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Publication/Creation

London : Printed under the Superintendence of Her Majesty's Stationery Office, [1869]

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*D^r Allen Thomson
with the author's kind regards.*

A
TREATISE
ON
THE TRANSPORT OF SICK
AND
WOUNDED TROOPS.

BY
DEPUTY INSPECTOR-GENERAL T. LONGMORE, C.B.,

HONORARY SURGEON TO HER MAJESTY ;
PROFESSOR OF MILITARY SURGERY IN THE ARMY MEDICAL SCHOOL ;
CORRESPONDING MEMBER OF THE IMPERIAL SOCIETY OF SURGERY OF PARIS ;
ETC. ETC. ETC.

ILLUSTRATED BY NEARLY TWO HUNDRED WOOD-CUTS.



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To His Esteemed Colleagues at Netley,

TO WHOSE AFFECTIONATE CARE HE IS SO GREATLY INDEBTED

FOR RECOVERY FROM RECENT SEVERE ILLNESS,

This Attempt

TO PREPARE THE WAY FOR FURTHER IMPROVEMENTS IN THE MEANS

OF AIDING WOUNDED SOLDIERS IN TIME OF WAR,

IS DEDICATED BY THE AUTHOR,

AS A MARK

OF HIS SINCERE REGARD AND GRATITUDE.

To His Excellency General Sir John

TO WHOM AFFECTIONATE CARE HE IS SO GREATLY INDEBTED

FOR RECOVERY FROM NEARLY SEVERE ILLNESS

This Attempt

TO PRESENT THE WAY FOR FURTHER IMPROVEMENTS IN THE MEANS

OF AIDING WOUNDED SOLDIERS IN TIME OF WAR

IS DEDICATED BY THE AUTHOR

AS A MARK

OF HIS SINCERE REGARD AND GRATITUDE



SUBJECT HEADINGS OF CHAPTERS.

AMBULANCE TRANSPORT; SO FAR AS REGARDS THE CARRIAGE OF SICK AND WOUNDED.

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INTRODUCTION.

THE best method of transporting sick and wounded soldiers from one place to another in time of war is one of the most important questions to be studied, as it is one of the most difficult problems to be solved, among the subjects which concern the medical service of armies. On numerous occasions in campaigning the safety of the lives of soldiers disabled by injury or disease, and, on all occasions, the abridgment of their sufferings, must depend upon the means of effecting their removal being proper in kind, efficient in condition, proportionate in amount to the need, and upon its being close at hand, so as to afford relief when required without unnecessary delay. But the importance attached to this service is not confined to the interests of the sick and wounded. The tone of moral feeling and degree of confidence among the troops, the preservation of due order in the ranks, are influenced by it; and even the strategical designs of a commander may be aided or thwarted on occasions of urgency according as this duty is well or ill provided for and carried into execution. As a matter of economy, too, the subject demands attention. The direct loss when the conveyances for the sick and wounded sent with an army prove useless, the greater indirect loss from the failure of their services, and the necessary expenses, under all circumstances, involved in the maintenance of an hospital transport establishment, sufficiently indicate the importance of securing for adoption the best system of sick transport, both as regards the matériel and the administration, that can be devised and adapted to the exigencies of warfare.

Yet, valuable on the one hand as a good system of hospital transport is, and, on the other hand, worse than useless the reverse of a good system, the established arrangements for this service are generally regarded, notwithstanding the many improvements which have been made in them of late years, as the most defective part of military organization, as they certainly are of the medical departmental organization in armies. The author of the most recent work on military surgery in France has written:—
“ L'enlèvement des blessés du champ de bataille et leur transport

“à l'ambulance sont la partie la plus défectueuse du service de santé en campagne.”* The alterations which have been made from time to time during the last few years in the organization of the personnel, the repeated failures of old forms, and the constant efforts made for discovering better forms of ambulance vehicles, not to mention the expressed opinions of many experienced officers, confirm this statement as regards this country; just as changes and experiments of a corresponding nature point to the same fact in other countries.

