, not straight, but presenting a slight double curve, so that the upper surface of the stretcher is concave at the middle and convex as it approaches each end. The inventor stated that this form was given because it answers to the natural curves which the body of a recumbent man follows when all the muscles are relaxed. The side poles are kept apart by two wooden traverses at the two extremities, and by a concave iron traverse midway between them. The stretcher is jointed, so that one part can be folded back upon the other part; the joints are not at the centre, but near the point where the middle third of the stretcher unites itself with the last third of its length. The joinings are made rigid by the insertion of two small bolts, attached to the stretcher

CHAP. V.

by short chains. The legs of the patient rest on the third section of the stretcher. The bottom of the stretcher is formed of cross-bands, or girths of leather, narrow spaces being left between them. On these the patient lies, a little leathern pillow being provided to support his head, and a small upright piece of wood to support the feet. The elasticity of the leathern girths is chiefly depended upon for prevention of concussions when the conveyance is in motion, no metal springs being fitted to it. There are two iron supports or feet, joined together at their extremities by a cross-piece, and attached to the part of the stretcher at which the patient's head rests; this support folds back, and can be fixed up to the under surface.

Near the joints of the stretcher, and outside each side-pole, two pieces of iron are placed; these support an axle, and upon this axle are two small wheels, each 30 centimetres, or about one foot in diameter. The axle is square, excepting its two ends which enter and turn in the supports just described. When the stretcher is wheeled along the ground, the wheels and axle turn round together. The wheels are capable of being moved along the axle so that they can be placed apart from each other, each at one end of the axle near its corresponding side-pole, or they can be brought close together at the centre of the axle. They are fixed in either situation by iron pins which pass through openings made for the purpose in the axle itself. When the last third of the stretcher is folded back over the other two-thirds, the wheels have then a position beneath what is thus rendered the end of a shortened stretcher. The weight of the whole is said to be 8 kilog., or between 17 and 18 lbs.

Its alleged advantages.

The advantages stated by the inventor to have been aimed at by adopting this form of stretcher are the following:—1st, to have in one and the same conveyance a simple hand-litter and wheeled litter; 2nd, to carry the weight below and far removed from the hands of the hospital bearer who conducts it, as this arrangement renders it easier for one man to manage the conveyance, since he can push it before him; 3rd, to be able to watch the patient along all kinds of roads, and even along footpaths, the two wheels being most convenient for ordinary routes, but one wheel for very narrow paths; 4th, to have it solid, at the same time very light, and this is accomplished by the small wheels, which render it so easy of carriage that one man can carry it with the aid of straps behind his back; 5th, to be able to clean away blood by a little water, as may be readily done from the bottom and pillow being made of leather; 6th, to obtain complete repose for the patient, with freedom from jolts; 7th, to have the mechanism simple and the price moderate (in the present instance the cost is 50 francs, or 2*l.*, with the girths in leather; 38 francs, or about 1*l.* 10*s.*, with the girths in hempen webbing); 8th, to be able to carry a man seated, as well as recumbent, as may be done with this stretcher by using it either extended or folded; 9th, to be able to put a wounded

man on it with the greatest facility, such as one can do on a litter slightly raised above the ground.

Observations on Castiglioni's wheelbarrow stretcher.

I did not see any trials made with this stretcher, but it appeared to me that it would be found very jolting if wheeled over rough ground, owing to the absence of springs and to the lowness of the wheels; that it would require to be made much more solidly than the pattern in the Exhibition to stand the strain of actual service, when of course the weight would be proportionably increased; that the smallness of the wheels would render them almost useless if the vehicle had to pass through deep ruts, or over very muddy or sandy ground. When the two wheels are used at a distance apart, in turning round a curve one wheel must drag, as is always the case when wheels and axle turn together. At the same time, for passage over smooth roads in good condition, this stretcher seemed capable of affording most of the advantages claimed for it.

Bn. Mundy's one-wheeled stretcher.

Baron Mundy's single-wheeled stretcher.—Somewhat similar to the foregoing in general form was a new wheeled stretcher exhibited by Baron Mundy, delegate from the Austrian Minister of War. It had the same doubly curved form and nearness to the ground, but differed in not being capable of being folded in two, and in only having a single wheel. This wheel, which measured about one foot in diameter, was broad, solid, and turned with its axle. It was held in a central position beneath the stretcher by a triple-branched iron support. Two of the branches of this support were fixed to the side-poles, from which they curved downwards to form the axis of the wheel. The third branch, also curved, came from a concave traverse below the stretcher, and forking near the wheel formed a short arch over it. The two ends of this arch were fixed to the ends of the other two branches where they formed the axle, and the whole arch helped to keep the wheel from rocking upon the axle or swaying from side to side when in motion. The bottom of the stretcher was formed of hempen webbing interlaced. To prevent the risk of a patient rolling off the stretcher a rail was placed on each side at the low middle part of the stretcher; and in order that these rails might not interfere with the facility of placing a patient on the conveyance or taking one off, they were jointed in the middle and capable of being detached at one end, so that they could be folded back out of the way whenever necessary. Shoulder-straps were attached to the handles of the stretcher to assist the bearers in carrying, or a single bearer in drawing it.

Its construction.

Observations upon this contrivance.

Independently of the general objections arising from the use of low wheels, which apply to this as much as to the preceding pattern, another defect was observed in this contrivance, owing to the presence of only a single wheel. On trying to wheel a person upon it, it was found very difficult to keep the stretcher level, especially when the weight was not distributed upon it with exact evenness. Moreover, the triple iron support, which was very substantial, increased the weight considerably. The

CHAP. V.

weight of the conveyance complete appeared to be about fifty pounds.

M. Devillers' one-wheeled stretcher.

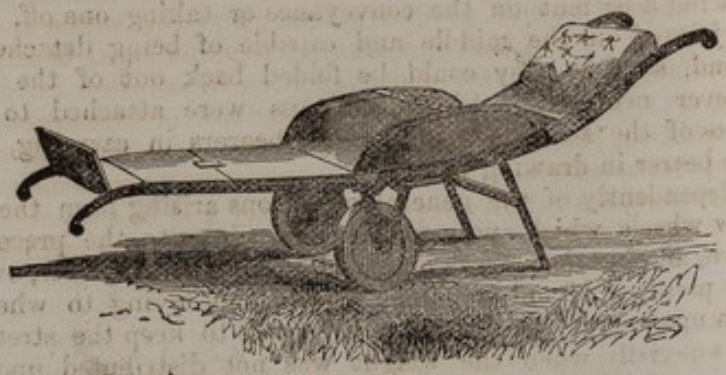
A single-wheeled stretcher, constructed on nearly the same principles as the above was also exhibited by a French exhibitor, Dr. Devillers. The wheel in this instance was expanded near its circumference, so as to offer a still broader support on the ground, and to diminish the liability to tilting over to either side.

Bn. Mundy's two-wheeled stretcher.

Baron Mundy's two-wheeled stretcher.—Baron Mundy subsequently sent to the collection a two-wheeled stretcher, very similar in general features to Castiglioni's stretcher, before described, but differing in some of its details of construction. Like Castiglioni's, the wheels were moveable along a small square axle, and could be fixed together as a single central wheel, or used as two separate wheels near the side-poles. The supports by which the wheels and axle were attached to the stretcher were two single curved steel bars, fastened by screws and fly-nuts to the under surfaces of the corresponding side-poles. These supports therefore acted to a certain extent as springs, and thus supplied a deficiency which existed in the fixed support of Castiglioni's stretcher. The crossed pieces of leather in the latter stretcher were replaced in Baron Mundy's by a canvas sacking bottom, which was moveable, being attached to the side-poles and traverses by short straps and buttons.

Bn. Mundy's improved two-wheeled stretcher.

Baron Mundy's improved two-wheeled stretcher.—A further improvement has been made by Baron Mundy in the stretcher just described, the effect of which has been to make it more portable, and to do away with the inconvenience, before noticed, of the dragging of one wheel in turning which existed when the wheels and axle rolled together. In this last contrivance, which, like the two former already described, has been made by Messrs. Fischer, of Heidelberg, under the inventor's direction, the two wheels are separately supported; the weight has been diminished to a very low limit, about thirty pounds; and the whole conveyance is so jointed that it can be folded up into a package small enough to be carried on the back of a bearer like a knapsack. The illustration which follows represents the general form and construction of the wheeled stretcher under description.



XCVI/

Fig. ~~X~~—Baron Mundy's Stretcher on two low wheels.

In folding it up for package, the strap connecting the two side-wings is unbuckled, the small bolts which depend from short chains are withdrawn from the hinges, the head-piece and pillow are folded down upon the middle section, the front piece is folded over, and the two wheels are folded inwards, when they lie nearly flat and in contact with each other. The strap, which when the litter is in use serves to connect the two side-wings, is now used to fasten the whole package together. Shoulder-straps are provided with each litter to assist in its movement, and by their means the whole, when folded up, is also carried on the shoulders of the bearer.

Mode of packing the stretcher for carriage.

SECTION II.—CONCLUDING OBSERVATIONS ON HAND-WHEEL LITTERS.

The remarks accompanying the various forms of wheeled stretchers which have now been described show that, while many of them possess many features of usefulness and some exhibit great ingenuity in construction, no one pattern can be held to possess all the qualities requisite to fit it for the general purposes of campaigning. The special objects aimed at by the introduction of this class of conveyances, which have been already mentioned in the general observations preceding the descriptions of the contrivances designed to meet them, together with the defects which have been noted in particular examples, sufficiently indicate the desiderata which remain to be accomplished. For any wheeled stretcher to be accepted as a satisfactory article of field-hospital equipment, the stretcher part of the conveyance must possess all the qualities of a good hand-litter; it must be capable of being rapidly and securely mounted on its wheeled support, and as rapidly dismounted when necessary; it should be so balanced on its wheels as to be easily drawn or pushed by a single bearer; the effect of jolting in passing over uneven ground must be provided against on the stretcher and wheels being combined; while strong enough to resist the ordinary shocks of field use, the wheeled stretcher complete must be light enough with a patient upon it to be carried by two bearers in case of ditches, or other impediments to progress on wheels, being met with; it should be capable of standing on its own supports, in case of occasion occurring for the bearer temporarily to leave his charge, as, for example, when a bearer with another wheeled litter requires assistance; it should not be costly, so that a sufficient number may be readily provided; it should be so contrived that none of the minor parts are likely to be lost or disarranged; and the whole should be capable of being folded and secured together so as to constitute a suitable package for conveyance on board ship or on store wagons. The qualities just mentioned are of first necessity; if, in addition, the objects aimed at by Dr. Gauvin in his contrivance can be attained, so that the stretcher when removed from the wheels can retain adequate elasticity and be available for use on country wagons without springs, or on railway trucks, then

Qualities required in a military hand-wheel litter.

CHAP. V.

the value of the contrivance will be materially increased. Several of the wheeled litters which have been described possess all the necessary qualities for use in the service of fixed hospitals, or with any establishments, such as large factories, where accidents are liable to occur entailing the removal of persons to hospitals situated some distance off, the roads and other circumstances being at the same time suitable for their employment, but none of them have been found to have all the qualities just described to be necessary for fitting them for use in military operations.

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CHAP. V.

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Wheeled by Men.

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Borne by Animals.

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CLASS III.—CONVEYANCES BORNE BY ANIMALS.

General Observations.

CHAP. V.

We come next to the conveyances in which the transportation is accomplished, not by means of men, but of quadrupeds. These naturally become at once divided into two very distinct classes. In the first of these, not only the movement, but also the sustentation of the patients is directly effected by the animals; in the second, the patients are sustained on vehicles, wheeled or otherwise, resting on the ground, and the translation only is effected by the animal. In the former, the conveyances which carry the patients are themselves *carried by the animals*; in the latter, the conveyances are not thus supported, but are *drawn by the animals*, or if partly also sustained by them, as in the instance of two-wheeled vehicles, it is only comparatively in a small degree that the powers of the animals are taxed in this respect. The first division, comprising *conveyances borne by animals*, constituting the third class of sick-conveyances in general, will now be considered.

Quadrupeds chiefly employed in ambulance transport.

The quadrupeds chiefly employed in carrying conveyances designed for ambulance transport are mules, horses, and camels. Rarely, elephants also have been used for the same purpose. The two former are employed in all climates; camels and elephants are almost exclusively used in tropical countries, or in countries bordering upon them. The Indian elephant has alone been employed for transport purposes, the African elephant not being apparently capable of being rendered available for such a purpose. The camel is used both in Asia and in Africa, and is the only available means of transport in districts where wide sandy plains exist, or between countries divided by extensive deserts.

Leading forms of the conveyances borne by animals.

It is obvious that the condition and circumstances of sick and wounded men render it necessary that some appropriate artificial support shall be interposed between them and the sharp projecting spines, and shelving backs and sides of the animals just mentioned, so that they may be conveyed with comparative ease and security. The supports or conveyances which have been devised for this purpose are of various kinds, and have certain leading varieties of form. The support may consist simply of a saddle, or level pad, adapted to the shape of the animal's back, acting itself as a seat or supporting a litter placed above it; or it may be a seat or litter, suspended from a pack-saddle, and

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CHAP. V.

held in position by the side of the animal, being balanced by another similar conveyance on the opposite side; or it may be supported between extended poles or shafts, while the ends of these shafts are caused to rest upon the backs of two animals, one in front, and the other behind the conveyance.

The forms of the conveyances must be adapted to the animals that carry them.

Peculiarities in the size, mode of progression, and the habits of the animals which are employed in carrying sick and wounded, lead to corresponding differences in the forms and qualities of the seats and litters for the sick which are placed upon them. Indeed, the kinds and shapes of these contrivances have usually such definite relations to the animals to which they have been adapted that, in considering them, it will be most convenient, first, to take a separate glance at the characteristics, so far as they concern ambulance transport, of each of the animals which have been mentioned; and then to describe the particular vehicles which are in ordinary use with them.

The special circumstances under which the several quadrupeds employed for carrying sick and wounded, or the conveyances borne by them, are particularly serviceable will be remarked upon as each animal and its conveyance comes to be described.

Limits to the use of the 3rd class of conveyances.

But it may be here noticed as a general rule, that no conveyances borne by animals are capable of being employed nearer to a field of action than the place which has been fixed upon for the first line of surgical assistance. The steadiest and most practised mules would be rendered too restive by the noise of musketry and cannon close at hand, to allow wounded men to be laid upon the litters borne by them without the greatest difficulty and danger, even if other circumstances rendered their presence on such occasions admissible. But stationed at the first line of aid, this class of conveyances is capable of affording very efficient help. As fast as men wounded in the upper extremities who have been able to make their own escape from the field of action to the place of surgical aid, and men more helplessly wounded who have been fortunate enough to have had the opportunity of being carried away on stretchers, receive their first dressings, so fast they can be placed on mule cacolets and litters, or other such conveyances, and be removed to the field hospitals, wherever they may be situated. After a combat has ceased, the animals employed in bearing litters can not only be taken close to the wounded who remain lying on an open field, but often can be led to situations which no wheeled conveyance could approach, and in which even bearers would find it difficult to move along with patients carried on stretchers.

SECTION I.—CONVEYANCES BORNE BY MULES AND HORSES.

In accordance with the plan just laid down, I will first refer to the several kinds of sick-transport for which mules or horses are employed. Such conveyances as are used with the former are generally adapted for use with the latter kind of quadruped.

Mules regarded as beasts of burden for ambulance purposes.—Mules, if proper animals be selected, are to be preferred for ambulance purposes to horses or ponies, especially in mountainous districts, and over roads which are strewed with loose stones.* Mules walk well, and no creatures, when carrying heavy burdens, so easily pick their way, or are so sure-footed on bad roads, or can move along narrow paths and over restricted spaces with such safety. They are, indeed, independent of roads altogether. On good roads their pace is more uniform than that of the horse, and they are less liable to be startled whatever casualty may occur,—qualities of special importance where wounded or feeble patients are concerned. They, moreover, have advantages over horses of a general nature in reference to the circumstances of campaigning, for they are less subject to diseases, thrive better on rougher fare, live and work twice as long, and are constitutionally more hardy and endurant of prolonged fatigue.

Mules preferable to horses for ambulance purposes.

Qualities which render them preferable.

Mr. Bailey, of the Commissariat Department, who organized and conducted the duties of the transport establishments for the expeditionary force in China in 1860, testified in his report at the close of the campaign to the serviceable qualities of mules as transport animals, "Of all the animals used for transport "purposes during the campaign, the mules sent from India were "the best, and performed their work in the most satisfactory "manner; they were hardy, and seldom afflicted with illness or "other ailment." † And General Sir Hope Grant confirmed this report, stating that they were "undoubtedly the best."

The mule is deficient in speed, that is, it cannot gallop well, but this is no defect as regards the carriage of sick and wounded, whose circumstances demand a regular, steady, and even walk on the part of the animal carrying them. A more rapid pace, especially an uneven one, would be attended with intolerable jolting. Another objection frequently urged against the mule is its stubbornness. This quality, however, when it exists, seems usually attributable either to neglect in the breeding, or to bad after-treatment of the animal. A well-bred and properly tended mule is as thoroughly good-tempered and as easily managed as any creature employed in man's service. In Spain, where the greatest care is paid to rearing and keeping these animals, good mules are as gentle as the best horses in England.

Want of speed and stubbornness of mules.

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* The mule which is best fitted for carrying burdens is the produce of the male ass and the mare, and chiefly resembles the male parent in form. The mule resulting from the intercourse of the stallion and she-ass is a smaller, less hardy, and in all respects less useful animal. The countries in Europe in which mules are chiefly found are Spain, Portugal, and Italy. The Spanish mules are produced by a breed of asses of particularly fine shape and large size. Mules are also common in the East, and in the southern parts of America, but those which have been reared in the colder climates are found to be more fit for labour than those which have been reared in hot climates.

The kind of mule most fit for carrying burdens.

† See Mr. Bailey's report in the Appendix to the Report (1867) of the Committee on the Administration of the Transport and Supply Departments of the Army.

CHAP. V.

Need of mule transport in certain positions.

In some situations, scarcely any other kind of transport can be found to take the place of mule transport. In the mountains of the Pyrenees, during the Peninsular war, no other means were available to the British troops for carrying away the wounded but the backs of mules; in some of the mountain campaigns of India, mules have proved the most valuable means of conveyance; in the Crimea, in some of the long narrow ravines leading down to Sebastopol, along which no wheeled vehicles could pass, and over the plateau when the depth and viscidity of the mud rendered it impracticable for carts and wagons, no kind of transport proved so efficient, and at the same time so economical, for removing the wounded as the French system of transport by mules. The French have relied entirely upon mules for transporting their sick and wounded in all their distant expeditions in Algeria, and have accorded the highest praises to their valuable services.* It is, however, a point to be constantly borne in mind, that it is not every mule will answer for such service; the weight of a pair of cacolets or litières, with a couple of men lying upon them, not to mention the pack-saddle and its accessories, necessitates a certain size and stamina in the animal that is to carry them. The mules used for sick-transport in the French service are all large and robust animals, well trained, and equal in power to the demand which is made on their strength and endurance by the work in which they are employed.

Weights of loads carried by mules.

The weight which a mule can carry varies very much in different countries, and in different individuals, according to breed. A good Spanish mule, of proper age, is said to be able to travel for several months continuously with a weight of from six to eight hundredweight on its back; but only the best, full-sized, and well-limbed animals can accomplish this task. Mr. Darwin mentions, with regard to South American mules, that it is the custom for each animal in a troop to carry a load of 416 lbs. when the ground is level, but that in a mountainous country the mule's load is only about 300 lbs.† It has been stated that 150 lbs. was found to form an average load for a mule in Abyssinia, although the mules imported for service with the batteries of 7-pounder mountain guns carried loads of 250 lbs., and upwards. The regulated weight of the load carried by the field-pannier mule in the British service, when regiments take the field, is 200 lbs., but this is independent of the weight of the pack-saddle and harness. But a mule of comparatively small size and moderate power answers well enough for this service, one that would be useless for the purposes of sick transport.

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* See remarks on p. 273.

† "Narrative of the surveying Voyages of H. M. Ships *Adventure* and *Beagle*. Passage of the Cordillera." Vol. 3.

East Indian mules.