It is not surprising that this part of the military system should be still in an imperfect state. There has probably never been a time when endeavours have not been made to improve the destructive implements of war and to ascertain the most effective methods of employing them. These are subjects in which the community at large take interest, for it is felt that power as well as protection are involved in their possession; but it is comparatively a short time ago since attention was first given to determine practically the best means of meeting the pressing necessities, in respect to transport, of those who are disabled by the effects of war, and even during the interval of time which has since elapsed interest in the question has been limited, with comparatively few exceptions, to the persons officially concerned with the special duties belonging to it. There is not a systematic work published on the subject in any language, as far as I am aware. The subject is casually referred to in almost all modern works which treat on the duties of army medical officers, but usually only very briefly and superficially, unless some particular system of transportation, or special form of conveyance, is advocated by the writer; while what is felt to be wanted by every one taking a practical interest in the question is a work of reference in which may be found, without much loss of time, an account of what has hitherto been done towards its solution, an explanation of existing arrangements, and such guiding principles as may not only serve the purpose of preventing a repetition of former failures, but also of steering the way to future improvements. This is the information which I have attempted to furnish in the present work.

The personnel of ambulance establishments, the men to whom the duty is entrusted of picking up and carrying the wounded to the field hospitals, of attending upon them under the directions of the surgeons while they are in hospital and during their subse-

* *Traité de Chirurgie d'Armée*, par M. le Dr. Legouest, Professeur au Val de Grâce page 904.

quent removals, are so inseparably connected with the appliances which are placed in their hands for carrying on this service, that a description of the one would necessarily be very incomplete without a description of the other. I have therefore traced the history of this branch of military service through its successive changes, from its first introduction in a systematic form in any army down to the present time. I have more particularly shown the successive improvements made in the organization of the Army Hospital Corps of the British service; at the same time I have not omitted to sketch the constitution given to similar corps in other countries, under the belief that this information may be useful as well as interesting for purposes of reference and comparison. The arrangements and regulations for their field duties, more particularly for those connected with the transport of the wounded, have been almost exclusively kept in view in these descriptions of the ambulance personnel of different armies.

The various forms of ambulance conveyances hitherto used will be found to be systematically classified, and each class separately described under its respective heading. The general plan adopted is first to indicate the objects sought to be attained in each class of conveyance, and then to describe particular examples of the class; at the same time, when seeming necessary, the merits and deficiencies of each example are pointed out, and the extent to which it has been found to answer its intended purposes in practice is noticed. Mention is made of all the examples of each class of conveyance that have attracted attention, or that appear to be noteworthy on account of any peculiarity in their design or construction. In describing the qualities of particular conveyances, whenever I have not had the opportunity of personally observing them I have made every endeavour to obtain the results of practical observations made by others; and whenever I have been able to obtain them the authority is mentioned. Nothing but actual use and observation can determine truly the merits or defects of particular inventions; ambulance conveyances constructed on the best principles theoretically have over and over again proved failures when subjected to the rough tests of service, to the great disappointment of their designers.

When the carts and wagons constructed for the conveyance of the sick and wounded were sent out with the army to Turkey in the year 1854 the Director-General of the Army Medical Department, anticipating that many defects would be discovered in both, from such appliances at that time being only known theoretically

in the British service, issued a departmental memorandum* requesting medical officers to suggest whatever alterations and additions they might think calculated to render them more suitable and efficient. This request produced some reports on the subject, but not so many, nor those so full, as would have been desirable, for the subject in respect to service in any country excepting India was a new one to most army medical officers. At the same time, while the war in the Crimea was in progress, various persons in England, actuated by patriotic motives, turned their attention to devising new forms of conveyance for the sick and wounded in the field, and brought them to the notice of the War Department. Many of these supposed improvements of the then existing forms of ambulance transport were rejected at the first examination from their evident unfitness for use under the circumstances of campaigning. Others, after examination and approval of the designs by committees of competent persons, were ordered to be constructed, and were then sent to the seat of war, and to camps and garrisons in England, to be subjected to the test of actual employment in the purposes for which they were designed. The results of these trials are only to be found by reference to the multifarious correspondence with which the various public offices connected with the administration of the army at that time abounded. I have had the opportunity, through the kindness of the late Director-General, Sir James Gibson, at whose suggestion this work was first undertaken, as well as of the present Director-General, Dr. Logan, of making myself acquainted with the reports and decisions which have been preserved among the records of the Army Medical Department on some of these inventions. Records of this kind are calculated to be valuable not only as regards the general consideration of the subject of ambulance transport, but also for preventing useless repetition of experiments of a similar nature on future occasions. Unfortunately the decisions in many instances are limited to a declaration of opinion as to the fitness or unfitness for service of the particular invention which has been submitted to the judgment of the reporters, without at the same time the reasons on which the decision has been based being recorded. But in others this information is furnished, and the reports are proportionably all the more instructive and valuable.

During the year 1867 the Universal Exhibition at Paris gave a fresh stimulus to the study of the questions involved in the subject

* 20th June 1854.

of ambulance transport. A committee of persons, deputed from the "Societies for Help to Wounded in Time of War" of different countries, brought together and deposited in the Exhibition Park a large collection of conveyances which had either been used, or had been suggested for use, for the carriage of sick and wounded troops, and offered prizes for the best forms of hand litters, wheeled litters, and wagons. Several Governments also exhibited the authorized ambulance conveyances of their respective countries. I was fortunate enough to have an official opportunity of examining this large collection, and of assisting in practical trials of many of the conveyances included in it, and thus of further adding to my knowledge of the subject.

The ambulance arrangements of the British service require not only that the kind of transport most suited for use in European warfare should be studied, but also the best kind for use in India, and in the various colonies of the empire. The transition state through which India has been passing as regards road improvements, railroad communication, and steam conveyances on its great rivers, but more especially the changes which have taken place of late years in respect to opportunities of employment for the labouring population, have exerted an influence which has tended to curtail the old, almost exclusive, use of the dhooly system of transport for sick and wounded; while special features in the climate, of the surface of the country in certain districts, in the habits of the natives, and in the usual characters of Indian warfare, have made it difficult to decide upon any suitable form of sick transport to take its place. There is every reason to believe that eventually the system of ambulance transport in India will be adapted in principle to the system which is now in force in the general British service; that is, to certain proportions of hand, bât-animal, and wheeled transport being allotted to every field force, the forms of the conveyances being severally modified to suit them to the climate and adapt them to the habits of the natives. This question is, however, still under discussion, and remarks upon it will be found incidentally in the chapters describing the conveyances which have been hitherto employed in India, and those which have been proposed either as substitutes for them or as supplementary to them.

Nor is the question of the best forms of ambulance transport for other parts of the British empire one easy of settlement. Each colonial possession presents such peculiarities, either in its climate, or in the character and general features of the country, its soil, its

mountains, ravines, valleys, the habits of the people, the kind of draught usually employed, that it is more than probable that a special modification of the common forms of ambulance conveyances will be required for each. This, again, is a subject considered at some length in the chapters on special conveyances.

It would be scarcely possible for any written description to convey an accurate knowledge of the forms of the vehicles and appliances to which reference is made in the course of this work. Numerous illustrations have therefore been added; and although these are not drawn to any general scale it is believed they will answer the purpose proposed, which is not so much to afford plans and drawings for the construction as to furnish general ideas of the design and forms of the conveyances described in the text.

I am aware that many deficiencies exist in the work, but I trust it will be found to be so methodically arranged that the task of improving what it contains, and adding what is deficient, will be comparatively an easy one. It will, at any rate, serve to show what difficulties exist in devising such a system of ambulance transport, and such conveyances, as will be thoroughly serviceable under all the varied circumstances of field service; how many efforts have been made by the authorities in England, since attention has been turned to the subject, to overcome these difficulties; and it will, I hope, have the additional advantage of assisting in the attainment of the main object which all have in view, viz., the perfection of the system of transporting the sick and wounded of armies in time of war, and of advancing the economical administration of this important branch of military service.

CHAPTER I.

GENERAL REMARKS ON THE TRANSPORT OF SICK AND WOUNDED SOLDIERS IN TIME OF WAR.

THE necessity for providing suitable and adequate means for transporting those who fall sick, or who are wounded, among bodies of troops, exists under all the circumstances of military life, in time of peace, as well as in time of war.