Baggage mules abound in some of the mountainous parts of Eastern India, but they cannot be turned to account for the carriage of European cacolets and litières, with a couple of sick or wounded men upon them. They have not the requisite size or strength. They were tried for this purpose experimentally, at Huzara in 1864, by Captain Hughes, commanding the Peshawur Mountain Battery, but were found to be quite incapable of sustaining such a load. These mules are thoroughly efficient for the tasks they have to perform, for carrying supplies over rocky and precipitous defiles, or in the interior of a country where there are no roads, because their loads are properly proportioned to their size and power of endurance; but only a mule that is capable of carrying without distress a weight of from 400 lbs. to 500 lbs. can do the work required in the European mode of sick-transport,* and any attempt to get mules of less power to perform this service satisfactorily must always end in disappointment and loss.

Horses suitable for carrying sick men.

Horses as beasts of burden for ambulance purposes.—But if horses have to be employed instead of mules for carrying sick and wounded men, then animals of moderate size, stout-built, and compact in frame, sure-footed, hardy, and capable of enduring much fatigue, should be selected for the service when practicable. This is the description of animal which is found of most service in travelling over broken and irregular ground, and through hilly districts, and is necessarily the most suitable for carrying sick and wounded men under the ordinary circumstances of campaigning. Neither high mettle, showy action, nor speed are wanted for ambulance purposes; but a steady even gait, sufficient strength, power of endurance, with a tractable and equable temper, are the qualities most to be desired. The object in selecting animals of moderate size, such as ponies,† is chiefly to facilitate the process of putting disabled patients on their backs, and taking them off, as well as to diminish the risks of injury to them in case of accidental falls. It should always be ascertained that ponies have been carefully trained before they are permitted to be employed in carrying sick or wounded patients. Some ponies are restive and unmanageable by nature, and can never be broken in to the steady and regular gait which is essential for the easy conveyance of feeble and suffering men; others, on the contrary, make good pack animals

* The pack-saddle complete with bât-horse bridle, pair of litters complete, and paillasses, together weigh 167 lbs. The weight of two men, at the moderate average of 10 stone each, 280 lbs., being added, gives 447 lbs. If the knapsacks, arms accoutrements, &c. of each soldier be also carried, the weight would be increased 120 lbs. more, making a total of 567 lbs. But these articles ought not to be added to the mule's load; the regulations arrange for spare mules to carry the knapsacks, &c. of patients under such circumstances.

† A horse beneath thirteen hands in height, four inches being reckoned to the hand, and the measure being taken at the fore-leg and shoulder, is usually styled a pony; but in practice this definition is not always attended to. Horses of even fourteen hands in height are often designated ponies.

CHAP. V.

without any trouble. The same qualities which make a pony a serviceable pack animal for carrying stores, will also, as a rule, make him a useful one for purposes of ambulance transport.

Sick men not to be seated on saddles.

Substitutes for sick conveyances of regular forms.—Saddles, or pads, of whatever description they may be, though they have occasionally under emergency been employed instead of regular conveyances, are quite unsuitable for the carriage of invalids on mules or horses. Invalids are not only incompetent for the exertion necessary to preserve their seat, but, what is of great importance, the erect position in which the trunk and head have to be maintained is calculated to induce faintness and the worst consequences to persons weakened by sickness or injury. Occasionally saddles have been employed for sick-transport purposes, but only because no better way of removing the patients concerned was at the time available. General Sir George Bell records in his published "Notes" the sufferings of the wounded of his brigade, whom he escorted, sitting on pack-saddles on mules, from one of the battle-fields high up in the Pyrenees to Alizondo, during the Peninsular war. The use of mule litters for military purposes, or of any other mode of mule carriage permitting a wounded man, even with such an injury as a fractured thigh, to assume a recumbent position, was then unknown. In a private letter, Sir George writes: "We had no "ambulance vehicle—no other conveyance but the mules sup-"plied by our commissary, with the usual common pack-saddle "always in use for carrying sacks of biscuit and kegs of rum. "The wounded men were carried in the fashion I have stated out "of the hills; two of them on a broad pack saddle sitting astride, "or both legs to one side, as the case might be, their wounds "bandaged up and spliced as well as our surgeons could manage "it at the time of this unexpected trial. There was no alterna-"tive,—we could not afford efficient soldiers to carry the "wounded."

Wounded carried on pack-saddles during the Peninsular war.

Use of cavalry horses for carrying sick in the Crimea.

In the early part of the Crimean war, when the sick became accumulated in large numbers, and it was necessary to remove them from the front at all hazards, and when from the state of the roads and other causes the heavy ambulance wagons could not be used, the horses of the cavalry were sometimes employed for transporting the patients to Balaklava on ordinary saddles. Under these circumstances it has happened that a debilitated man who had been carried from the tent in which he had been lying, and then lifted into his seat upon the horse, has died even before the sick from the several regiments of the division could be all got together for the cavalcade to leave the ground. Deaths also occasionally took place during the journey. These fatal events were manifestly due in a great degree to the effects produced on the very enfeebled frames of the men, by the change from the horizontal to the upright position. Unfortunately the evil was unavoidable, for there were no other means available for the removal of the sick from camp, where to remain, under

the circumstances of the time, was almost certain death for such patients. The horses in these instances were led by the dismounted cavalry soldiers. In old times, before the general introduction of wheeled vehicles, seats behind the saddles, or pillions, were often used for the conveyance of weakly persons. The pillion was sometimes made like a chair, with a support for the back of the person sitting upon it, and with a footboard suspended from it, on which the feet might rest, not unlike the seats still occasionally employed for children. In this way the invalid, sitting behind the horseman on the saddle, was relieved from all exertion in guiding or holding on to the horse, and received a certain amount of general support, which rendered his position less trying and painful. Had it, however, been possible to arrange contrivances of such a nature in the Crimea for the use of the sick, it is doubtful whether the horses, who were extremely enfeebled also, would have been able to carry the increased weight for the necessary distance; and, moreover, the evils of carrying extremely weak patients with the upper part of their bodies in an erect position would not have been remedied by such an arrangement.

Pillion seats.

Arab mode of removing wounded on mules.

The rapidity and sure manner in which the Arabs manage to carry off their wounded from a field of battle on the backs of mules or horses, without any regular mechanical conveyances, and with the aid only of the common pack-saddle, sacks, and cords which are used in carrying stores, have been a subject of frequent remark among the French during their contests with them in Algeria and Kabylia. Dr. Bertherand, Director of the School of Medicine of Algiers, has described at some length the manner in which the transport is effected.* The same method might be adapted anywhere with transport mules, in case of the absence, or of insufficiency in numbers, of the regular and authorized contrivances for removing wounded. The plan is briefly as follows:—The mule being ready saddled, two large sacks are stuffed full of straw, leaves, or grass. One of these sacks is then firmly corded on each side of the pack-saddle, and this is done in such a manner that the convexities of the two sacks, and the upper surface of the pack saddle are all in the same horizontal plane. Any depressions between the saddle and the bags are made level, by stuffing in hay and grass. This forms the litter. All that remains is to throw over all a cloak, so as to make the support soft and even for the patient, who is then placed upon it in a recumbent posture, *across* the animal, not parallel with the line of his walk. The litter formed in the manner described has quite length enough from side to side to carry the patient cross-wise. Afterwards, as opportunity occurs, branches are arched over it, so as to protect the patient, in case of need, from sun or rain.

* Campagnes de Kabylie. Histoire Méd. Chir. des Expéditions de 1854, 1856, et 1857, par le Dr. A. Bertherand. Paris, 1862, p. 117.

CHAP. V.

Dr. Bertherand states that Europeans, as well as natives, who have travelled long distances in this fashion, declare that this mode of transport is very easy, and almost entirely free from jolts. If it be a wounded man who is thus carried, and he is suffering from such a severe injury as to be incapacitated for himself helping to preserve his position, or from a broken limb, so that it is necessary to take every precaution against accidental local displacement, the patient is securely tied to the litter, and, when thus fixed, he can be carried away out of reach of shot even at a gallop without risk, or excess of pain, from the movement.

The objection to such a method of transport would be its bulk, unfitting it for passing along narrow winding paths, or through crowded places, and the want of economy in using the animal's services for the transport of only one person. Exceptional circumstances in an open country, and the steadiness of support gained by the patient being placed across the animal, might on occasion render it desirable to have recourse to this mode of conveyance.

Regular Forms of Mule Conveyances.

Origin of mule-cacolets and litters.

Mule-cacolets and mule-litters.—The principal regular forms of conveyances used with mules and horses are mentioned in the Medical Regulations under the names of cacolets and litters.* The former conveyances are also occasionally spoken of as mule-chairs, and the latter, using the French name, as litières. They have only been introduced among the articles of English ambulance equipment since the period of the Crimean war, and their introduction was then chiefly due to observation of the advantages of their employment by the French army in the East. The French appear to have originally derived the idea of these conveyances from the inhabitants of the Pyrenees, where the word "cacolet"† is in ordinary use to signify a sort of pannier in which supplies, and occasionally persons, are carried on mules. Having found them of great value in their Algerian campaigns, they subsequently adopted them as part of their regular field equipment for general service. This occurred some years previously to the Crimean war. In addition to the cacolets and litières here referred to, mule-panniers have occasionally been employed by the French for transporting patients. In the United States, and in Italy, special forms of mule-litters have also been employed. These several forms of conveyances will presently be described in detail.

Mule-panniers.

* Med. Regs. 1859, Art. XIX.—Regs. for field hospitals.

† It has been stated that the mule-chairs were designated "cacolets," from their resemblance in principle to the contrivance used for carrying milk ("câque au lait") by the peasants of Bordeaux; but good authorities consider that there is no foundation for such a derivation of the term. It has also been suggested that "cacolet" is a corruption of "cabriolet," the original meaning of which was, a sort of little arm-chair. The term, however, is probably of local origin in the Pyrenees.

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CHAP. V.

Views of French officers on the use of mule-litters.

The French officers, who have served in Africa, have always spoken in high praise of the use of mule cacolets and litters. The following passage regarding them occurs in a report by Marshal St. Arnaud on the re-organization of the *Equipages Militaires*, dated Paris, Feb. 1852. "The use of the mule with "a cacolet or litter was first adopted in Algeria. By means of "these ingenious equipages hundreds of wounded, amputated, "and sick soldiers have been transported in safety to our base of "operations." Marshal Bugeaud was a warm advocate of the mule-litter, he compared the good they effected with what he witnessed in Spain, in 1814, when, in consequence of the want of transport suited to the ground, whole divisions had been obliged to leave their wounded on the field. So strongly did Marshal Bugeaud feel the bad effect which such neglect must produce, that he went so far as to say,—"Perhaps, the courage "of our troops would not have sufficed for the conquest of "Algeria, if we had not been able to save our sick and wounded "from the Arabs." Marshal Bugeaud was led to recommend that the ambulance equipment of all the divisions of the French army, cavalry and infantry, should be exactly similar to that of the army of Africa, and that wheeled carriages should be attached to the reserves alone.

Mule-litters in the British service.

It was not without full inquiry and matured consideration that mule-chairs and litters were introduced among the conveyances of the British service. At an early period of the Crimean campaign it was reported home, as already elsewhere mentioned, that the ambulance transport sent out with the troops had failed from various causes, and at the same time it was stated by numerous army surgeons and others* that the mule-chairs and litters in use by the French were acting very efficiently. In consequence of these reports the Director-General, Dr. A. Smith, sent out instructions to the principal medical officer in the field to convene a board of experienced medical officers for the purpose of reporting on the merits and demerits of the mule ambulance conveyances used in the French army. This board was composed of Inspector-General Dr. Hall, and the Principal Medical Officers of three divisions of the army. These officers made their report on the 20th of January 1855, and it was greatly in favour of the conveyances under consideration. They reported that they considered the merits of the French cacolets and litières chiefly consisted in their general applicability to the circumstances of warfare, in their admitting of the removal of sick and wounded from every description of ground, and over every kind of road where males and horses can travel, and to the rapidity with which the removal could be effected over roads where wheeled carriages could not travel. On the other hand, the only demerits which they noticed were their uneasy motion in cases of serious gunshot injuries, and the liability of some of the animals to stumble or fall.

Steps taken before their introduction.

* See Recommendations and Evidence in the Parliamentary "Report upon the State of the Hospitals of the British Army in the Crimea, &c."—Lond. 1855.

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CHAP. V.

Col. Blane, Assistant Adjutant-General and Commandant at the head-quarters of the army, at the same time reported that "The "cacolets and litières now in the French service appear to be by "far the most perfect system which has yet been devised for "the transport of sick and wounded with an army in the field."

Their first employment in the Crimea.

These recommendations led to patterns of the conveyances being obtained from the Director-General of Military Transport at Paris. Similar conveyances were then manufactured in England, and a supply of two hundred of them was in due course forwarded to the Crimea. After a sufficient time had elapsed, in September 1855, the Director-General ordered another report to be furnished to him upon the qualities of the conveyances sent out from England, and the results of their use in the field. The Board, which consisted of the Principal Medical Officers of four divisions of the army, made their report on the 2nd of October 1855. This report stated that "The Board, having "personally tried the mule-chairs and litters, consider them "better adapted than the wagons for the conveyance of the sick "and wounded, provided that the mules are good-tempered, "well-practised at the work, and sufficiently strong for it, with "careful drivers;" and the Principal Medical Officer of the army, Sir J. Hall, in forwarding the report, remarked that "if "the ambulance transport be increased, I would suggest chairs "and litters to be sent out in preference to wheeled carriages."

The men in charge of the mules.

The limitations and provisos introduced into the report of the Medical Board indicated defects which had been experienced in regard to both animals and drivers, principally, however, in regard to the latter, with whose efficiency the proper working of the conveyances themselves, as well as of the animals, was inseparably connected. Sir J. Hall, in forwarding the report of the Board, remarked, "The ambulance corps is imperfectly "organized at present, and would not work well if the army "were to take the field. It has not nearly the number of officers "and non-commissioned officers that it ought to have to make "it efficient. It is essentially a service of detail, and requires "not only an additional number of non-commissioned officers, "but that these non-commissioned officers should be sober, "steady, trustworthy men." It is obvious that however perfect may be a contrivance, the success of which depends upon the concerted efficiency and right action of other appliances or persons having to co-operate with it, the contrivance itself is always liable to be objected to, or even condemned for imperfect results which are really independent of itself, unless sufficient care is taken to investigate and appropriate correctly the sources of the failure. The Board, therefore, were only right, while speaking in praise of the mule-chairs and litters themselves, to call the attention of the authorities to the qualifying collateral provisions named in their report, for they are essential to the successful employment of mule conveyances for purposes of ambulance transport. It unfortunately has too often happened that on an emergency arising, which has led to the necessity

of a certain amount of sick-transport being despatched for service in the field, both animals and conductors have been without the necessary training and experience for the proper performance of their duties. The animals have been purchased in numbers together at whatever market they could most readily be obtained, and the men have been enrolled in the service almost in an equally extemporised manner. But a hasty collection of animals for the purposes of sick-transport will never present the amount of efficiency which is requisite for the successful attainment of the objects for which they have been collected, nor can a body of men either be found who will properly appreciate, by a rapid system of self-teaching, as it were, the necessities of the sick and wounded who are to be transported under their direction, or the thousand details of attention which are essential for the proper care and preservation of the animals under their charge. Hurry in such matters invariably leads to confusion and loss, if not failure; and though after a time part of the men and animals engaged may acquire the experience necessary for effective co-operation and right execution of duty, the experience so obtained is purchased at a high cost. But not only have ignorance of the nature of mule conveyances, and want of training in their practical employment, led to their being objected to for the transport of sick, but they have been sometimes condemned under circumstances where failure was an almost inevitable result of the manner in which they were tried. Some mule-litters and cacolets were sent to India, and were tried in the Madras Presidency. But there were no mules there to try them upon, and the conveyances were, therefore, put for observation upon a horse, and afterwards upon a camel. As might be expected, it was reported that the amount of jolting rendered carriage in them altogether insupportable. Mule-cacolets and litters were sent out to New Zealand during the recent Maori war in that country, but proved to be altogether useless. There were no mules in the country, nor bât-animals suited for carrying them. To be able to judge fairly of any conveyance, not only must the contrivance itself be complete and in good order, but every adjunct that belongs to it, and is necessary for its efficiency, must be complete also, and in proper working order.

Both mules and drivers require training.

The termination of the war in the Crimea not long after the date of the report, last quoted, by the medical officers there, prevented the further employment at that time of mule-conveyances; but the experience already gained was afterwards thought sufficient to warrant a decision for them to form part of the regular field hospital equipment of the British army.

The special construction of the conveyances themselves will now be described.

Cacolets.—Cacolets consist of folding chairs made to be hooked by pairs to the two sides of a pack saddle, and so to be carried upon a bât-mule, or pony. Each cacolet can be placed indifferently, either on the right or on the left side of the pack-saddle, and each forms a seat for one patient. When the pair are secured in their places, the arrangement is such that the two

CHAP. V.

patients sit one on each side by the animal's flanks, with their faces turned towards the animal's head, and their feet supported on the cacolet steps near the animal's fore legs.

Fig. XCVII.—Convoy of wounded being removed on mule-cacolets.

Construction of cacolets.

The main portions of the framework of the cacolet are made of wrought iron; but for certain parts, such as the support for the back of the patient, the circular band attached to this back support by which the patient is secured from falling forward, and for some other minor details, straps made of leather are employed. Openings are made in the iron uprights, so that these straps can be secured to the top at either end of the chair. The seat is covered with a leather cushion. The foot-support consists of a little plank of wood suspended by two straps, which hang vertically down from the front of the seat. The upright and horizontal rods of the framework are connected by hinged joints, and thus the whole conveyance can be folded closely together, and turned up against the saddle boards of the saddle. The projecting vertical ribs of the pack-saddle, within

which it lies when thus folded up, partly protect it from injury, while at the same time, if thought right, the saddle (notwithstanding the presence of the cacolet) is rendered available for the carriage of packages. As the iron hooks for suspending the cacolet to the pack-saddle form part of only one side of the framework, when a cacolet that has been used on the left flank of an animal is required for any reason to be placed on the right flank of an animal, it is necessary to shift the strap by which the back of the patient is supported to the opposite part of the cacolet. In like manner the straps which support the footboard must be unbuckled and placed over at the side where the back-strap was before fixed. These are the only changes that are necessary for reversing the position of a cacolet, or adapting one for being placed on either side of the pack-saddle.

To reverse a cacolet.

The weight of a pair of French cacolets complete, when weighed in the Crimea, was found to be 89 lbs. 12 oz. The English cacolets sent out to the Crimea from Woolwich were heavier, viz., 103 lbs. 2 oz. The weight of English cacolets has since been much reduced; the weight of a pair of present regulation, or Royal Carriage Department, pattern mule-chairs being now 56 lbs. The weight of the pack-saddle complete is 64 lbs.; the weight of the whole conveyance on the mule's back when unloaded being therefore 120 lbs. This pattern cacolet is shown in the two following drawings.

Weight of cacolets.

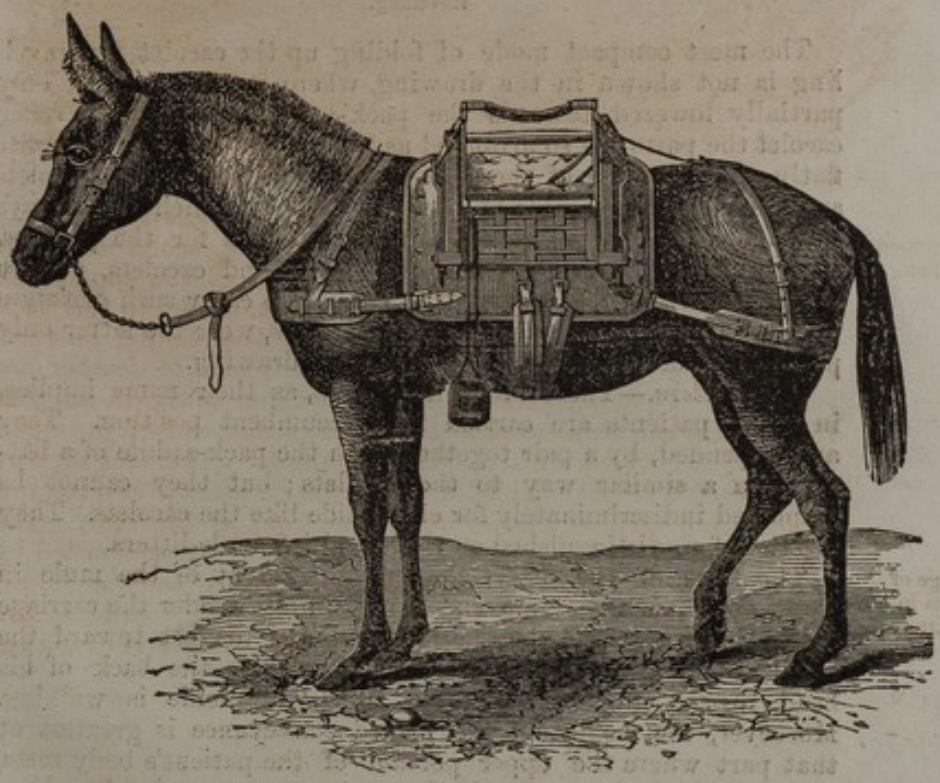


Fig. XCVIII.—Side view of mule chair or cacolet attached to its pack-saddle.

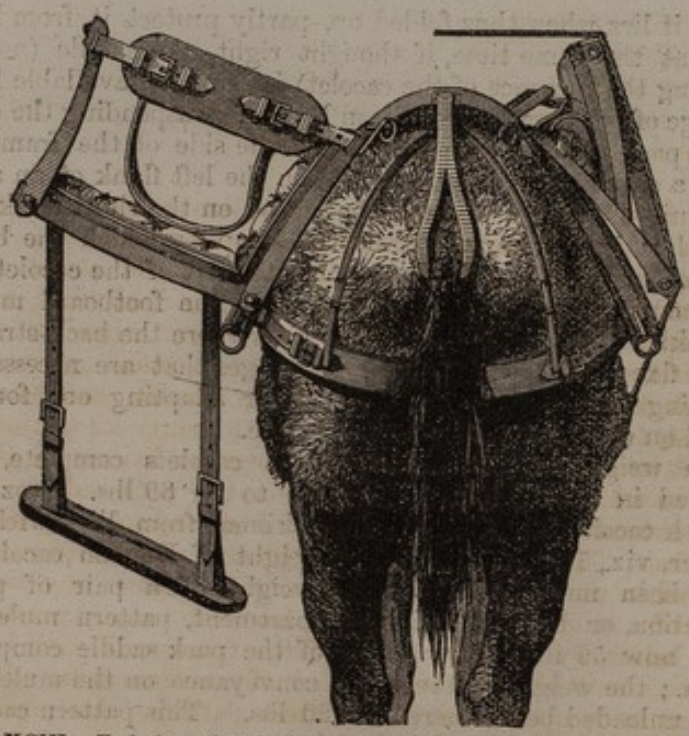


Fig. XCIX.—End view of mule chair or cacolet, open for use, and packed for travelling.

The most compact mode of folding up the cacolet for travelling is not shown in the drawing, where it appears to be only partially lowered towards the pack-saddle. In the French cacolet the parts are so arranged as to be capable of folding quite flatly upon the side of the pack-saddle; and, when both cacolets are thus packed, a couple of boxes of biscuit, which are always supplied for use in the field of convenient sizes for the purpose, can be readily placed over the pack-saddle and cacolets, and so be securely carried. It would not be easy to carry such packages without injury to themselves or the cacolets, were the latter only partially folded up, as represented in the drawing.

Mule-litters.—These are conveyances, as their name implies, in which patients are carried in a recumbent position. They are suspended, by a pair together, from the pack-saddle of a bât-mule in a similar way to the cacolets; but they cannot be employed indiscriminately for either side like the cacolets. They are therefore distinguished as right and left mule-litters.

Carriage of patients in mule-litters.

The form of the litter, the greater height of the mule in front, and its mode of movement in walking, render the carriage easier for the patient when he is placed with his feet toward the hinder part of the animal, and therefore with the back of his head toward the direction in which the mule is walking. Moreover, the weight of the loaded conveyance is greatest at that part where the upper portion of the patient's body rests, and this weight is most easily borne by the animal when suspended near its shoulders. The recumbent patient on a mule-

litter is, therefore, carried in a direction contrary to that in which the sitting patient is moved on a mule-chair.

Construction of mule-litters.

The framework of the litter, like that of the cacolet, is made of wrought iron, and jointed into three principal parts, so as to fold up into a comparatively compact form when not in use. The litière used in the French army can be folded up completely, though not into so small a space as the cacolet, and when thus packed, two cases weighing from fifty to sixty kilogrammes can be put upon the mule and carried above the litières in the same way as when cacolets are folded upon the pack-saddle. When fully extended, the length of a litter from end to end is six and a half feet. The bottom or bed of the litter is made of strong canvas secured to the iron frame by cords in the same way as to the sides of a stretcher. This canvas has been usually pressed upon from below by the cross parts of the framework, and in consequence a mattress has been added of convenient length for the patient to lie upon; but in the latest patterns this pressure has been got rid of by altering the forms of the cross-pieces, and with these the supply of a mattress has not been found to be necessary—the canvas is soft enough without it.

At the head of the litter there is a canvas hood, which can be thrown back or raised at pleasure. Another piece of canvas is attached to the foot of the frame, and this can be drawn upwards so as to completely cover the patient.

Weight of mule-litters.

The weight of a pair of French litières complete, when weighed in the Crimea, was found to be 136 lbs. The weight of a pair of English litters at that time was nearly the same as the French, viz., 138 lbs. 12 oz The weight of a pair of litters of the present Royal Carriage Department pattern, without paillasses or the pack-saddle, is only 84 lbs.; with the paillasses and pack-saddle, 167 lbs.

One form of English litter was secured to the saddle by an horizontal iron bar, forming part of its frame, being passed through two openings made for its reception in the projecting vertical ribs of the tree of the pack-saddle. One end of this iron bar was furnished with a screw, and on this an iron nut was secured, so that the bar might be prevented from slipping back through the apertures in the saddle-tree after it had been placed in them. At present it is connected with the saddle by a long, solid, vertical iron hook-piece attached to the litter being hooked on to projections in the ribs of the saddle. In the French service each litter is hooked on to the pack saddle by a chain of three links, the rest of the attachment being a continuous piece of iron, jointed to the side of the litter-frame. The litters can thus be raised or lowered a little, according to the link used when attaching the chains to their respective hooks, which cannot be done with the solid iron hook-piece or horizontal iron bar in the English patterns.

It is an obvious advantage to be able to adapt the height of a litter to the height of the animal which is to carry it. The necessity for some such arrangement is also shown in the following rule, which appears under the directions for "Loading of

CHAP. V.

"Pack Animals" in the "Military Train Manual." The rule is equally applicable to the carriage of sick men as to ordinary loads: "Great judgment is required in loading pack animals, "and care should be taken that the animals are not over-"weighted, that the load is well put on, that it is neither "pitched too high upon the saddle, thereby causing it to roll "upon the back, nor too low, which adds to the weight and "encumbers the animal, but that the lower line of the load "should be even with the shoulders."*

By either plan, however, whether with hooks only or hooks and chains, the litters can be detached from the saddle or secured to it in a few moments without any difficulty.

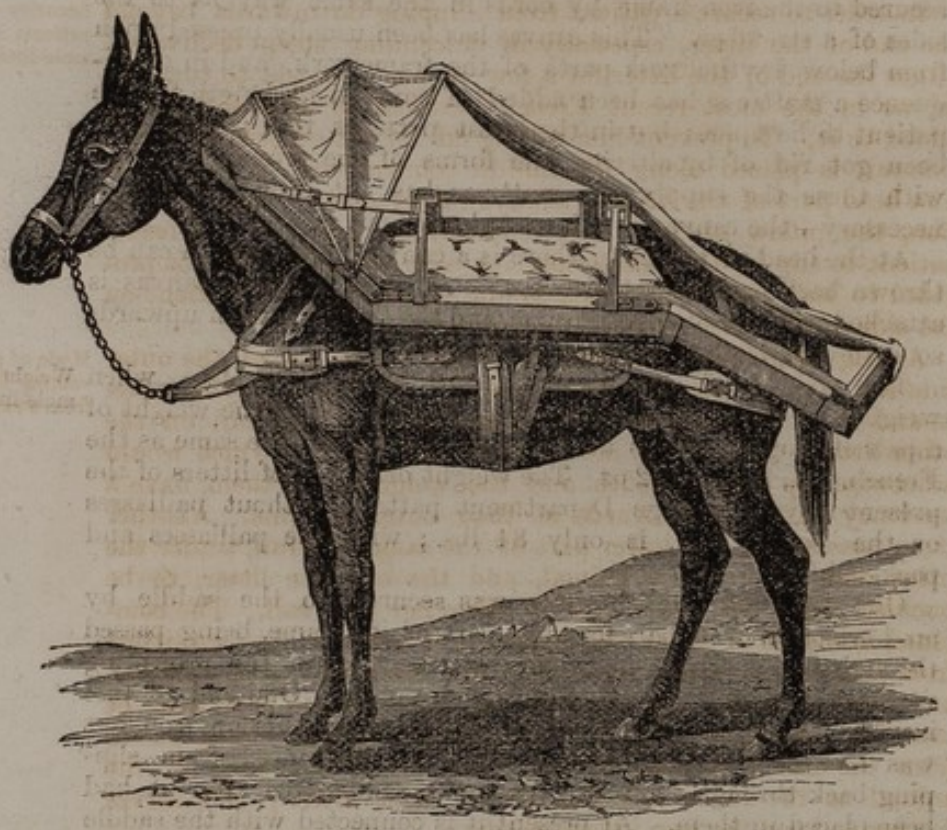


Fig. C.—Mule-litter attached to its pack-saddle.

Mule-litters removable from pack-saddles.

When the litters were first made in England, they were constructed in such a way that they could not be readily detached from the pack-saddle. When a patient had to be removed on one of these conveyances, it was necessary to lift him up into it; a proceeding which, in many varieties of dangerous gunshot injuries, involved the bearers in much difficulty and greatly increased the risks and suffering of the patient.† This was

* "Military Train Manual," 1862, p. 37.

† The inconveniences experienced from the defective construction caused the insertion of the following passage in the Med. Regs., p. 77:—"The cacolets and litters ought to be removable from the pack-saddles."

afterwards remedied. The litter, as at present constructed, can be at once detached from the pack-saddle by unscrewing the single iron nut, and withdrawing the bar by which the connexion is obtained, in the one case; or lifting the hook-pieces of the litter out of their connexions with the pack-saddle, in the other. When required for use the litter is laid on the ground, the wounded man placed upon it, and, as soon as he is settled in his place, the litter is raised by three men to a level with the saddle and hooked on; or, if provided with the horizontal connexion, the bar is caused to slide through the openings made to receive it and the nut is screwed on. In either case the litter is securely fixed in its place.

Security of patients in mule-litters.

In order to secure a patient from slipping downwards beyond the end of the litter, especially in descending steep declivities, either the end of the litter for a few inches is made to turn up, or, as in the most recent French patterns, a small foot-rail is added to it. To prevent him rolling off on the outside, a double side-rail is placed along the middle compartment of the litter. The head part of the litter is always raised a little, and, in addition, the pillow obviates any tendency on the part of a feeble patient to slip in that direction. A side pad is sometimes provided to lean against the pack-saddle, and protect the patient on the side of the litter near the mule's flank.

Mode of preventing litters from swaying.

A long strap is made to pass from the upper bar of the outer side-rail of one litter, *over* the litter and the patient lying upon it, and over the pack-saddle to the corresponding rail on the other litter. This strap holds up the two litters, which would otherwise by their breadth and the weight upon them, have a tendency to dip downwards at their outer margins. Another strap passes from the lower part of the same side-rail, *under* the litter, the belly of the animal, and the opposite litter, to be buckled round the lower part of the other side rail. The combined influence of these two straps is to prevent the two litters from swaying up and down during the movement of the animal, and thus to lessen the disturbance which would otherwise be caused to the patients lying upon them. A third strap passes from the inner side-rail of one litter under the belly of the animal to the inner side-rail of the other litter; this serves further to keep the two litters steady.

Peculiar motion of mule-litters.

A certain amount of movement it is impossible to prevent. The kind of movement communicated to mule-litters by the action of the animal in walking is peculiar. It is totally different from the sudden jolts, or the general concussion, liable to be communicated to patients when carried on wheeled vehicles. Good mules are so sure-footed, and so steady in their gait, that they rarely ever stumble so as to jolt the patients they are carrying. But the progression of the animal causes the litter to have a movement which has something of an undulatory character, and impresses a looker-on with an idea that it would not be unlikely to cause a condition akin to sea-sickness. Some mules

cause more of this kind of movement to be given to the litters than others. It forms one of the chief inconveniences connected with mule-litters, so far as the ease of the patients carried by them is concerned; but in estimating this objection to their use, it must be weighed against the necessities of the occasions which lead to their employment, and also against the inconveniences which are apt to accompany conveyances of other descriptions.

Before proceeding to describe some of the mule conveyances which differ in construction from the litters at present authorized for use in the British service, which have just been described, it will be useful to mention the manner of using these latter, so that accidents from their employment may be guarded against, and the risks and inconveniences connected with this mode of transport reduced to the lowest limits.

STEPS TO BE TAKEN IN ORDER TO PREVENT ACCIDENTS, AND TO LESSEN INCONVENIENCE TO PATIENTS, BY THE USE OF MULE-LITTERS.

General rules for loading and unloading mule cacolets and litters.—Great care is necessary to prevent accidents during the act of raising and attaching cacolets and litters, but especially the latter, when loaded, to the pack-saddles. Without due caution it may readily happen for a patient to roll off a litter while it is in the act of being raised; and equally, without mutual understanding and concerted action on the part of the bearers, there may be a good deal of delay and difficulty in connecting the sliding-bar, or two hooks, of the litter to the pack-saddle, together with unnecessary jostling and disturbance of the patient. Equal caution and system are required in detaching and removing litters and patients from the animal. It is necessary to provide some one to keep the mule steady while the patients are being placed on or taken off the animal's back; for another person to steady the loaded litter on one side while its fellow litter is being detached from the opposite side; and, under all circumstances, particularly when connecting or disconnecting a litter, to ensure the bearers keeping it level, and so to remove all cause for apprehension to the patient of his being subjected to a fall during the operation. Particular care should also be taken that all fastenings and straps are properly secured before the mule is permitted to start with his load.

While either a cacolet or a litter with a patient upon it is being fixed to one side of the saddle, the opposite side requires to be held down very firmly, or there is a risk of the saddle turning, and the patient being upset. So when the conveyance has been got into its place, for the same reason equal care is necessary to provide for maintaining the balance of its weight by a corresponding weight on the opposite side. If circumstances admit of the arrangement, two patients of nearly equal size and weight should always be put on the same animal. If this cannot be accomplished, the conveyance sustaining the

lighter weight should have its weight supplemented by the addition of a knapsack, or any other convenient article at hand, so as to obtain the necessary equipoise. If it be a cacolet, and only one patient is to be carried, then the leader of the animal must himself take the opposite seat, in order to preserve the balance. If there is only one patient to be carried, and that patient must be carried on a litter, then a cacolet is placed on the opposite side, and the leader of the mule takes his seat in it, if there be no attendant to do so, still with the same object in view. But under the circumstances in which these conveyances are ordinarily employed, there are usually patients enough to occupy every vacant seat and litter. As the patients carried in cacolets are usually less severely injured than those placed in a recumbent position, one leader is commonly regarded as sufficient for two cacolet mules, the leading rope of the hinder mule being simply attached to the saddle of the leading mule. But for the opposite reason, mules bearing patients on litters should invariably each have their own leader.

Special directions for the instruction of bearers in the use of mule litters, as well as in placing patients on and taking them off litter-mules.—Assistant-Surgeon Moffitt, when acting as instructor to the Army Hospital Corps, found the following plan of conducting the operation of placing patients on litter-mules and taking them off again, to be the easiest for the bearers, safest for the patients, and at the same time the speediest in accomplishment:—

(*a.*) With each mule for the carriage of litters should be a driver, whose duty it is to attend to the animal, to see that it is properly harnessed, and to drive it. **The mule conductor.**

(*b.*) Four orderlies or bearers are required both to load and to unload the litters.* **The litter-bearers.**

These are named respectively No. 1, No. 2, No. 3, and No. 4 bearer.

(*c.*) When it is required to load the litters, the joints of the litters should be fixed by means of the pins attached for the purpose; the cover should be unbuttoned on the outside, and neatly folded along the inside of the litter; and the hood-rods should be lowered, the hood-strap being placed along the folded cover. The litter should then be brought to the spot where the patient about to be transported is lying, and it should be placed on the ground with the foot-piece touching his head, or alongside the patient if he is himself able to get into it without being lifted. **To place patients on mule-litters.**

* If the litter-mule can be brought to where the sick or wounded men requiring carriage are lying, the requisite number of bearers will almost always be at hand. As the sick or wounded men will have to be carried on two stretchers to the litter-mule, when circumstances render it necessary for the animal to be stationed some distance away, and, as each stretcher will have two bearers with it, these same bearers will supply the requisite number for loading and attaching the litters to the pack-saddle, whether the patients are brought to the litter-mule or the mule is brought alongside the patients.

CHAP. V.

Two bearers, one at each side, should lift the patient by grasping hands under the shoulders and under the buttocks, while a third takes charge of the part where the patient is injured. Raised in this way, the patient is carried along the length of the litter until his head is over the pillow at the head of the litter, and then he should be carefully lowered by a simultaneous action.

Position of bearers before raising a litter.

(*d.*) No. 1 bearer should now take a position on the inside of the foot-piece of the litter; No. 2 on the inside of the head-piece; No. 3 on the outside of the centre-piece; all three facing the litter. No. 4 bearer stands on the opposite side of the saddle and mule.

Next No. 1 and No. 2 bearers should take hold of the side of the litter, each with one hand, and with the other hand, the litter-hook, preparatory to connecting it with the saddle. The hand holding the hook should be laid on the outside of the iron, with the thumb down, to avoid its being crushed between the saddle and hook. While Nos. 1 and 2 bearers are thus engaged, No. 3 bearer lays hold of the framework of the centre-piece with both hands.

Raising a litter.

(*e.*) The litter should now be raised by Nos. 1, 2, and 3 bearers, and carefully placed on their shoulders; No. 3 releasing one of his hands, passing it underneath, and taking hold of the inside of the framework, while Nos. 1 and 2 each retain their hold of the litter-hooks, as before described.

Connecting a litter with the pack-saddle.

(*f.*) The litter is thus carried close alongside the mule, with its head turned towards the animal's head. It is then hooked on to the saddle, Nos. 1 and 2 bearers guiding the hooks into their places. At the same time bearer No. 4 takes a firm hold of the saddle on the opposite side to prevent it from turning. As soon as the litter is secured to the saddle, No. 1 and No. 2 bearers fall out, leaving No. 3 bearer to support the loaded litter on its outer side. Nos. 1 and 2 bearers are now joined by No. 4 bearer, and these three proceed to place the next patient on the second litter, which they load, and attach to the saddle on precisely the same plan as that just described.

Connecting the second litter.

Securing the two litters together.

(*g.*) The hood-rods should now be raised over each patient's head, and the hood-strap attached to the foot-rail. The cover should then be pulled over and buttoned. This done, the upper suspension strap should be buckled, and then the short and long belly straps.

To unfasten the litters.

(*h.*) When necessary to detach the litters, the belly straps and upper suspension strap should successively be unbuckled, the cover of each litter folded along the inside, the hood-strap loosened, and the hood lowered.

Preliminary positions of the bearers.

(*i.*) No. 1 bearer should take up a position on the inside of the foot-piece of one of the litters; No. 2 on the inside of the head-piece; No. 3 on the outside of the centre-piece; and No. 4 bearer on the outside of the centre-piece of the opposite litter.

(*k.*) Each bearer then places his shoulder under the litter; Nos. 1 and 2 bearers take hold of the litter-hooks nearest to them respectively, each with one hand; and No. 3 bearer passes one hand under the litter, and takes hold of the inner side of framework. At the same time No. 4 bearer puts himself in position for well supporting the opposite litter, as soon as its counterpoise is taken away.

To unhook the first litter.

The three bearers now raise the first litter until it is sufficiently high for Nos. 1 and 2 bearers to slip the hooks off.

(*l.*) The first litter being then carried to its destination, Nos. 1 and 2 bearers, aided by No. 4 bearer, at once proceed to unload the second litter in the same manner as that just described.

To unhook the second litter.