In time of peace, both on home and on colonial service, military arrangements require that the hospital in which the sick and hurt soldiers of a stated force are treated shall be detached from the barracks in which the men ordinarily live; and, as a matter of course, from time to time instances occur of soldiers being too weak, or too much disabled by injury, to make their own way from the one building to the other. Provision has therefore to be made for the conveyance of these helpless individuals. The same rule for the detached position of the hospital holds good, when the troops are encamped or hutted, and the same need exists for providing means of carrying those soldiers who are disabled by casualties from getting to hospital without such assistance. No difficulty is experienced in the execution of this service, under any of the circumstances just mentioned. Whether the troops are quartered in barracks or are encamped, a certain number of hand conveyances are always issued, and any amount of assistance from their comrades that may be required can always be obtained. Appropriate wheeled conveyances of an authorized pattern are furnished if the distance from barracks to hospital, or the nature of the ground, necessitates such a mode of transport, and if a soldier meets with an accidental injury of a serious kind, or is seized suddenly by illness, at a distance from his comrades and the regular military means of transport above mentioned, he has the same opportunity of obtaining removal to hospital as is open to all other persons of the civilized community in which he is for the time placed. Although it must be confessed that even in the chief cities of England the arrangements made for the transport of persons suddenly disabled by casual injury or sickness, like that for the carriage of patients labouring under infectious maladies, is far behind the methods adopted in some continental cities, both as regards the plan for meeting such emergencies, and the kinds

CHAP. I.

Suitable transport for sick soldiers necessary in time of peace as well as war.

Military hospitals detached from barracks.

Means of transporting sick and hurt in time of peace.

CHAP. I.

Change of circumstances when troops take the field.

Moveable character of field hospitals necessitates special means of sick transport.

of vehicles available for the service; still the soldier has the same advantages as the civilian under like circumstances, and no practical impediment is ever met with as regards the accomplishment of the main object, his removal to hospital.

But when troops are called upon to take the field, when they leave behind them all the resources of civilized life, and exchange them for the limited resources available under the conditions in which armies are placed in time of war,—frequently in movement, compelled to carry with them all that is necessary to supply their wants, for the most part dependent on their own stores, transport, and exertions, whatever may be the circumstances of season or locality, and exposed to the sudden exigencies which spring from battle,—under these circumstances the question of the proper provision to be made for the carriage of the sick and wounded becomes involved in many difficulties. All the conditions are changed. The hospital is no longer a fixed building, but is as moveable as the troops to whose service it is devoted; it is, in fact, an ambulance.* The means of transporting the sick and wounded among the troops must be of a peculiar nature, must possess the construction, capacity, and all the other qualities essential to fit it for ambulance purposes. Although in peace time and on home service it is best for many reasons, and is the custom, to employ the ambulance conveyances which have been adapted for meeting the wants of an army in the field, yet any conveyance suitable for the carriage of sick would fulfil the object equally well; but for ambulance purposes, special vehicles, specially contrived, are matters of absolute necessity. Nor is this matériel of the sick transport the only part

* The term "ambulance" has been adopted in English from the French language, and is derived from the Latin "ambulare," to walk. The word has, however, a different signification among all continental people, from that which is frequently applied to it by English writers. An *ambulance* never means among foreigners anything else but a *field hospital* attached to an army and moving with it—*hôpital ambulante*,—for the primary reception and care of its sick and wounded. The "ambulance" of the "Quartier Général" is the field hospital at Head Quarters. The "Ambulance Volante" (Larrey) is a field hospital fitted for very rapid movements; "Soldats d'Ambulance" (Percy) are infirmen attached to the field hospital; *les caissons d'ambulance*, *les voitures d'ambulance*, the store-transport and the sick-transport carriages of a field hospital. In England the term ambulance is very often applied to the conveyance itself, by which the sick and wounded are carried to or from the field hospitals or elsewhere, a sense in which it is never used in any foreign writings. "The supply of ambulances;" "the ambulances for the conveyance of the sick were too heavy," meaning the transport vehicles; "the French ambulances," meaning the French mule litters and cacolets; and other such expressions are constantly met with in published documents connected with the Crimean War. The same misuse of the term has been adopted from the English by several writers in the United States.