(*m.*) When the litters are not required for carrying patients, the pins should be removed, and the litters folded up and fastened close to the sides of the saddle. It is easier for the mule to carry them thus packed, and the litters are less liable to be damaged.

Litters to be folded up when not in use.

(*n.*) Patients, if possible, of nearly the same weight should be carried on each pair of litters. When this cannot be accomplished, the heavier patient should be made to lie close to the inside of his litter, while the lighter should be placed on the outer side of his litter, a pad being placed to keep him in position; but should the disproportion of weight be so great that this arrangement will not preserve the balance of the two litters, a pack, rifle, or some other weight must be superadded to make up the difference.

To balance litters.

(*o.*) When a patient with a fractured bone has to be transported on a mule-litter, not only should the limb be protected by the ordinary means adopted in such cases, but any available means of support, such as straw, hay, or articles of clothing, that can be obtained should be arranged on the litter as padding to secure the limb in an easy position, and to prevent the movement, which is unavoidable with such conveyances, from acting locally on the injured part.

Carriage of patients with broken limbs on mule-litters.

Other forms of mule-litters.—The cacolets and litters which have been hitherto chiefly described are the mule conveyances which, according to present regulations, constitute part of the authorized field hospital equipment in the French and English military services. But other forms of conveyances of a corresponding nature have been either proposed for use at different times, or have been actually used in other armies, and some of these it will be useful to mention.

Mr. Hill's two-mule litter conveyance.—In the year 1855 Mr. Hill, a civil engineer, brought before the notice of the committee ordered by the Secretary of State for War, Lord Panmure, to report upon hospital conveyances, a machine, borne by two mules, which he had invented for the easy carriage of a couple of wounded men lying on a couple of litters. The machine was first fixed to the mules, and the patients, being placed on the litters, were then hoisted and slung within it. This conveyance was nearly as objectionable in principle as the two-horse litter else-

Mr. Hill's contrivance.

CHAP. V.

Objections to it.

where described (*see* page 292), for while, by the ordinary mule-litter arrangement, each mule carries two patients, by Mr. Hill's plan the proportion was only one patient to each mule. But, in addition, the weight of the machine and its litters was 284 lbs.; and this fact, together with its complicated construction, and the difficulty of transporting it, caused the committee at once to pronounce it to be unfit for military service.

Shortell's modified mule-litter.

Serjeant Shortell's modification of the regulation mule-litter.—It is under many circumstances inconvenient to take an ambulance mule to the place where a wounded man is lying. At the same time the patient may be a considerable distance off, and his condition may make it objectionable to place him first on a stretcher, and then to transfer him to a litter, if this double movement can be avoided. Obviously in such a case, if the litter itself could be conveniently carried and used in place of the stretcher, so that the wounded man might be placed upon it, conveyed directly to the place where the mule was stationed, and, without further change, put upon the mule for removal to hospital, time would be saved, and suffering prevented. With this view Serjeant Shortell, of the Army Hospital Corps, in 1865, placed in the Museum of Military Surgery, at Netley,* a model of a litter, the several parts of which were capable of being fixed rigidly together like a stretcher, and to which, at the same time, handles were added. The latter were attached to the four corners of the framework in such a way that when not required for use they could be folded back out of the way to avoid any inconvenience from their projecting outwards; but when required they could be at once brought forward, and be at the same time thoroughly safe for bearing the weight of the litter and patient during the act of transportation. The only additional weight was that of the small bolts used in fixing the several sections of the stretcher, and that of the handles. At the time this model was made neither the litter in use in the French service nor that adopted as the English pattern could be fixed for use as a stretcher. This adaptation has, however, as already described, been since made, and by means of small pins or bolts similar to the plan used in Shortell's model. Handles have not been added to the regulation mule-litters, probably to lessen weight, and also because it is considered unlikely that mule-litters will ever be used for the carriage of patients for any but very short distances, when the sides of the litter-frame will answer sufficiently well to be taken hold of by the bearers.

Mule conveyances at the Paris Exhibition of 1867.—Several forms of mule chairs and litters for sick and wounded were exhibited at the Universal Exhibition of Paris in 1867. Of the patterns exhibited the experimental trials left no doubt that the French were the most handy, best contrived for general use, and

* Spec. No. 1251*b*.

on the whole, as easy as any others to the patients carried. There were Italian and Portuguese litters, as well as some from the United States Sanitary Commission, but none were so portable or capable of being folded up so thoroughly and compactly against the flanks of the mules as the French mule-cacolets and litters.

Design of Locati's mule-litter.

M. Locati's mule conveyances.—The Italian cacolets and litières at Paris, invented by M. Locati, of Turin, exhibited much ingenuity. The litters especially were designed for moving through very narrow defiles, and for avoiding as far as possible such impediments to their progress as might be met with from branches of trees in their way, whether overhead or on either side. With these objects in view the conveyances themselves were kept within as narrow dimensions as they could be consistently made; all angles were removed, and one of the rounded convex sides of each litter was made to fit into a concave depression in the pack-saddle, so as to diminish as much as possible the projection of the conveyance beyond the flanks of the mule. It was said that the natural impediments which were met with in the transportation of the wounded along the narrow rocky paths, and through the wooded tracks of the Tyrol during the campaign in that mountain region in 1866, led M. Locati to devote so much attention to these qualities in the construction of his mule conveyances. All the Locati conveyances of the litter kind intended to be carried by mules were formed of curved steel bars, those forming the bottom or mattress, on which the patient was supported, being a little stouter in substance than ordinary hoop iron. The object in using this material was to ensure a certain amount of elasticity as well as strength and comparative lightness in the contrivance. The sides of the litters were continued in a curve round each end, so that each litter, regarded as a whole, formed an elongated oval frame. This frame was divided into three hinged sections, these sections being fixed in position, when the litter was required for use, by iron pins attached to small chains. The sides to which the steel ribs forming the mattress were attached, and on which the maintenance of the form principally depended, were stout and substantial. There were, in addition, two large ribs, which were made to curve outside, and at some distance from the ribbed mattress; these served to keep articles from casually coming into contact with the mattress, and also prevented the patient from coming into contact with the ground when the litter was laid down. Wooden feet were attached to these outer ribs in some examples.

Its construction.

The general aspect, and particularly the curved form that was given to the litters, gave them something of the appearance of a cradle. The division of the sides into three sections caused the litters to be capable of folding up to a certain extent, but under no circumstances could they be so reduced in size as to allow the mule carrying them to be used for carrying packages when the litters were not required for the conveyance of patients.

CHAP. V.

The mode of applying one of these side-litters to the pack-saddle is shown in the following sketch:—

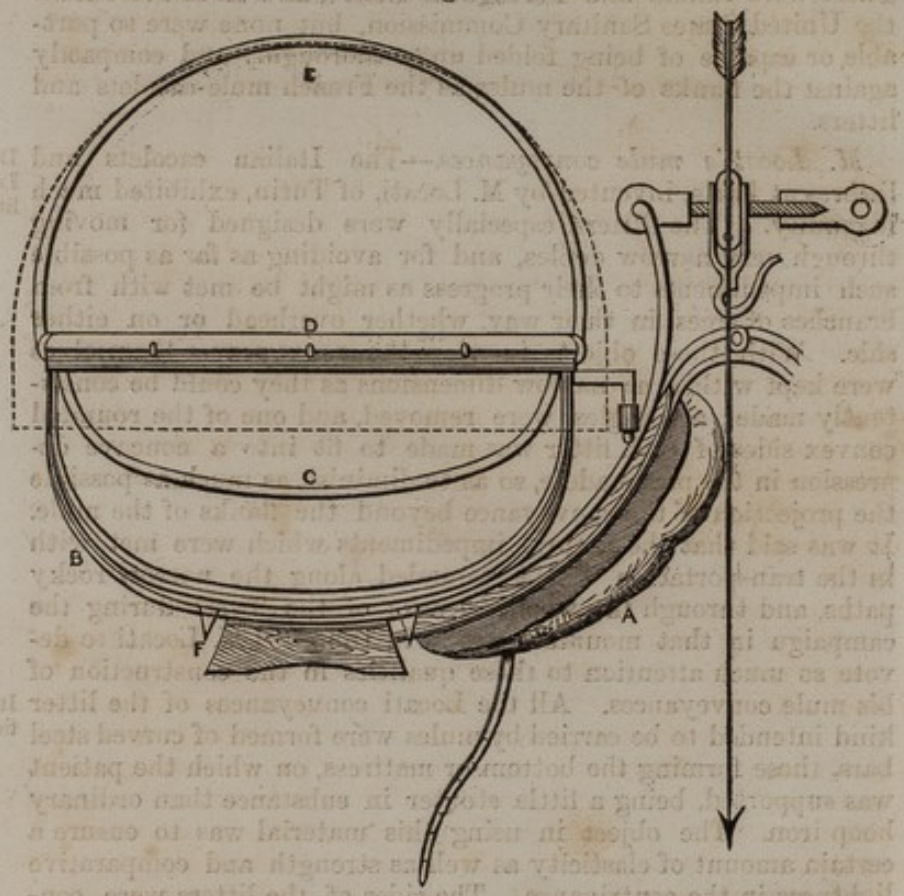


Fig. CI.—Sectional view of one of M. Locati's side litters fixed to its pack-saddle. A, pad of one side of pack-saddle. B, outer rib of litter. C, level of ribbed mattress for patient. D, back of lateral frame of litter. E, hoop for supporting cover. F, wooden foot of litter.

Construction of Locati's single mule-litter.

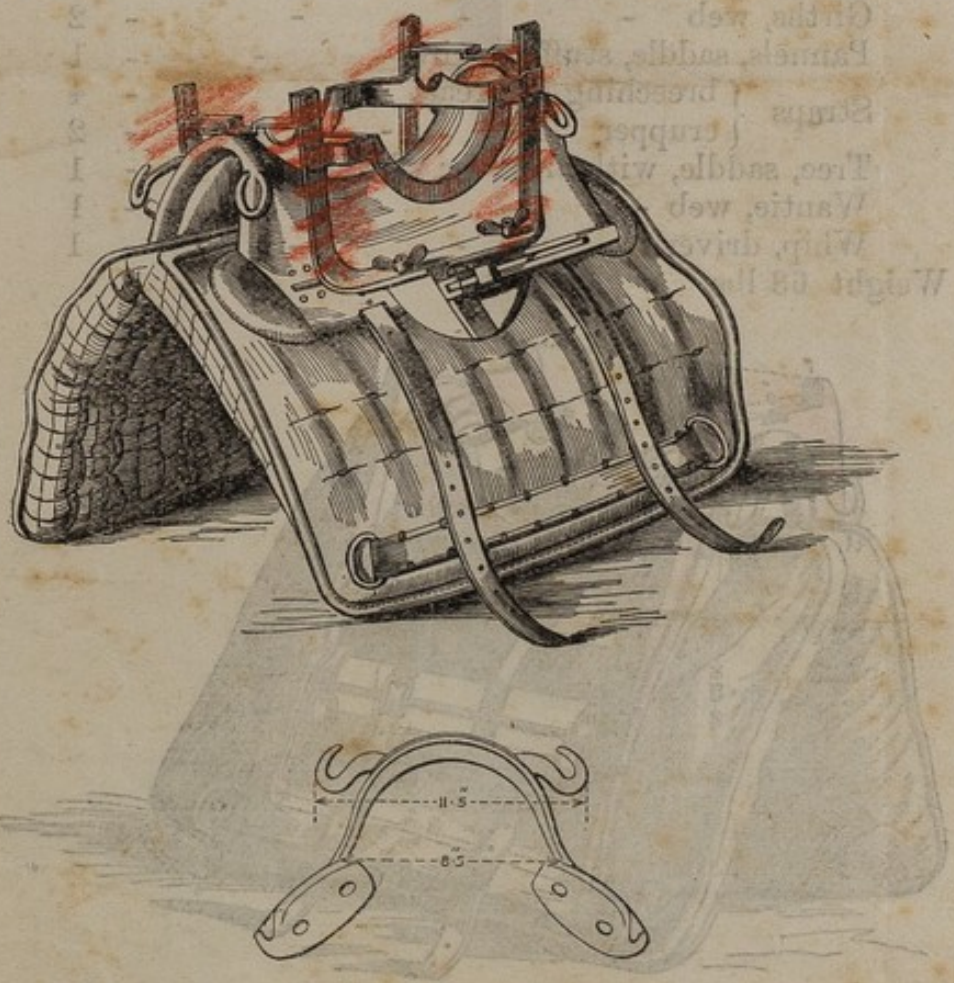
M. Locati's single-litter mule conveyance.—One of the Locati mule conveyances was peculiar, the pack-saddle, and the litter carried upon it, being both designed to be borne by a mule destined to carry only a single patient. The purpose of this contrivance was to ensure the transport of a wounded man without interruption along the very narrowest passages or defiles, or along roads encumbered by numerous vehicles; in short, anywhere where the mule itself could pass. In this instance, there was upon the pack-saddle a small wooden plate turning readily upon a pivot. This revolving plate had upon its upper surface four holes or sockets, and the litter was connected with it by four small iron feet, projecting from the two principal ribs, which were made to fit into these depressions. The litter was no less peculiar in form than in construction. Instead of presenting a simple bed or cradle, which form would have given rise to inconvenience from the animal's head in its movements striking against it, the litter from the middle is separated into two divisions, shaped so as to receive the legs of a patient, one

Each saddle is supplied with a waterproof cover.

Submitted by Superintendent Royal Carriage Department.
Recommended by the O.S. Committee, *Minute* 23,140.
Approved *provisionally*, 19th September 1867, $\frac{7678}{\text{Stores}}$ / 7

Note.—The annexed cut, showing the Otago pattern pack-saddle, is inserted in illustration of § 1500. Previously to this there were several patterns of pack saddles in the service, but the Otago pattern differs from all of them, principally in the construction of the tree, which is made so that the load is taken on the animal's back on a long bearing, and the withers are relieved from any undue strain. This saddle is also suitable for riding upon if necessary.

The iron cradle shewn in the cut as fitted on to the saddle, was proposed by Commissary General Bailey, for the carriage of guns, &c. It has been fitted to only 50 of the saddles issued for the Abyssinian expedition, for experimental trial.



NAME	Troop or Company	Date of Crim-	By	By

CHAP. V.

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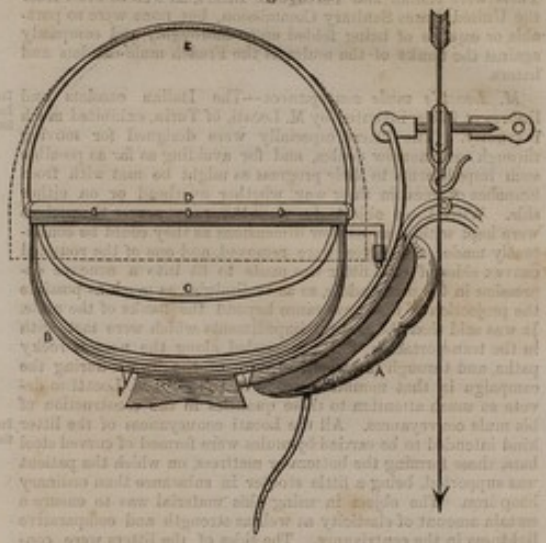

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Borne by Animals.

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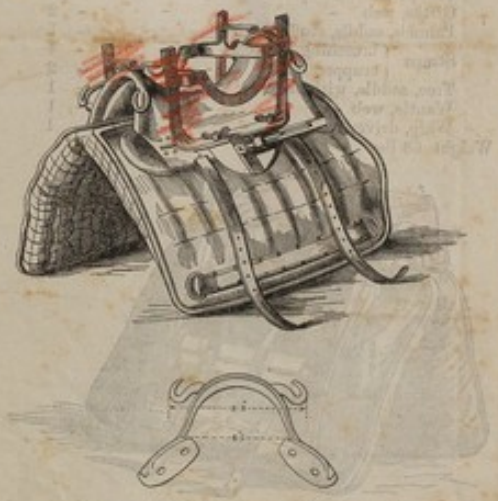

NAME	Troop or Company	Date of Crime	Crime	By whom Reported	Punish-ment	By whom Ordered	REMARKS

Borne by Animals.

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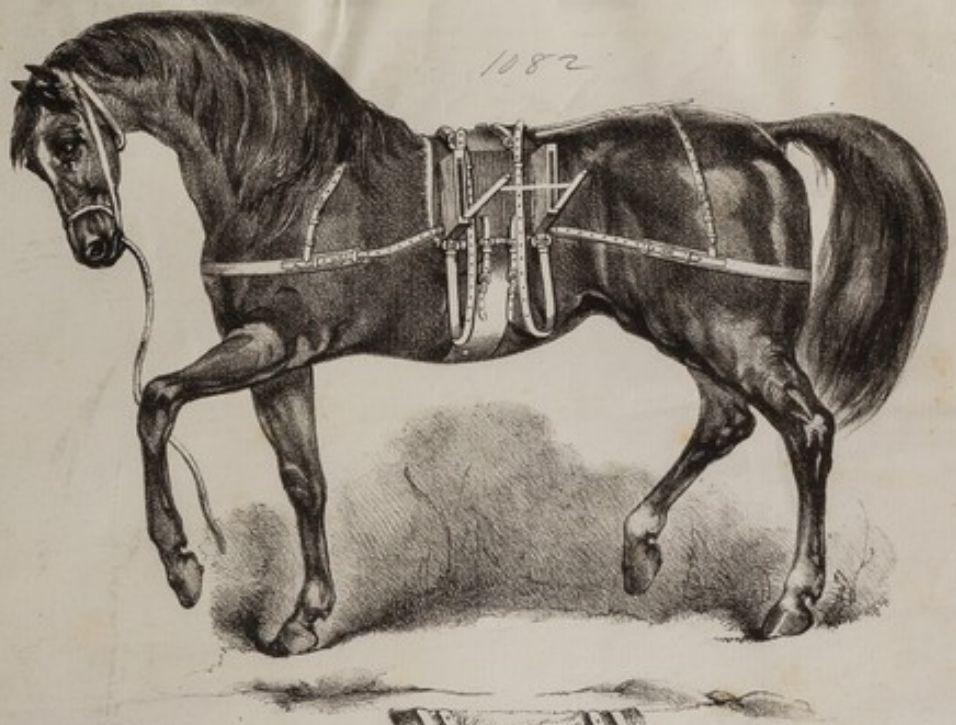


The Figure of the Horse shows the **Patent Portable Pack Saddle ready for Loading.**

The Small Figure shows the **Patent Portable Pack Saddle when folded up.**

TO OFFICERS AND GENTLEMEN.

THE NEW PATENT PORTABLE PACK SADDLE

Contains the following advantages—it is much lighter than any ever yet introduced; it will fit any kind of horse or mule without any alteration in stuffing. It folds up into a very small compass, and can be used as an ambulance to carry two persons—can be loaded in five minutes by one person. It cannot possibly hurt the back or sides of the animal, and will carry two hundred weight in any shape or bulk. The Patentee begs to remark, that at this present time there are hundreds of bat horses and mules rendered utterly useless, owing to the imperfect construction of the Pack Saddle now used, and frequently baggage is abandoned in consequence of the Pack Saddle not answering the purpose intended. The Patentee will warrant it will answer the purpose better than any other ever made.

GEORGE WOODS, *Patentee*,

WHOLESALE SADDLER & SADDLERS' IRONMONGER,

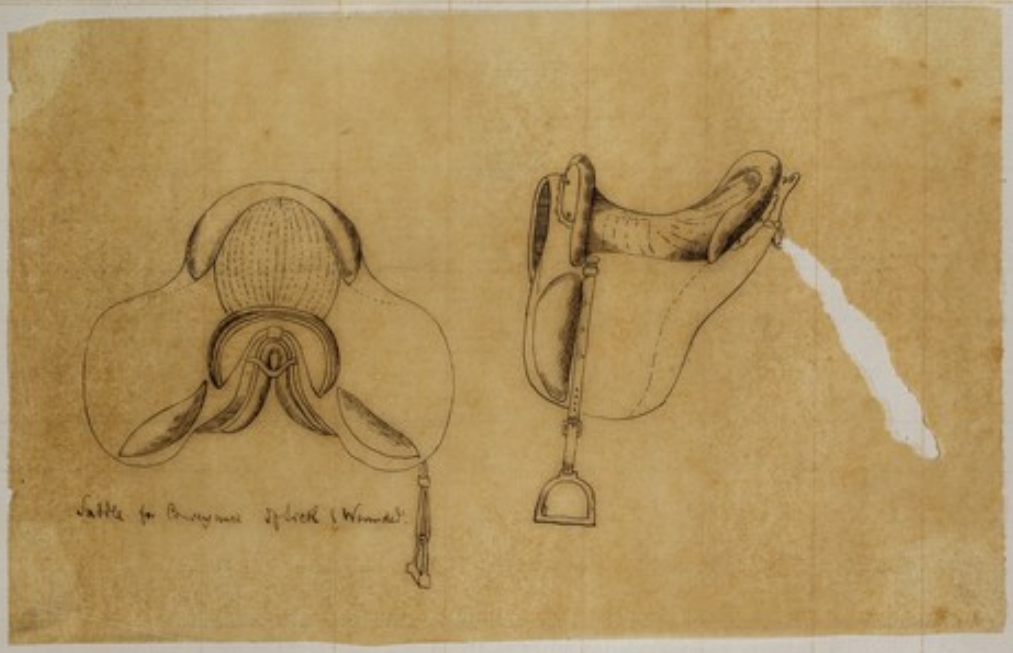
60 and 61, CROWN STREET, FINSBURY SQUARE, LONDON.

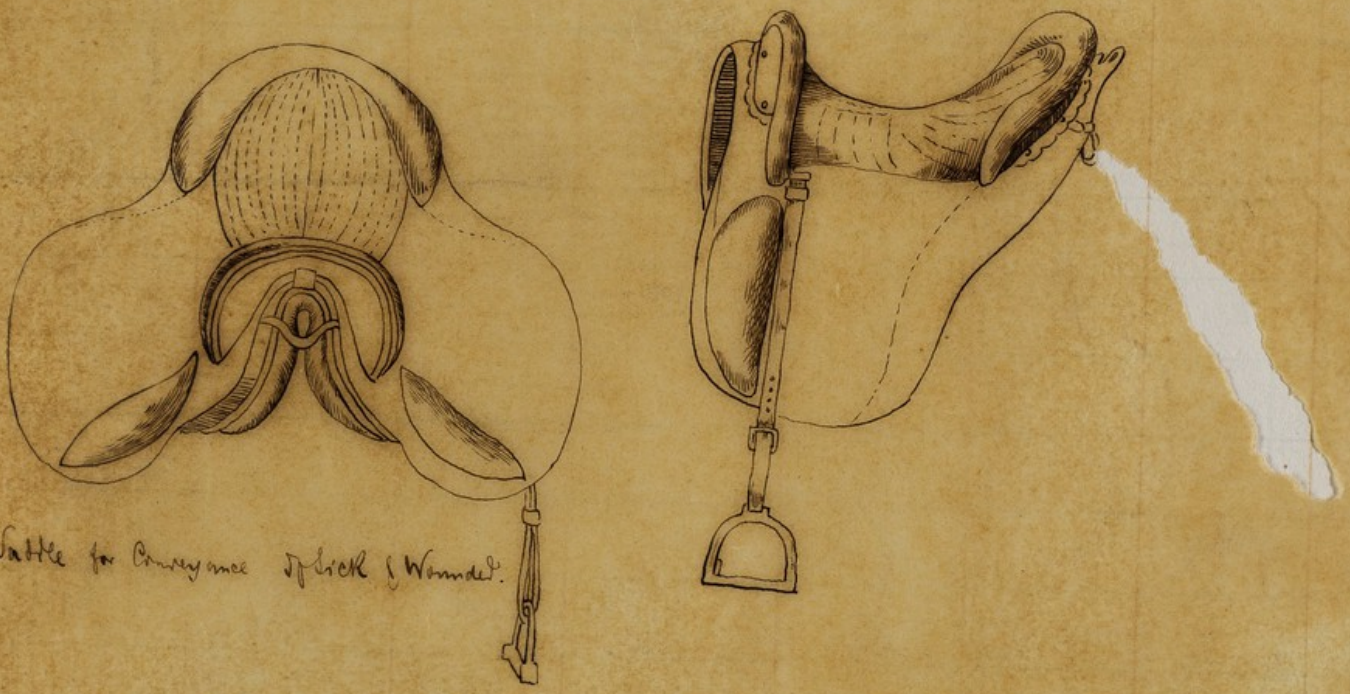
To be had of all Saddlers and Outfitters in the United Kingdom.

NAME	Troop or Company	Date of Crime	Crime	By whom Reported	Punish-ment	By whom Ordered	REMARKS

Borne by Animals.

NAME	Troop or Company	Date of Crime	Crime	By whom Reported	Punish-ment	By whom Ordered	REMARKS





Saddle for Conveyance of Sick & Wounded.

NAME	Troop or Company	Date of Crime	Crime	By whom Reported	Punish-ment	By whom Ordered	REMARKS

Borne by Animals.

Punishment	By whom Ordered	REMARKS

CHAP. V.

readily made use of for the transportation of sick and wounded. Mule conveyences, were, therefore, not really required for purposes of ambulance transport, and they appear to have been hardly ever employed. The Surgeon-General, in his remarks on the means of transportation of the wounded, states that "altogether 700 or 800 of them were supplied to the troops, but "they were soon laid aside." *

Construction of mule-panniers.

Mule-panniers.—These conveyances are simply long wicker-work baskets, with rather low sides, in the form of cradles, covered by an arched canopy of canvas supported on four hoops. They are carried in the same way that cases containing stores of matériel are carried by bât animals, and are suspended and secured in a similar manner. They do not admit of being folded up, or reduced in size in any way. Mule-panniers do not form part of the regular equipment of any army, and have only been employed in the absence of the necessary number of regular litters. Similar contrivances can readily be made in the field wherever the means of making gabions exist. In some respects such panniers, where sufficient bedding or other soft materials have been placed in them, answer well enough the purposes of regular litters, particularly for the carriage of men disabled by extreme weakness, as they afford support on every side to such patients; but their cumbrous size and unyielding forms quite unfit them for general use as conveyances of the class under consideration.

Fig. CIV.—Mule-panniers in use for the carriage of sick and wounded.

* Circular No. 8, Surgeon-General's Office, Washington, 1865, p. 82. On this page of the circular there is a drawing of the cacolet in use in the United States' army, as well as two others showing wounded men in the act of being transported on mules both by cacolets and litters. The same drawings may also be seen in Ch. XX., "Du service de Santé en Campagne" of M. Legouest's "Traité de Chirurgie d'Armée," Paris, 1863.

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CHAP. V.

Former use of two-horse litters.

Two-horse litters.—It is necessary to notice another form of sick-transport litter issued for use in the early part of the late war in the United States, in which, instead of two litters being suspended across one horse or mule, one litter was suspended between two horses. This is a very ancient form of litter in Europe. Frequent notices of it occur, showing its common use on occasions of state and ceremony, as well as its employment for the carriage of sick persons * in the records of our own country prior to the introduction of coaches. It seems curious that its use should have been revived in modern times in America.

Construction of the United States' two-horse litter.

The order for the issue of these litters was first given by the United States' Army Medical Board in January 1860 in the following terms:—"Ordered, that horse-litters be prepared and "furnished to posts where they may be required for service "on ground not admitting the employment of two-wheeled "carriages; the said litters to be composed of a canvas bed "similar to the present stretcher, and of two poles each 16 feet "long to be made in sections, with head and foot pieces con-"structed to act as stretchers to keep the poles asunder."

The side poles were to be of ash, the head and foot pieces nine inches in height, of canvas stretched over strong iron wire. The canvas part to be five feet ten inches in length, two feet three inches in width.

The following drawing shows the plan of the litter.

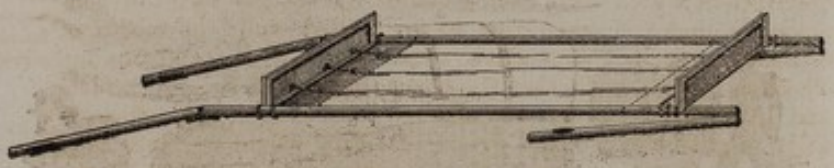
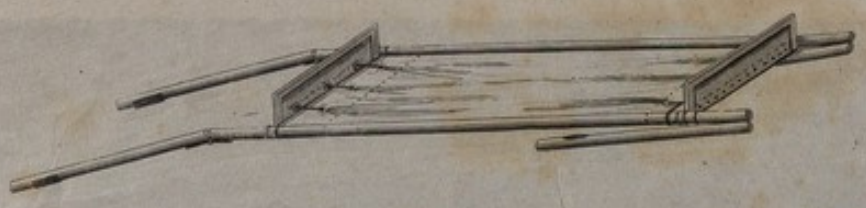


Fig. CV.—United States' two-horse litter.

The tukta-rewan.

A similar kind of conveyance is used in some parts of India, where it is called a "Tukta-rewan." The central part is more like a sedan chair than a litter, but this, inconvenient as it would be for an European, is convenient enough for the Asiatic, from the peculiar ease with which he is able to take his rest in a

* This form of litter is referred to as late as the reign of Charles the 2nd. A quotation introduced into the first volume of Knight's London, pp. 24, 25, mentions that "Major-General Skipton, coming in a horse-litter to London when wounded, as "he passed by the brewhouse near St. John Street, a fierce mastiff flew at one of the "horses and held him so fast that the horse grew mad as a mad dog; the soldiers were "so amazed that none had the wit to shoot the mastiff, but the horse-litter, borne "between the two horses, tossed the Major-General like a dog in a blanket."



sitting posture upon a flat cushion. Like the two-horse litter just described, it is attached to two long poles, and is carried in the same way between two horses, one of which walks before, the other behind the conveyance. The poles rest on slings passed over the pads which are girthed to the backs of the two horses. Native ladies not unfrequently travel in these vehicles.

Remarks on the use of two-horse litters.

Two-horse litters seem to be conveyances of very doubtful expediency, if expedient at all, under any circumstances. It is a very unprofitable expenditure of labour for two horses to be devoted to the carriage of one sick man, when the same purpose can be more economically accomplished by other means. The comparatively little width of space occupied by such litters gives them some advantage in moving along narrow ways through a partially cleared country, but they cannot travel along narrow tracks presenting short turns, such as winding paths with steep acclivities on one side, which are so frequently met with in hilly districts. The conveyance is too long and unyielding for such movement. Again, it is unsuited for any but tolerably level roads. It is destitute of any provision for preserving its level in case of the leading horse elevating the fore part of the long poles, while the hinder part is depressed, or *vice versâ*, so that a road presenting either a steep ascent or descent would cause great inconvenience to any invalid in the litter during the act of transportation.

The two animals are not easily managed by a single conductor under various circumstances, and to supply a second man, so that each horse may have a conductor, would add still more to the wasteful outlay of labour which, without such an addition, is already a sufficient objection, not to mention others, to the employment of two-horse litters in military service.

Résumé on the use of mule conveyances for military service.

Concluding remarks on mule and horse conveyances.—The descriptions which have been given of the several forms of conveyances under consideration have afforded sufficient means of estimating their comparative value for use in campaigning. There can be no doubt that the latest patterns of French cacolets and litters are in every way the most serviceable and efficient, as it might be expected *à priori* that they would be, since they form so important a part of the ambulance transport of the French army. The advantages advocated for these conveyances may be summed up to be:—the ease with which they are carried on the march; their applicability under circumstances and in places where wheeled vehicles would be altogether inadmissible; the facility with which they can be taken over the most broken and precipitous ground to the very spots where wounded are lying; the ease with which wounded can be conveyed by them to distances which would be far too great and tedious for the use of stretchers carried by bearers; and, lastly, the many field uses to which the mules with their pack-saddles can be turned, when not required for sick-transport purposes. At the same time

it is necessary to remember that, to ensure their efficiency, certain qualifications are requisite in the mules, which are not attainable without considerable expense and systematic care, as well as in those who have to conduct them, and to attend upon the wounded. Unless the mules possess sufficient strength to carry the weight of the two men in addition to the articles of their equipment, in the first instance, and unless they are sufficiently docile and trained for the work, in the next; unless the corps in whose charge the animals are placed is properly organized and practised, so that the care, feeding, protection, harnessing, and working of the animals are duly attended to; and, finally, unless the men, to whose charge the wounded are intrusted are sufficiently practised in the proper exercise of their responsible duties, among others, in the best modes of placing them on these conveyances, taking care of them during the transport, and on their removal to their places of destination—without these essential adjuncts, it is obvious that in actual campaigning the animals and conveyances will quickly become unserviceable, and, under any circumstances, have their purposes accomplished but in a very imperfect way.

SECTION II.—CONVEYANCES BORNE BY CAMELS.

Camels as beasts of burden for ambulance purposes.—Next in order to horses and mules, as regards usefulness in transporting sick and wounded, are the dromedaries, or one-humped camels. These animals are very extensively diffused over Asia and Africa, and are generally attached in considerable numbers as beasts of burden, when armies take the field in the regions included in those divisions of the world. The remarkable ease and security with which they are able to travel over dry, hot, stony, and sandy regions, owing to the peculiar construction of their padded feet, causes them to be serviceable in some countries where the hoofs of horses and mules would be quickly rendered brittle and destroyed. Other advantages derived from the peculiar conformation and habits of these animals are the ease with which heavy weights, ranging from 400 lbs. to 800 lbs.,* are carried by them; their power of abstaining from drinking for long periods together, and of satisfying their hunger by means of the wildest vegetation, so that they can travel through countries destitute of verdure or streams of water; and, lastly, their powers of endurance, which enable them to keep up long

Useful qualities of camels as transport-animals.

* A stout Arabian camel is said to be able to carry a burden of 800 lbs. at the rate of 3 miles an hour, and some camels are stated to be equal to carrying 1,000 lbs., or even 1,200 lbs. The camel, like the elephant, will refuse to proceed, if loaded beyond a weight proportionate to his strength. In India the average load of a camel is 400 lbs., and the rate of movement about 2½ miles per hour. With a rider only, the camel is able to travel 12 miles in the hour, or even faster on occasion.

marches for many days in succession without inconvenience. There are other qualities which make camels most valuable as property to their owners, but which cannot be taken into account as regards their value for ambulance purposes. The special objection, as regards the use of these animals, at least, the ordinary class of them, for conveying sick and wounded, is their peculiar mode of progression. The camel in walking at each step raises the two legs on the same side of the body, not absolutely at the same instant, but one so immediately after the other that they appear to be both lifted up together, and the repetition of this action, first on one side and then on the other, causes an alternate depression and elevation of the corresponding sides of its body. This up-and-down movement of the two sides of the animal becomes the source of considerable fatigue to a rider, especially if he is not accustomed to the motion. It is not so much felt, however, when a person is carried in a well-balanced conveyance confined to one side of the animal, as it is by a person sitting on the animal's back; but still it is usually felt sufficiently to be a source of inconvenience to an invalid. This awkwardness of gait and rocking movement does not, however, exist to an equal extent in all camels. Dr. Partridge, of the Bombay medical service, who has served a long period in Upper Scinde, where no carts are used on the march but everything is carried on camels, has informed me that there is as much difference there, in respect to ease of movement between one camel and another, as there is between an awkward cart-horse and a gentleman's hack. A good sándnee, or riding camel, will carry a man with less fatigue forty miles than a baggage camel five miles. He has known a man, on a good riding camel, carry in each hand a glass full of water without any being upset, so little jolting was there in the animal's mode of movement. The ease or awkwardness of camel conveyance, Dr. Partridge says, entirely depends on the kind of camel employed. Sir S. Baker has noted the existence of corresponding varieties in the modes of movement of camels in Africa. "There is the same "difference," he writes, between a good hygeen or dromedary "and a baggage camel, as between the thoroughbred and the "cart-horse."*

Manner in which camels walk.

Modes of movement of different camels.

Another disadvantage, as regards the use of these animals for ambulance transport, is the waste of carrying power when applied to sick or wounded requiring to lie down; for while the camel can carry as much as two or three ordinary mules when carrying stores, none of the camel ambulance conveyances hitherto constructed have enabled the animal to carry more sick in a recumbent position than would be the burden of one mule. This, however, hardly applies to the case of patients who are able

* "The Nile tributaries of Abyssinia," Lond., 1867, ch. 5, p. 99.

CHAP. V.

Comparative economy of camel transport.

to sit up, for some conveyances are so arranged that four patients can be carried sitting; and even when carrying litters, the loss is in some measure compensated by the fact of the animal eating less than would be eaten by two mules and by his thriving on coarser herbs, as coarse, indeed, as those eaten by the ass. On the whole, however, camels must be regarded as animals only to be used for ambulance purposes in countries where horses or mules are not procurable, or not suitable on account of the peculiar features of the country, whether as regards its soil or nature of its vegetation through which it is necessary for the sick to be transported, and where, moreover, draught carriage is not admissible. There is economy as regards labour and cost, and gain as regards speed, when the use of camel conveyances is compared with the employment of dhoolies and dhooley-bearers; but nearly all the advantages to the patients, which exclusively appertain to this latter mode of carriage, and which have been fully described in a former part of this treatise, are unavoidably sacrificed when carriages borne by camels are employed.

Particular Forms of Camel Conveyances.

Larrey's Egyptian camel-litters.—In the winter of 1798–99, when the French troops in Egypt under General Buonaparte were preparing for a campaign in Syria, Larrey, the Surgeon-in-chief, found himself obliged to organize an ambulance establishment, and to employ camels for effecting the transport, they being the only animals adapted to the country and to the habits of the natives. Speed of conveyance was an essential requisite, in order that the wounded might be removed without any delay out of the risk of casual attacks by Arabs, as well as from the chances of suffering from hunger and thirst. Larrey experienced insurmountable difficulties in his efforts to obtain some form of ready-made carriage sufficiently light for the animal to travel with speedily, and at the same time easy enough for his patients. At last he got a hundred panniers constructed for the purpose. They had the general appearance of ordinary camel-trunks, but they were made to open and fasten in such a way that sick or wounded could be easily placed and securely carried in them. When required for the carriage of a patient in a recumbent position, one end of the litter was let down and supported, draw-bridge-fashion, at the requisite angle by two iron racks, one on each side, so as to afford the necessary length. These conveyances were suspended by flexible leathern bands, two on each side, one before, the other behind the animal's hump. By this arrangement the animal's movements in progression were not impeded, while two wounded men could be easily placed in the panniers on its two sides by making the camel sit down for their reception, in accordance with the ordinary habit of the animal when being loaded with baggage.

Construction of Larrey's camel-litters.

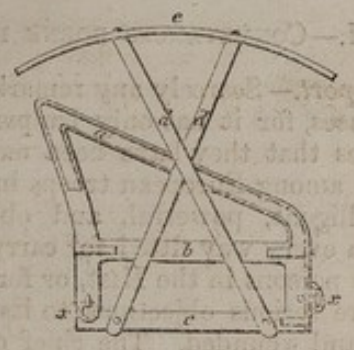


Fig. CXII.—End view of Brett's camel dhooley. *a, b, c*, part of the wooden framework. *d, d*, cross bars to support the roof *e*. *x, x*, iron rings through which the rope is passed.

The advantages of these camel-dhoolies, according to Mr. Brett, were: (*a*), that they formed an advantageous substitute for the hackeries previously in use for the sick of the force; (*b*), they were very economical as regarded the cost of their maintenance compared with other conveyances; and (*c*), they superseded the necessity for a proportion of the dhoolies.

Their alleged advantages.

In respect to (*a*), while the conveyance by hackeries exposed the sick to much jolting, prolonged restraint, and to the heat of the hottest part of the day, the patients in them, though starting at daybreak, not arriving in camp till about 1 or 2 o'clock in the afternoon; the camel-dhoolies, on the other hand, enabled the patients to be brought to the camping ground by 9 or 10 o'clock in the morning, and in a far easier and more agreeable manner.

In respect to (*b*), four camels, with eight litters, could be maintained at something less than the monthly expense of one dhooley, which, at the time Dr. Brett wrote, was 32 rupees a month.

In respect to the third advantage (*c*), they answered for all ordinary cases of sickness as well as dhoolies, the only exceptions being cases of fracture, dysentery, and of extreme debility. At the same time eight sick men could be carried at the same cost as one sick man by a dhooley.

Brett's camel-dhoolies as substitutes for dhoolies carried by bearers.