Without the explanation just given it would be scarcely possible for an English student to understand the signification of such a French sentence as the following:—"Les secours à donner aux blessés, sur le champ de bataille, comprennent trois phases bien distinctes:—1^o, le premier pansement, fait sur le terrain; 2^o, le transport à l'ambulance; 3^o, le pansement, ou l'opération nécessaire, à l'ambulance" (Arrault). The aid to be given to the wounded on the field of battle comprises three very distinct phases:—1st, the primary dressing on the ground; 2nd, the transport to the ambulance; 3rd, the dressing, or necessary operation at the ambulance.

In this treatise when the term "ambulance" is used as a noun substantive the signification of a field hospital is preserved, and when employed adjectively, as in "ambulance arrangements," "ambulance wagons," it implies connexion with a moveable field hospital.

of the subject demanding particular consideration; the nature, amount, and organization of the personnel employed in transporting the sick must be equally considered, for the system on which the transport service is to be conducted, can only be properly regulated when the ambulance matériel and personnel are mutually adapted to each other. To determine these matters so that the sick transport service may be satisfactorily and at the same time economically performed during a campaign, is a subject full of difficulties. Yet under no circumstances can the need for perfect arrangements, and for adequate means of transporting sick and wounded men, be so urgent as it is when troops enter upon a campaign. This can be easily rendered evident. It can equally be shown that the general good, as well as the interest of the individuals immediately concerned, demand that this urgent need shall be suitably provided for.

It will be useful briefly to consider the manner in which the want of proper hospital transport particularly makes itself felt under some of the principal circumstances of active service; namely, with troops on the line of march, on the field of action, in standing camps, and at the several military posts established along the line of communication with the base of operations of an army.

The need of suitable sick transport considered under the varied circumstances of field service.

On the Line of March.—When bodies of troops are marching under the circumstances of warfare, they are necessarily separated for periods of greater or less duration, and by certain distances, from direct communication with the principal points on the line of operations in rear. Under such circumstances, in a strange or intricate country, in one that is nearly destitute of inhabitants, in tropical or other unwholesome climates, there is little hope of saving men who are rendered incapable of marching through sickness or wounds except by carrying them on with the main force. If it be a hostile country through which the troops are marching, men so left behind may be exposed to death from the sword, as well as from the effects of neglect or starvation.* On

Sick transport on the line of march.

Disabled men must be carried on.

* Baron Larrey mentions that this must have been the fate of the wounded with the French army that had to retreat after the abandonment of the siege of St. Jean d'Acre, owing to the total want of any kind of conveyance for the wounded, had it not been for the order issued by General Bonaparte on that occasion, that all the horses of the staff officers were to be employed as substitutes for the deficiency in regular means of sick transport, an order which he enforced by example in giving up his own horses, and marching on foot like the rest of the army. The wounded must have been otherwise left in the field hospitals or abandoned in the desert, where they would have perished either from hunger and thirst, or from having their throats cut by the Arabs. (Campagne d'Egypte, p. 312; Mém. de Chir. Mil., tome 1, Paris, 1812).—Deputy Inspector-General Dr. Gordon, who was in medical charge of General Lugard's field force during the operations for the suppression of the Indian Mutiny in 1857-58, mentions that on more occasions than one it occurred that the numbers helpless from sickness or wounds were larger than the regular means of transport could accommodate. To have left the sick and wounded behind would have been to have doomed them to atrocities too horrible to contemplate, yet a continuance of the advance through the rebellious districts was imperative. Under these circumstances every available kind of conveyance was occupied, a strong escort of cavalry obtained, and a rapid retreat made to the nearest existing general field hospital. The patients having been safely deposited in this asylum, and the escort having returned, the main body was enabled to continue its advance. (Army Hygiene, by C. A. Gordon, C.B., p. 217.)

CHAP. I.

Transport of
wounded after
battle.

Importance of
speedy remo-
val from field
hospitals.

Urgent desire
of wounded
men for remo-
val from a field
of action.

Surgical im-
portance of
speedy removal
of wounded.