As the experiment had succeeded with the Governor-General's camp, Dr. Brett was led to advocate the employment of a proportion of these camel-dhoolies as part of the hospital equipment for all armies in the field in India, and as sick conveyances for general purposes. He argued that they would obviate the disadvantages in the field arising from dhooley-bearers being apt to escape in time of danger, and, in respect to general use as sick conveyances, that invalids might travel comfortably in them from 30 to 40 miles every night to the hills or elsewhere for change of air; each camel at the same time carrying an attendant who could wait upon the patients while moving along, as well as all necessary supplies, and this, too, at a much less expense, and without the interruptions incidental to dâk travelling by bearers.

CHAP. V.

SECTION III.—CONVEYANCES BORNE BY ELEPHANTS.

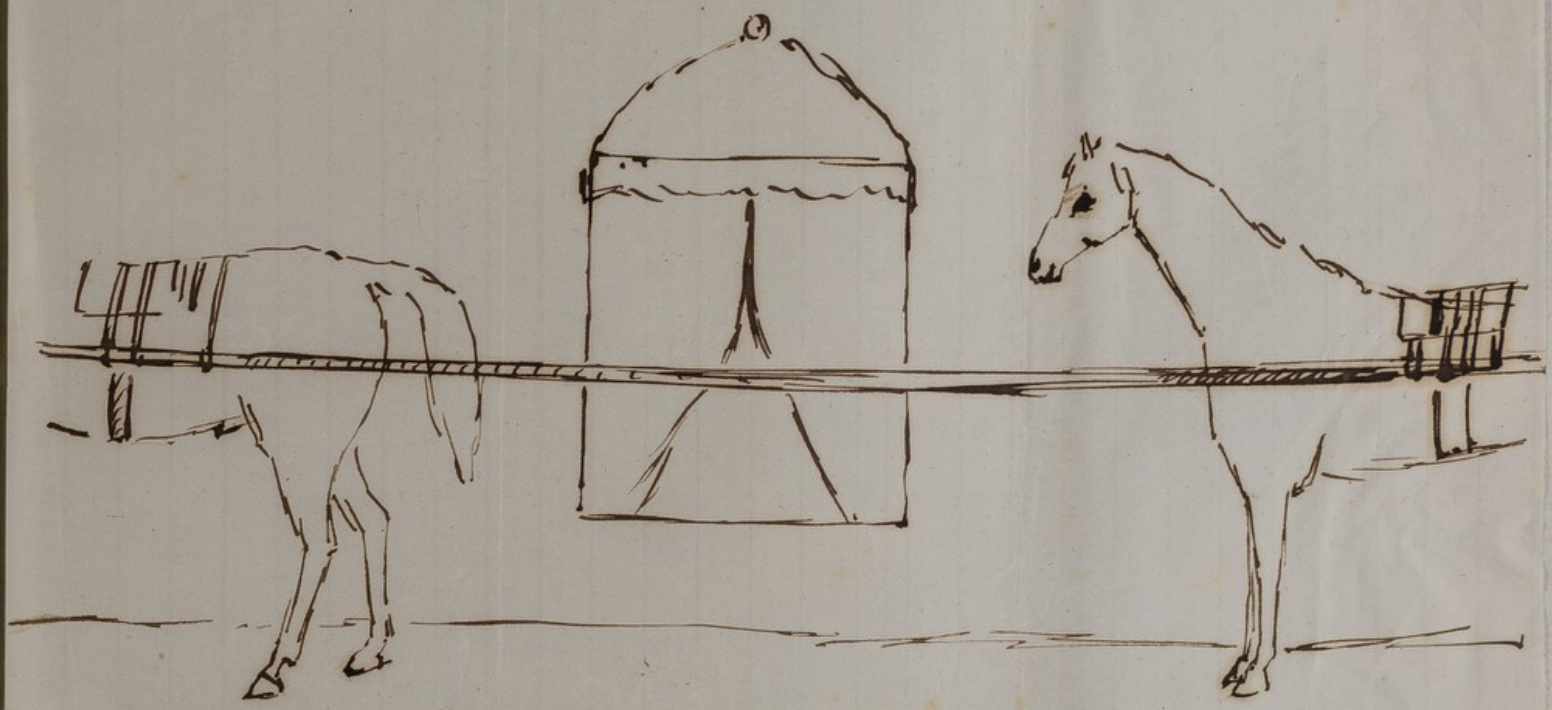
Elephant transport.—Scarcely any remarks are required about elephant conveyances, for it has only happened under very unusual circumstances that they have been employed for carrying sick and wounded among European troops in India.

Objections to the use of elephants for carrying sick.

Tractable, intelligent, powerful, and obedient as the tame elephant is, and in every way fitted for carrying conveyances for the use of private persons in the East, or for occasions of display and state, there are serious objections to its employment for the transport of sick and wounded. The chief of these is the costly nature of its maintenance, as well as the disproportion between the power of the animal and the use that can be made of it for the purposes under consideration. The elephant consumes twenty times as much food as the camel. It also requires the food for its maintenance to be of such a kind, that wherever that food is found there also can horses exist, and be turned to a more profitable account for hospital uses. The great force possessed by the elephant, whether applied to draught or pressure, is useless as regards ambulance purposes. Neither does any peculiarity in the physical construction of the elephant exist to fit it for employment in special parts of the globe for which other animals are unsuitable, such as causes the camel to be so useful in certain countries. Elephants are occasionally turned to account for hospital purposes in India, such as taking out convalescents to give them the benefit of fresh air and change of scene. In the instances in which I have seen these animals so employed no regular conveyances have been placed on their backs, but only pads so as to form a broad cushion for the men to sit upon.

Elephants occasionally attached to hospitals in India for the carriage of convalescents.

Tukta Dewan



NAME	Troop or Company	Date of Crim

CHAP. V.

Comparative economy of camel transport.

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Borne by Animals.

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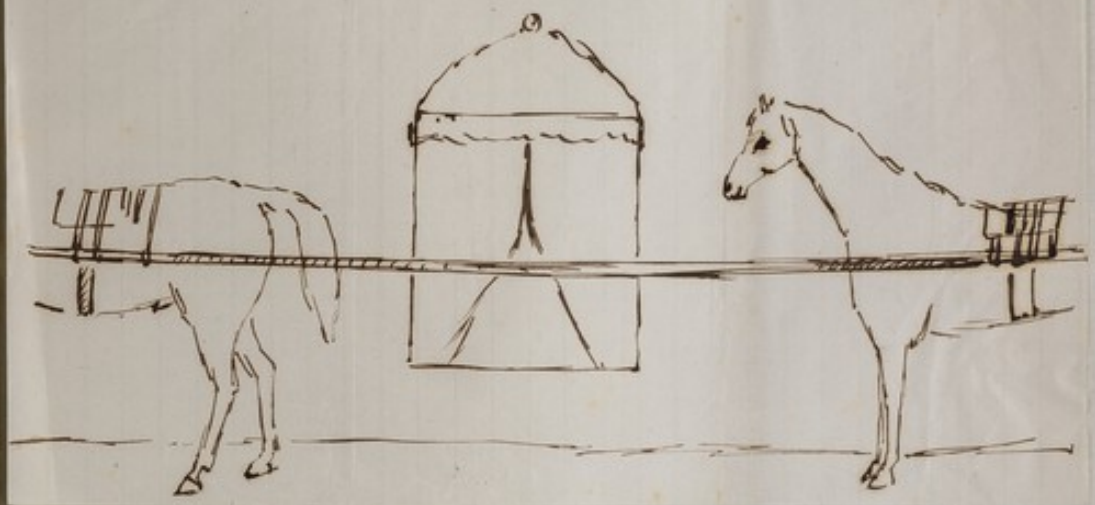


NAME	Troop or Company	Date of Crime	Crime	By whom Reported	Punish-ment	By whom Ordered	REMARKS

Borne by Animals.

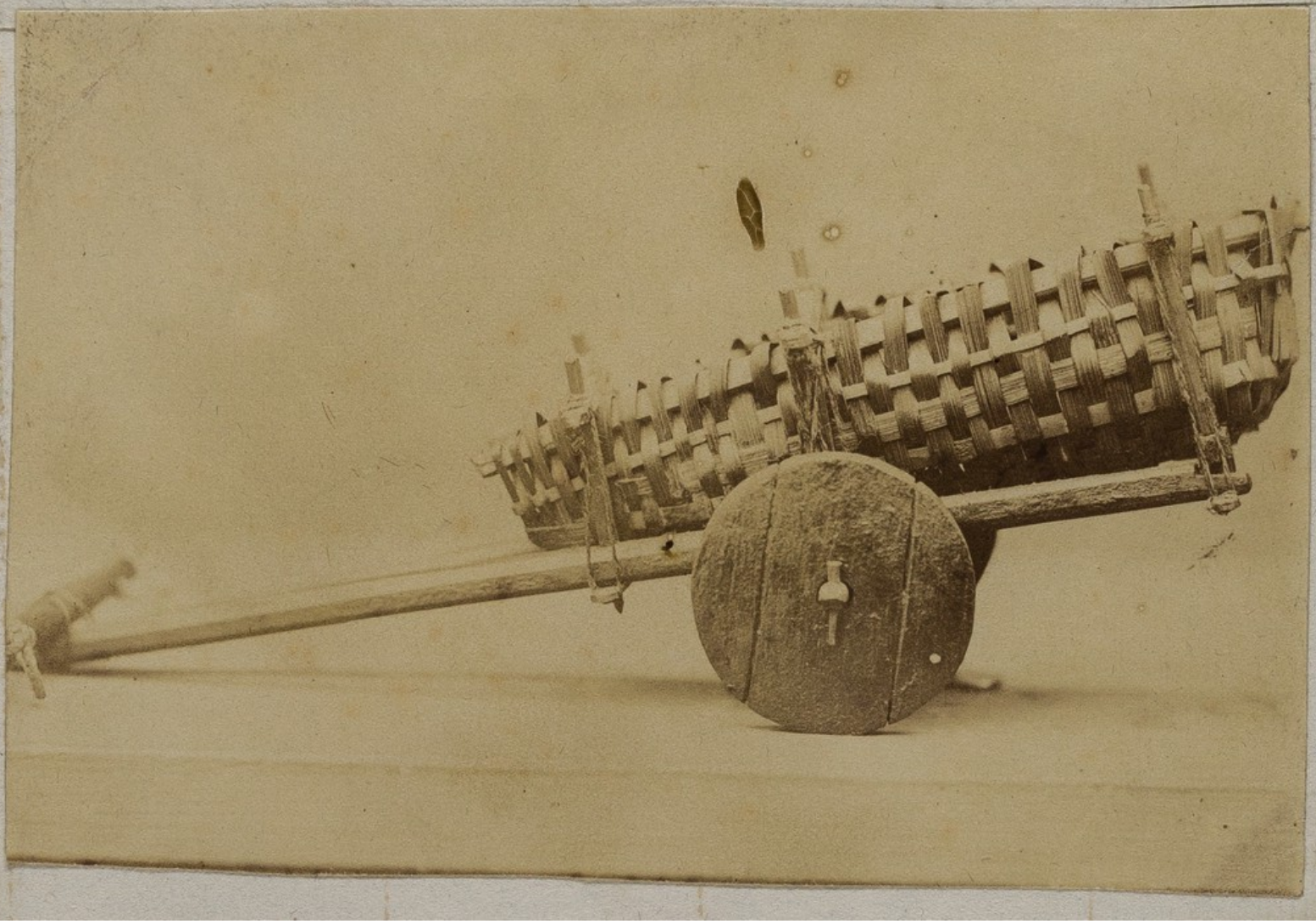
NAME	Troop or Company	Date of Crime	Crime	By whom Reported	Punish-ment	By whom Ordered	REMARKS

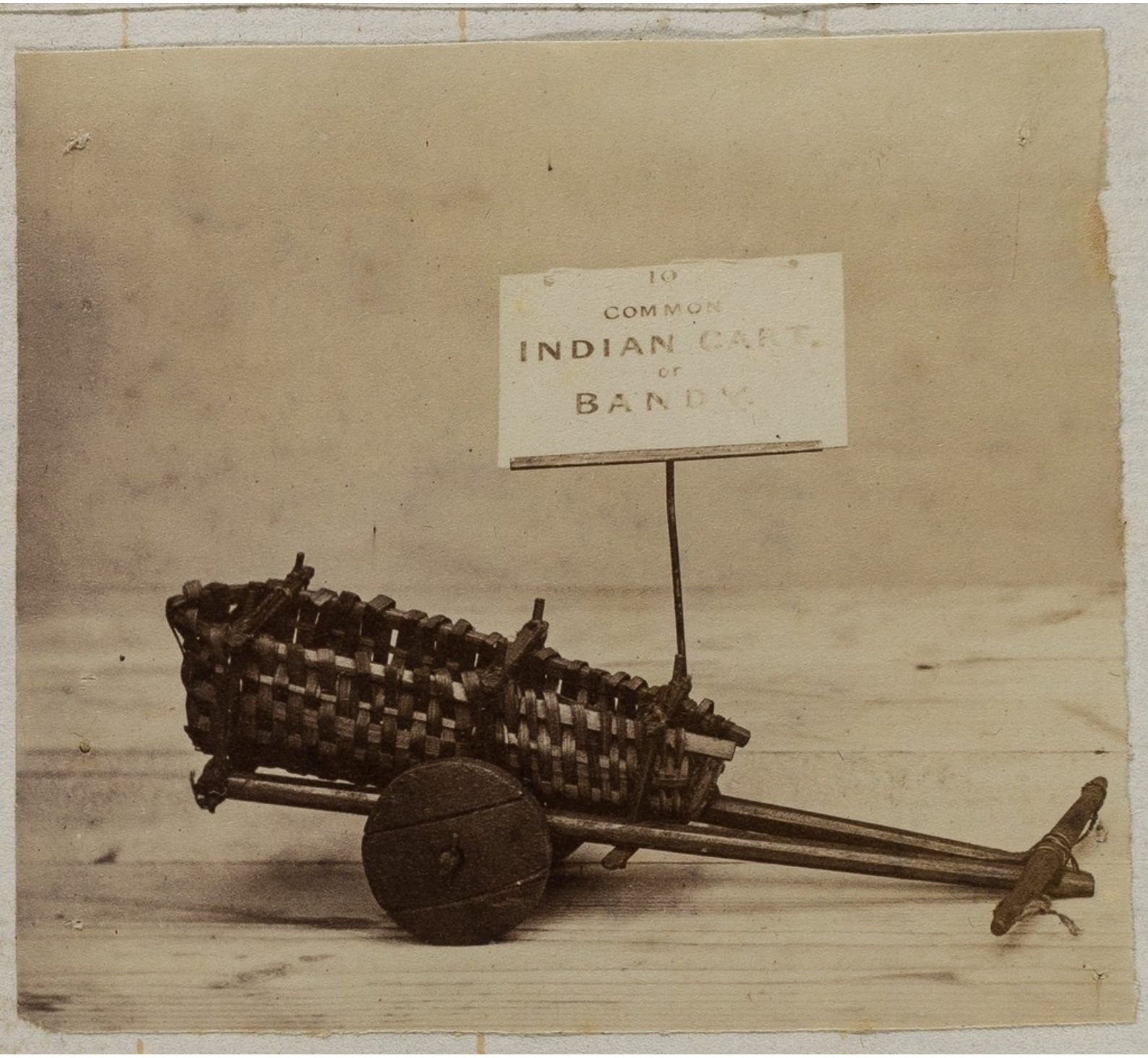
Borne by Animals.

2 Wheel Carts.

N. Guthrie's
for carrying
required

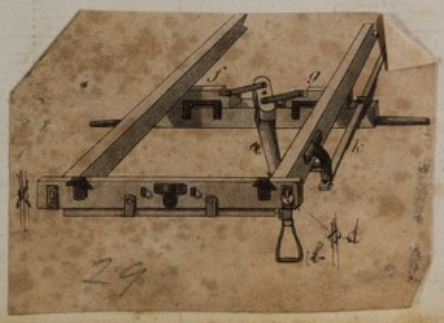
MARKS




10
COMMON
INDIAN CART
or
BANDY

Indian Hospital cart, pr draught by two bullocks

Cherry's Field Cart.



2 Wheel Carts.

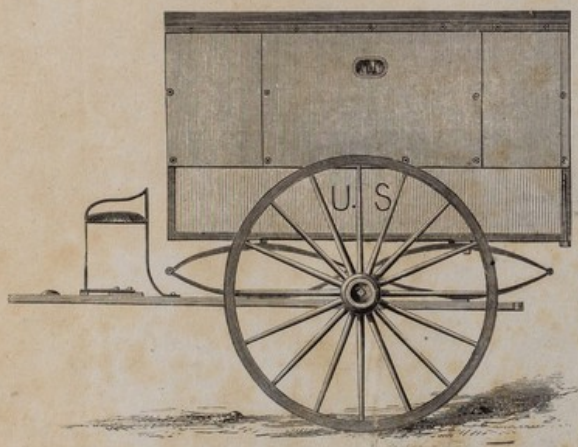
N. Guthrie's flat-topped Hospital Conveyance cart, ~~This cart was fitted~~ for carrying two patients lying on spring-stretchers on the floor, and a third, if required, on a stretcher slung from the roof, with room also for three persons sitting on seats before and behind. The ~~single~~ ~~two~~ single horse is not shown in the drawing.

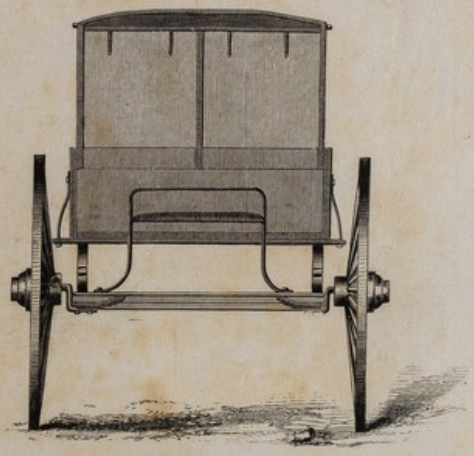
REMARKS

NAME

10

The 'Coolidge' ~~[illegible]~~ Sick-transport cart.





United States sick-transport cart

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2 Wheel Carts.

DR. TUFFNELL'S "AMBULANCE," OR "FIELD CART."

Dr. Tuffnell, professor of military surgery to the Royal College of Surgeons—a gentleman whose intimate acquaintance with the accessory sciences connected with his chair is admitted by all who have attended his lectures—has added a most important requisite to the field equipment of a campaigning regiment. For convenience we will call it a Military Field Cart. The peculiarity of Dr. Tuffnell's field cart consists in its great lightness, strength, and simplicity of construction, the accommodation it affords, and the perfect assortment of surgical and other requisites which it contains in an amount of space almost incredible to any person who had not an opportunity of examining the arrangement. We feel that, in an attempt to describe the field cart, we will do great injustice to its merits which must be seen to be fully appreciated. Yet as our military readers are interested in everything that tends to improve the condition of the soldier, and as humanity must rejoice over every comfort added to the scanty list in readiness for the wounded brave, we will endeavour to give some idea of this admirable contrivance.

The "cart" possesses the outward appearance of an outside car, of somewhat larger dimensions in every way than a large hackney car. The seats give ample sitting room for three men on each side, and the "well" is so arranged that a man can recline at full length. Under the well is a large moveable box, like in shape to a "market basket well," which extends the whole length of the car. This contains the surgeon's requisites—comforts, such as tea, coffee, wine, rum, preserved meats, soups, &c., with blankets, splints, bandages, and an extempore kitchen for cooking purposes. So that at any moment, and in any place, the moveable well provides on the field for the immediate wants of the wounded, while the "field cart," thus lightened by its removal, is ready to traverse the field for the removal of the disabled men. On the field the "cart" will take six men, who are able to sit on the sides, and one man stretched in the well badly wounded; but the sides are so arranged that the ends, as we may term the end boards, let down to any angle desired, and thus the side, covered with its waterproof cushion, becomes a stretcher or bed with a sloping pillow for the head, while the footboard, turned up and strapped, secures the wounded man in his place. Thus arranged, the cart will carry three severely wounded men in perfect safety and with comfort. The upper well, we may remark, lifts out and forms, by means of an ingenious contrivance, a hand stretcher, not unlike those used by our police force, and by an equally simple arrangement it can be converted into a sofa or into a field operating table. The cart is hung on light springs, and is drawn by two horses, and under the driver's foot-board is a water cask, with cock, drinking vessels, &c. Packed between the well and seats are iron rods for standards, which, with a waterproof cloth, form a complete head for the cart if the weather requires that the wounded be protected. This head, when removed from the car and set up in the field, forms a perfect tent—But there is, besides, in the same compartments a distinct tent, with its poles, canvass, and pins, &c.; and in the surgeon's chest or moveable well are several pairs of blankets, with eyelet holes and a jointed rod for each pair, which forms a roof pole for a hut, which may be erected in a few minutes by means of four muskets for main standards, their four bayonets for angle pins, and a few loose pins with cords, which are ready at hand. These two large tents and several small tents can be at once erected in the field by means of this remarkable and most useful contrivance. On the ordinary march Dr. Tuffnell proposes that each regiment should have at least one of these field carts for the use of footsore men. The side ends, when let down, so enlarge the seats that it will carry few men aside—while the same cart—the regimental companion in peace—constitutes the most perfect ambulance, as we have endeavoured to show, which has yet been constructed.

Dr. Tuffnell exhibited the "cart" yesterday to Lord Seaton, the Commander-in-Chief, and his staff, and subsequently to a distinguished circle of scientific men at the College of Surgeons, all of whom expressed the highest admiration of the contrivance. We believe her Majesty has expressed a desire to have it shown to her at the Palace, and that she purposes inspecting it prior to its being examined at the Horse Guards. We feel that we have not been able to do anything like justice to this contrivance, so creditable to Dr. Tuffnell's mechanical ability and to the Irish house where it was manufactured. Few who have read even these hasty remarks will fail to feel grateful to Dr. Tuffnell for his efforts in this much neglected department—efforts on the success of which we most sincerely congratulate him.

TO THE EDITOR OF THE FREEMAN.

DEAR SIR—I cannot but feel gratified by the favourable mention made in your journal of yesterday of the ambulance car which I have recently been engaged in constructing for the use of our troops in the Crimea.

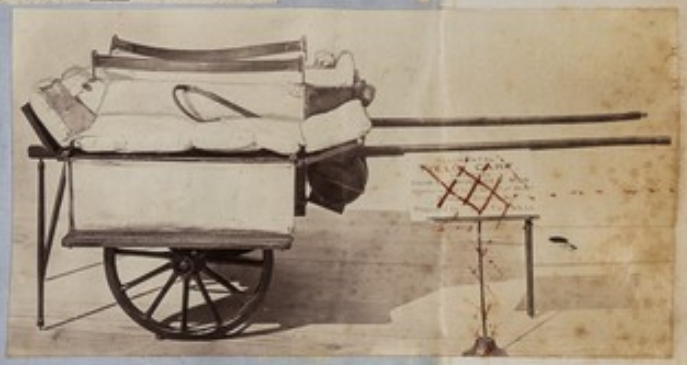
There were, however, two points omitted in it to which I should wish to call particular attention, and they are, firstly—the quality of the work; and secondly—the peculiar form of the springs. The comparative lightness of the car, together with its immense strength, can only be afforded by having the very finest material and workmanship, and such has been put into it by the Messrs. Hutton, in whose establishment it has been built, and by whom the most continued and anxious care has been given to the formation of every part. The whole practical knowledge of the house (and I might truly say, establishment) has been combined in the construction of the car, and I have no hesitation in saying that I believe a more genuine piece of workmanship will never have entered her Majesty's service than the present ambulance.

Messrs. Hutton's character as builders is too well known to require any eulogy from me, but I have throughout received such ready aid and willing assistance, with valuable suggestions, that I cannot do too much justice to the Messrs. Hutton, and indeed all engaged.

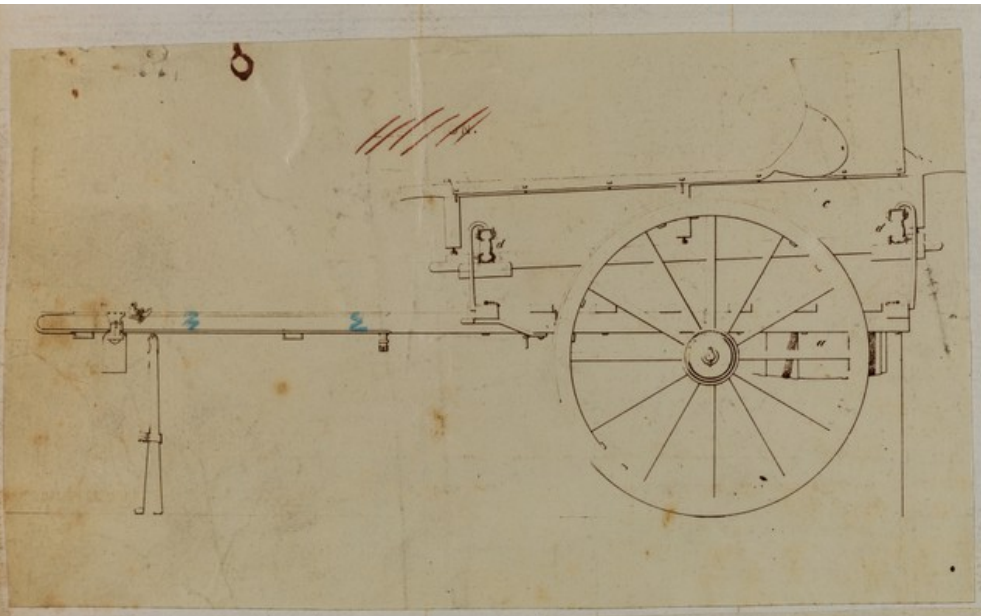
The mechanism of the springs is the other point to which I would wish to refer.

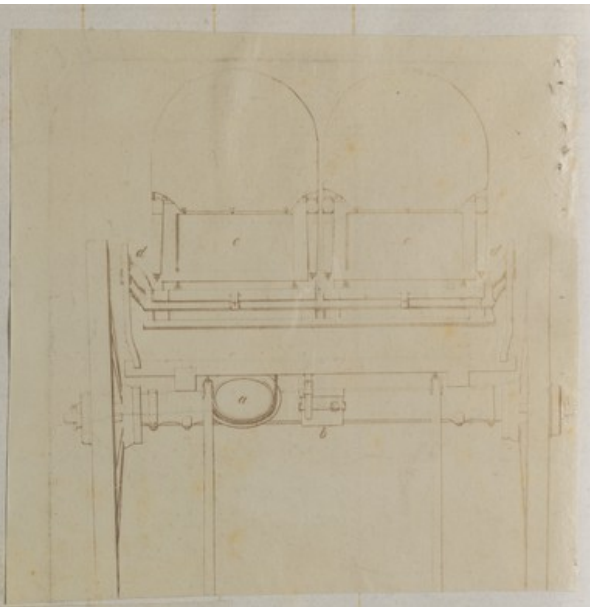
They are a combination of the C and elliptic principle, two C springs being placed on each side of the Elliptic, and unite the most perfect ease of motion, either with a light or heavy weight superimposed, and great strength at the same time. They are the invention of Mr. Henry Corbett, of Summer hill, and will, I believe, be found to supersede every other for the conveyance of wounded men for wheeled vehicles as applied to war. Apologising for so intruding at such length upon your space, I remain very truly your's,

JOLLIFFE TUFFNELL,
Regius Professor of Military Surgery, Dublin.

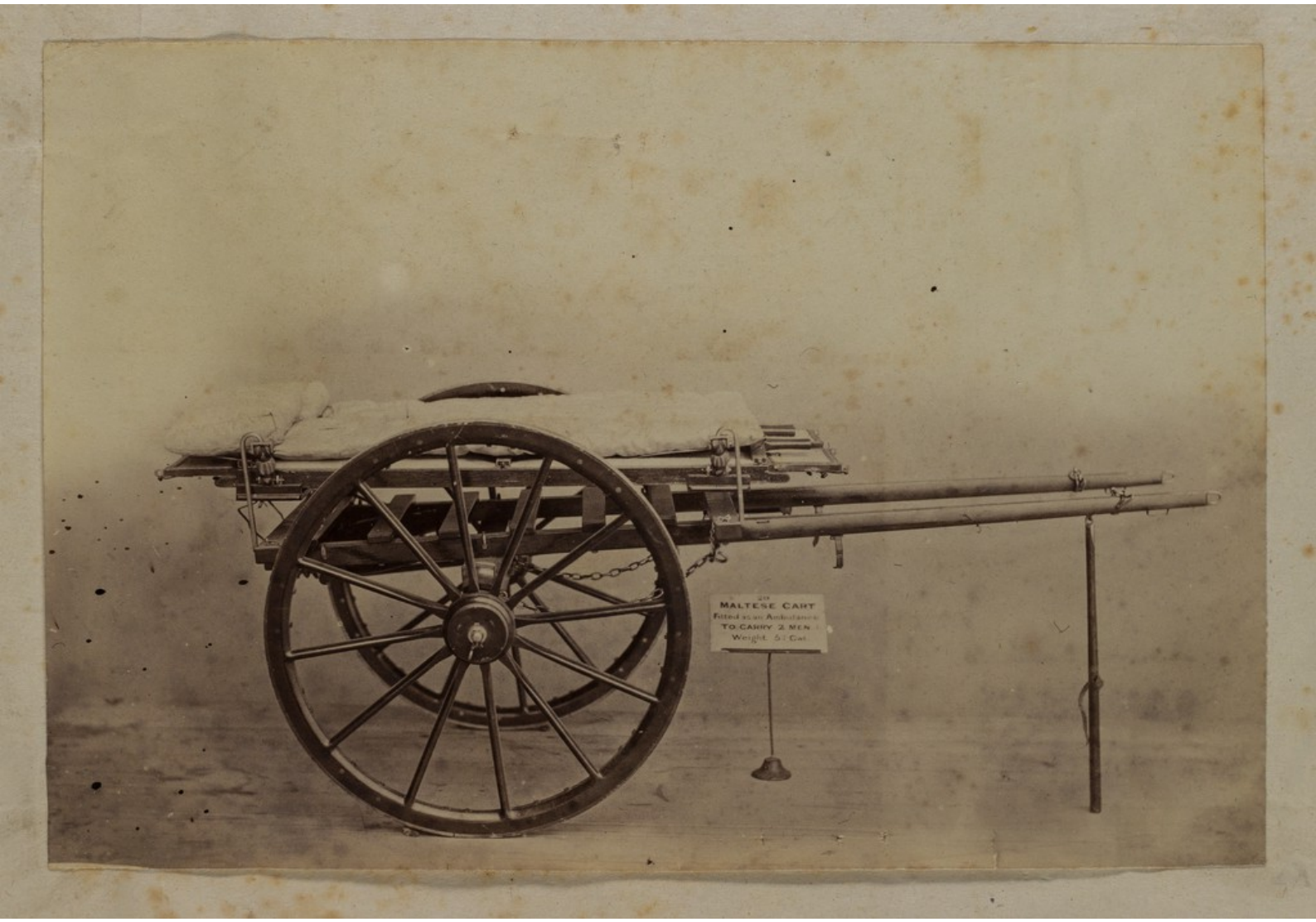


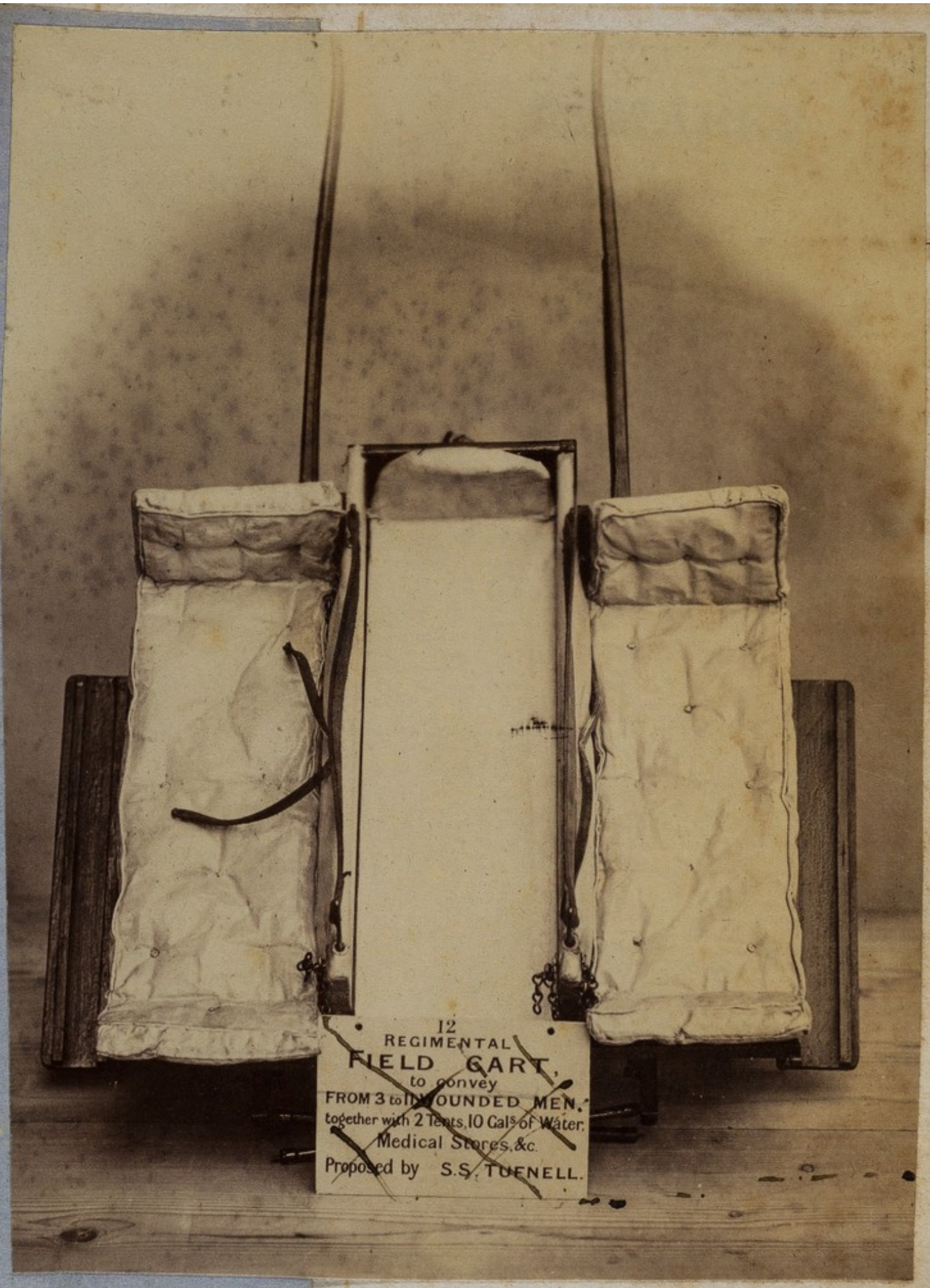
Mr Butcher's Field-cart for Commissariat, Ammunition, and Sick-transport, service.

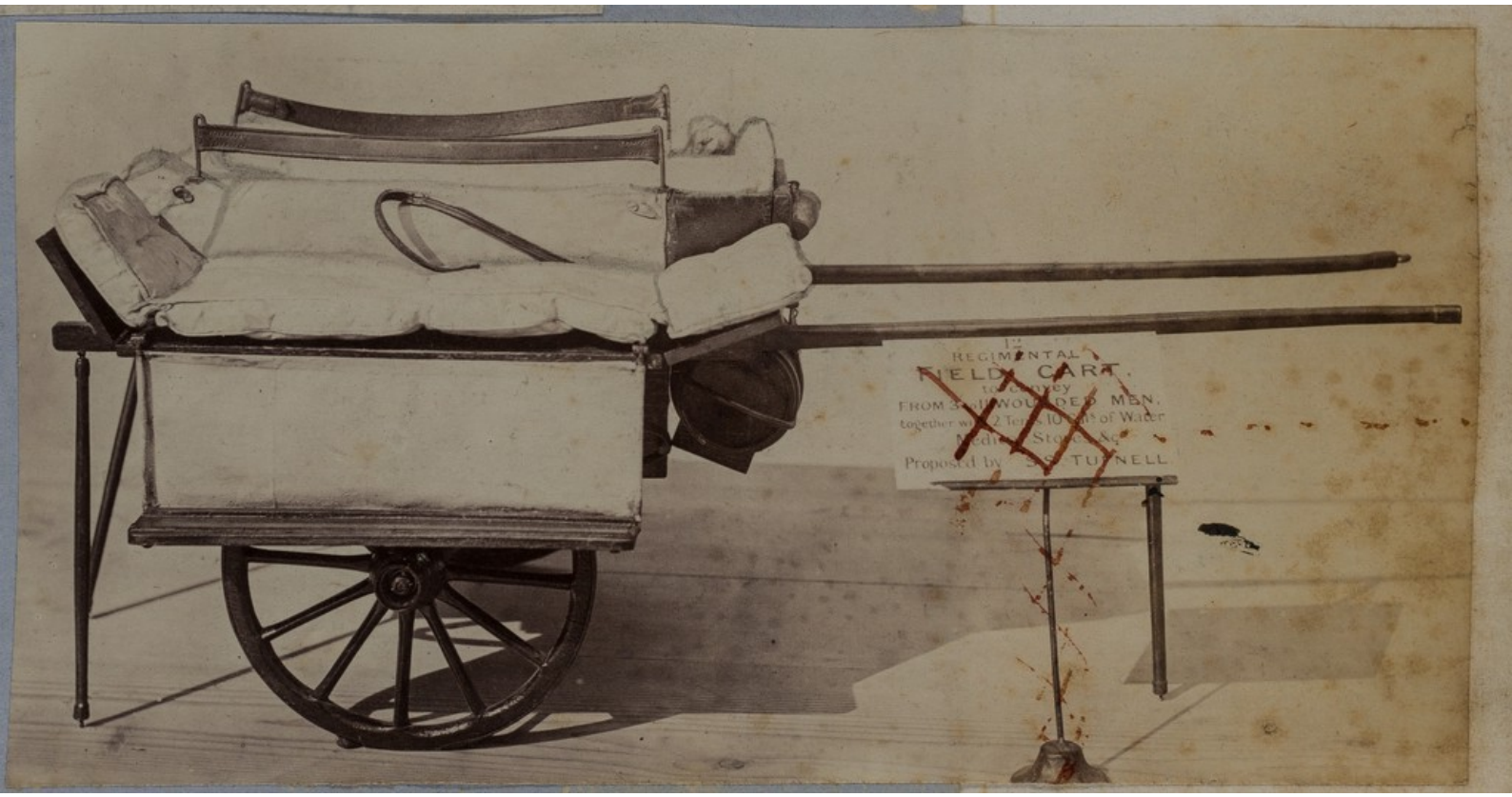




Maltese cart, with folding litters.

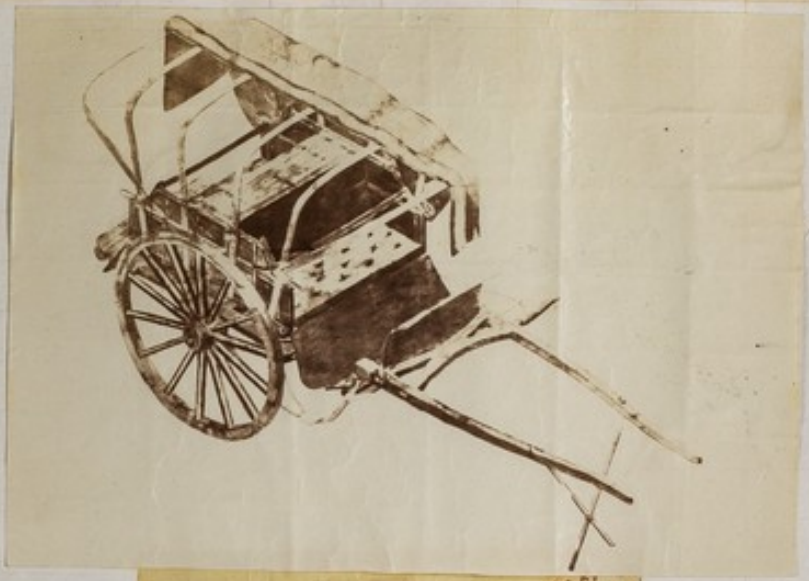

MALTESE CART
Fitted as an Ambulance
TO CARRY 2 MEN
Weight 5½ Cwt


12
REGIMENTAL
FIELD CART,
to convey
FROM 3 to 11 WOUNDED MEN,
together with 2 Tents, 10 Gals of Water,
Medical Stores, &c.
Proposed by S.S. TUFNELL.