Influence upon
the combatant
ranks.

the line of march of an army, therefore, it is essential that a due proportion of ambulance transport should accompany the troops to carry on those who become disabled by the way.

On the Occasion of Battle.—In a campaign, in case of a general action, the possession of an adequate amount of carriage for transporting the wounded in the first place to the field hospitals or ambulances, and in the second place, the wounded and sick from the field hospitals to the general hospitals in rear, is always a matter of vital importance to the troops, and occasionally it may be even to the accomplishment of the purpose for which the war has been undertaken.

The importance of the first named service, the transport from the field to the field hospitals, being well performed can scarcely be overrated as regards the interests of every officer and soldier who falls wounded on a field of battle. Every man who is rendered helpless by a severe wound naturally feels an urgent desire to get surgical aid as quickly as possible, as well as to be removed from the place of fighting, where he can no longer be of use, to a place of comparative security. But it is not merely the gratification of this longing for help that has to be thought of; it is the more serious fact that the safety of lives and the preservation of limbs in many instances will depend upon proper means of transport being at hand. Moreover, in almost all cases the efficiency of the surgical assistance rendered will be materially influenced by the time which has elapsed before the patient is brought to hospital and the care with which the transport is conducted. Nor is the manner in which this duty is performed without influence on the combatant ranks generally; the inconveniences and disorder which are apt to result when no systematic plan for its execution exists, or when the plan is injudiciously conceived, or insufficiently or otherwise ill-provided, are indeed sufficiently notorious.

General Sir Hugh Rose (now General Lord Strathnairn) when Commissioner at the French head-quarters in the Crimea, in a report on the military transport of the French army, forcibly described the importance of a well organized system of ambulance transport on the occasion of battle in the following words:—

“Transport of the wounded from the field of battle to a good ambulance, besides satisfying the rights of humanity and sustaining that spirit of confidence in the soldier which, like discipline, should never leave him, has another admirable effect; it obviates the incalculable disadvantage of troops engaged in action leaving their ranks for the purpose of carrying off the wounded. Certainly, good soldiers have no other motive in leaving their ranks for this purpose than sympathy for a suffering comrade. But on the other hand, all know that on a field of battle there are at times men of a different description, who either seek rest or refreshment, or are as desirous of placing themselves as their comrades in a place of safety, and four or five such men are seen assisting to the rear a man for whom one attendant would be sufficient. Nothing is so likely to insure a reverse in action as the want of confidence, and the gaps caused by men leaving their ranks to carry away the

wounded, which is most practised when it is most prejudicial, at the time and places when and where the enemy has caused the most casualties, and consequently when every available man should be present and ready to fill up broken lines and assist, by his concurrence and example, in resisting or attacking the enemy.*

Even the progress of a campaign may be affected on the occasion of a battle by the presence or absence of the necessary amount of transport for the wounded if the engagement be on a large scale, for important strategical advantages which would be probably attained by a rapid onward movement of an army may be lost if the means of speedily disencumbering it of its wounded are not forthcoming in an adequate amount. The absence of sufficient transport must necessitate delay while the wounded are being sent to a place of safety in the rear or otherwise disposed of. It would be an outrage on humanity to leave the wounded behind on the field without the requisite professional care and means of surgical treatment, and without the necessary protection against attack; and it is not likely that an army advancing upon an enemy could spare this aid from its ranks and move on, consistently with a due regard to its safety and own probable needs.

Influence upon the progress of a campaign.

It is equally important that the transport service from the field hospitals to the general hospitals in the rear of an army should be accomplished with due skill, judgment, and regularity. The best methods to be adopted for diminishing the pain and injurious consequences which result from badly contrived vehicles, careless attendants, and ill-trained drivers is a subject deservedly worthy of earnest consideration for the sake of the sick and wounded of armies; but a still more serious matter is the extent to which the general welfare of a military expedition is involved in this division of the hospital transport duties. The establishment necessary for this service is a source of general evil or general good, according as it is ill or well organized and conducted. An ignorant and undisciplined personnel and unsuitable conveyances obstruct the progress of a campaign and act as a constant drain on the resources of an army; while a well organized personnel and a good system of conveyance are calculated to clear its way for active movements by ridding it of incumbrances, as well as to minister to its strength by rapidly restoring to its ranks the men who had been only temporarily disabled for duty in them.

Transport from the field hospitals to hospitals in rear.

Influence of this service on the progress of a campaign.

In *Standing Camps* the want of an adequate amount of transport for ambulance purposes usually becomes the cause of inordinate demands upon the commissariat or descriptions of transport required for other services. If these demands cannot be complied with, if the sick cannot be conveyed away with regularity, they must necessarily accumulate in the camp hospitals, and, in order that they may be treated so as to afford a reasonable prospect of their being restored to health and efficiency in the ranks, in the same proportion as they accumulate must the demand on other depart-

Transport of sick from standing camps.

Ill consequences of accumulation of sick in standing camps.

* Extracted from Appendix 28 to the Report (1867) of the Committee on the Administration of the Transport and Supply Departments of the Army, pp. 469, 470.

CHAP. I.

Ill consequences of crowding in the general hospitals in rear.

ments be increased for tents, medical comforts, hospital stores, and utensils of all kinds. If such an accumulation of sick should occur at an inclement season of the year, or in an unhealthy site, then the restoration of the sick to a condition of strength to fit them for duty will be rendered very problematical, even although the increased necessities of the field hospital establishments as regards stores and supplies may be fully met.

An adequate amount of ambulance transport is not only necessary to prevent the evils which have been just mentioned on the line of march of an army, on the field of action, and in camps, but also to obviate those which spring from the accumulation of wounded men at the depôts and in the buildings occupied as hospitals in its rear. The ill effects of collecting large numbers of soldiers with suppurating wounds together in one locality, the development and spread of infectious diseases, the depressing moral influences, the increased mortality, were long since sufficiently demonstrated in numerous instances during the Peninsular campaigns, and have been strongly remarked upon by all the eminent British surgeons who have recorded the surgical experience which was gained in the wars of that period. Almost all the great battles in which the troops of Napoleon were engaged furnished illustrations of these ill results. The first Baron Larrey in his memoirs and campaigns sufficiently shows that he fully appreciated the necessity of not leaving large numbers of wounded soldiers united in one place more than could possibly be avoided, and that it was only the absence of sufficient means of transport which prevented him from dispersing them in situations sufficiently far apart. The mortality at one time in the general hospital at Scutari, the spread of pyæmia and hospital gangrene in the French general hospitals at Constantinople, and of typhus in the French field hospitals during the latter part of the campaign in the Crimea, demonstrated still further the evil effects of crowding together masses of sick and wounded men. Acting upon this experience, the present Baron Larrey, when surgeon-in-chief of the French army in Italy in 1859, took especial pains to scatter the sick and wounded in small collections as widely apart as the means of transport at his disposal would permit.

Illustrations of the evils resulting from deficient sick transport.

The necessity for ambulance transport with an army being provided in sufficient proportion for its wants, under the several circumstances which have just been named, may be best established, perhaps, by illustrations of the effects of the insufficient supply which there has been on some comparatively recent campaigns. It would be easy enough to note numerous instances of the sufferings and losses of armies in the latter part of the last and beginning of the present century from the same cause; but it is more instructive to refer to examples of recent experience, for systematic transportation of the sick and wounded has only been of late years a subject to which particular attention has been generally given in armies.

In the early part of the Crimean campaign.

The consequences of the absence of proper means of transport for sick and wounded *on the march* and *on the field of action* were

made manifest in the early period of the Crimean war, notwithstanding the close proximity of a large fleet and comparatively easy communication with it; and, still more recently, in the Italian campaign of 1859, and in some of the late American battles the results of deficiencies of a similar kind have been exhibited in startling relief. In the year 1855 a report on the state of the hospitals of the British army in the Crimea was presented to Parliament by command of Her Majesty. This report was based upon inquiries made from commanding officers and surgeons on the spot by commissioners despatched from England. Sir John Hall, the principal medical officer with the army, informed the commissioners that he had made requisition for 42 wagons for conveyance of stores and wounded men, 336 canvass bearers, and 672 men, but that only three wagons were embarked, and that these had no horses, harness, or drivers.* And the commissioners were led to report that they had reason to fear that men were lost in consequence of the want of means for carrying those who fell ill on the march.