REGIMENTAL
FIELD CART.
FROM
Proposed by

2 Wheel Carts.

NAME	Colonel Clerk's Hospital Cart.	Punish-ment	By who Order	RKS



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Colonel Clerk's Hospital Cart.

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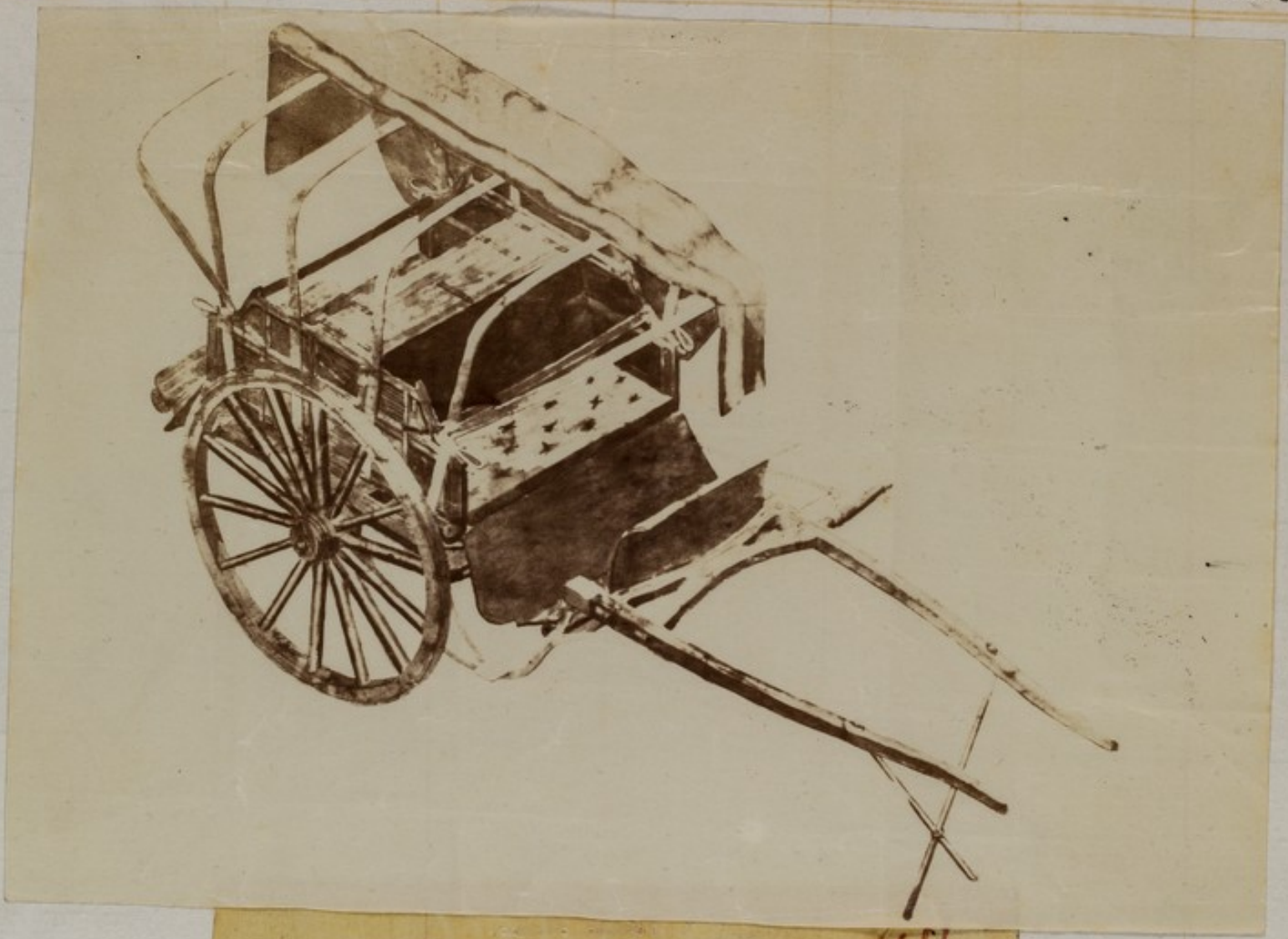
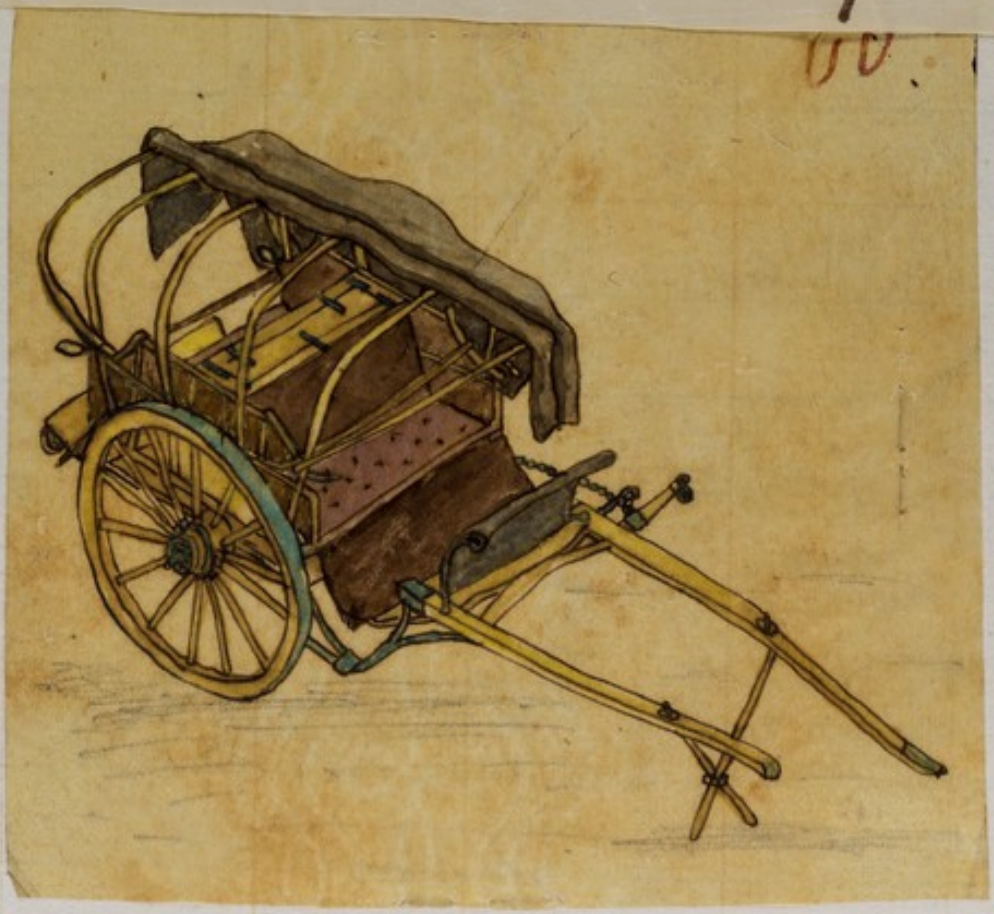
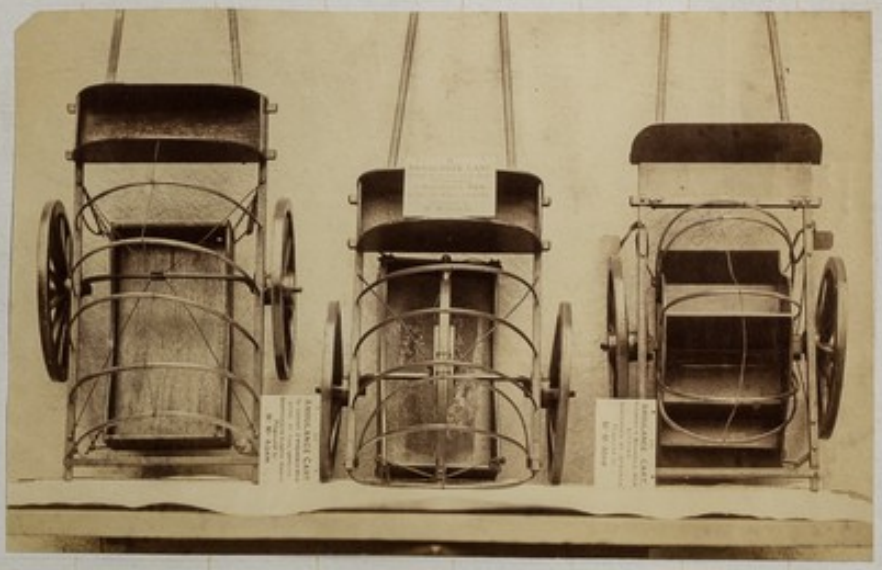


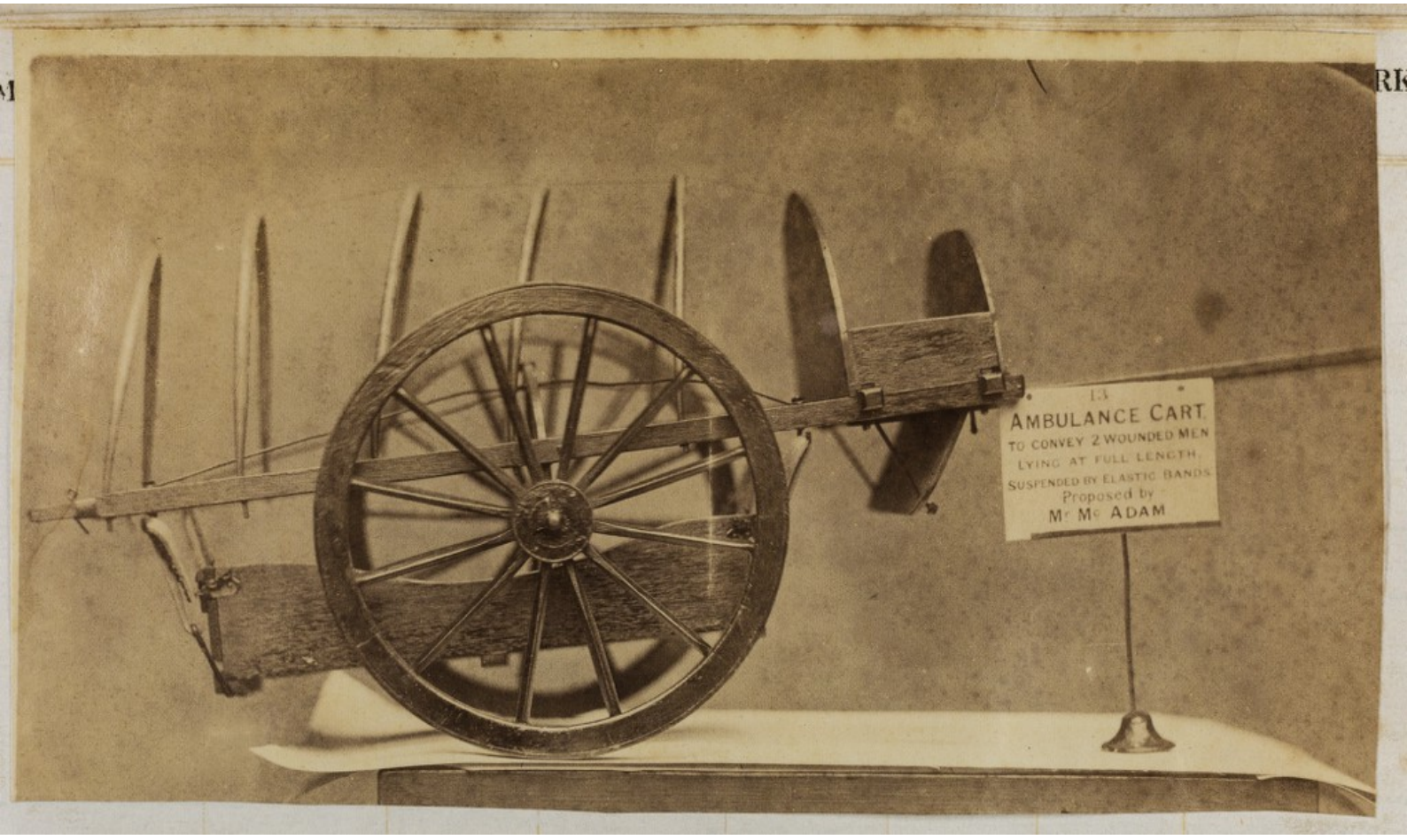


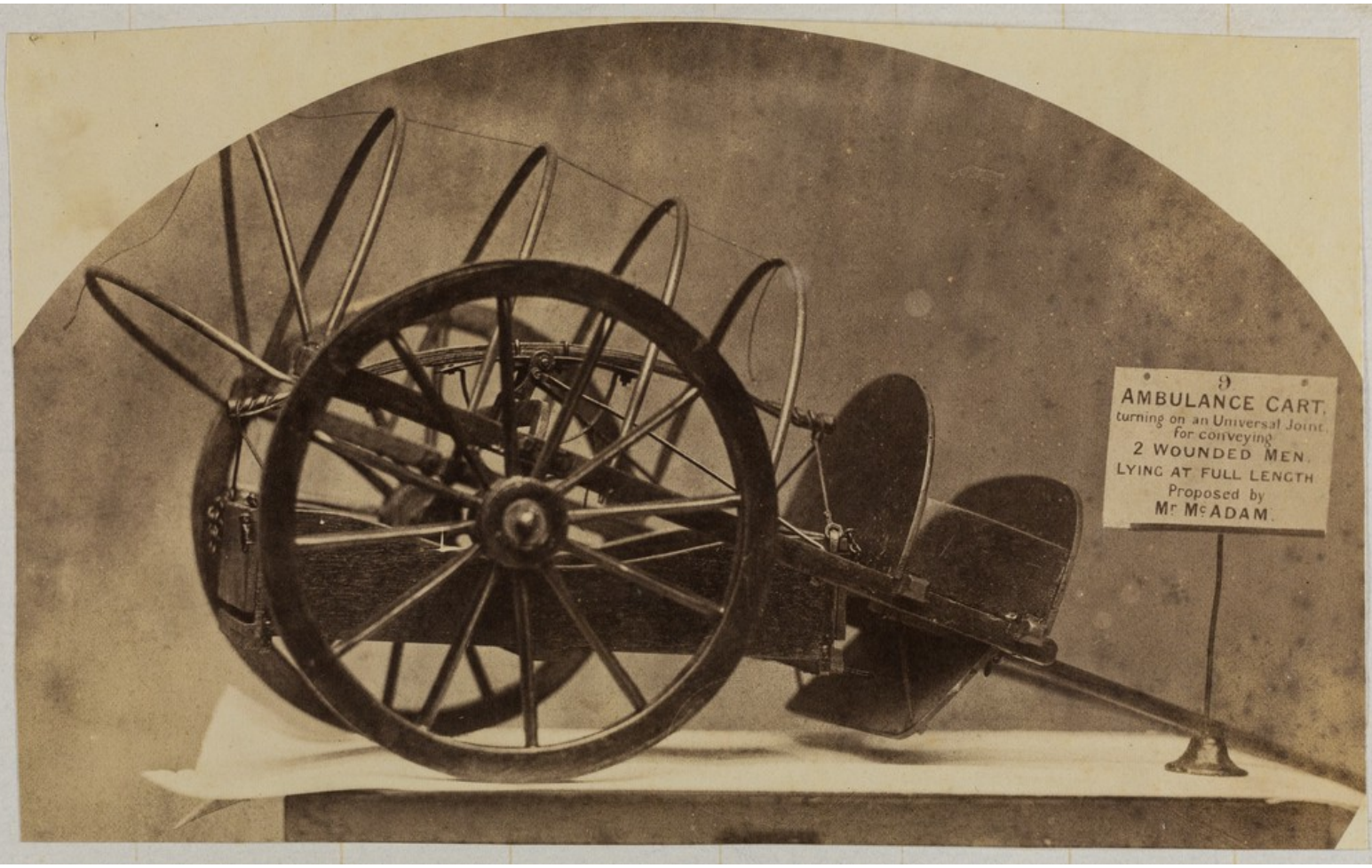
2 Wheel Carts.

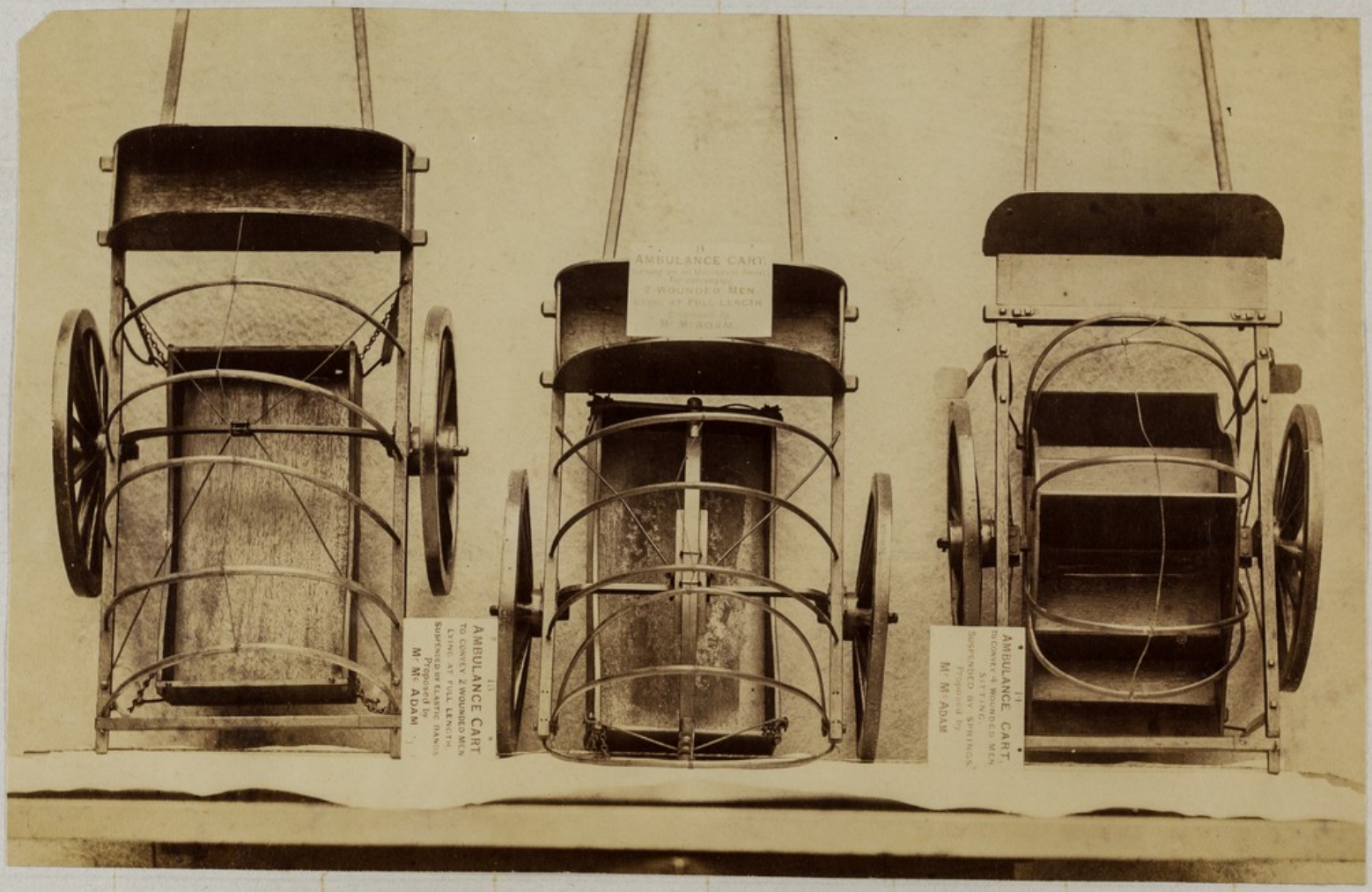
NAM RKS



. McAdam's silk-transport cart for two men.


13
AMBULANCE CART.
TO CONVEY 2 WOUNDED MEN
LYING AT FULL LENGTH,
SUSPENDED BY ELASTIC BANDS
Proposed by
Mr Mc ADAM


9
AMBULANCE CART,
turning on an Universal Joint,
for conveying
2 WOUNDED MEN,
LYING AT FULL LENGTH
Proposed by
Mr McADAM.



McAdam's sick-transport cart for two men.

2 Wheel Carts.

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