After the first action which caused any considerable number of wounded, viz., the battle of the Alma, the evil results of the absence of the necessary means for quickly carrying the wounded from the field of action to the ambulances, and from these again, after the first dressing of their wounds, to the vessels in which they were to be conveyed to the principal general hospital at Scutari, were again particularly experienced. "The want of the ambulance wagons," say the Commissioners, "was much felt on this occasion, and we believe that great delay in collecting the wounded and dressing their wounds was the consequence."†

The Director-General in his surgical history of the Crimean campaign‡ has also recorded the severe effects which resulted from deficiency of hospital transport in the following words:—

"Of these (peculiarities of the Crimean war) the first felt was the deficiency of conveyance for wounded, and for the transport of hospital stores during the early part of the campaign. It is now pretty generally known that the army landed at Old Fort with no other hospital transport or ambulance than one pack pony per regiment, for the conveyance of what are called the field panniers, small basket-work cases, intended to contain the surgeons' instruments, a few of the most requisite dressings and appliances, and a few medicines most likely to be needed on an emergency, the whole being limited by the weight-carrying powers of the sorry animal generally furnished for this duty. To this were added ten canvas stretchers per regiment for the conveyance of sick or wounded men on the shoulders of their comrades. For all other means of transport, whether of wounded, of instruments, of medical comforts, or surgical appliances, the army was left entirely dependent upon the resources of the country. These,

* Report upon the State of the Hospitals in the Crimea and Scutari, 1855, p. 339.

† Report, *supra cit.*, p. 4.

‡ Director-General's Surgical History of Crimean Campaign, Part II., p. 253.

CHAP. I.

Want of transport after the battle of Solferino.

Official report of the number of infirmiers sent to Italy in 1859.

it is now matter of history, failed to supply what was needed, and consequently after the first general action on the banks of the Alma the want of ambulance conveyance or of any description of vehicle suited for the transport of the wounded men was severely felt, and had it not been for the assistance afforded by the sailors of the fleet, and the loan of a portion of the ambulance of our French allies, the British army must either have remained several days longer than it did on the field of battle, or have left a large rear guard to protect the wounded."

The action on the Alma was fought on the 20th September, and, according to the report of the principal medical officer of the army, it was not until the evening of the 22nd that all the wounded were dressed and sent on board ship.

These battles were not to be compared, in the number of their wounded, with the battle of Solferino on the 24th of June 1859. At Solferino 300,000 men stood opposed to each other, the line of battle was five leagues in extent, and the fighting continued for more than 15 hours. The regulated numbers of ambulance conveyances were in the field on this occasion, but neither they nor the attendants whose duty it was to pick up and remove the wounded were in numbers at all adequate to meet the wants of the enormous masses of wounded who lay scattered over that extensive field of action. The fearful suffering from thirst, from want of surgical attention, the numerous deaths which were the direct results of a large proportion of the wounded being unremoved from the places where they fell until many hours had elapsed after the receipt of their injuries, the evils which resulted from blocking up of the temporary hospitals near the field from the absence of means of disencumbering them of part of their patients by transporting them to a more distant hospital, have been fully described in a work entitled "*Un Souvenir de Solferino*," by M. Dunant, a Swiss traveller, who happened to be in the neighbourhood of the scene of action, and who afterwards assisted in the hospitals.

We learn from official statements emanating from the Ministry of War at Paris, that the total number of infirmiers militaires sent into Italy during the whole period over which the campaign of 1859 extended, from the beginning to the close of the war, was 2,186.* A certain proportion of these would be rendered ineffective by sickness and injuries during the progress of the campaign, and those remaining effective would be distributed, partly with the troops in the field and partly among the numerous small hospitals (more than 200 in number according to Dr. Chenu)† established at the various bases and along the several routes by which the armies in the field operated. It is not possible from such data to estimate the proportion of infirmiers to the total

* Campagne de l'Empereur Napoléon III. en Italie, 1859. Rédigée au Dépôt de la Guerre d'après les Documents officiels, 3me édit., Paris, 1865, p. 34.

† Rapport au Conseil de Santé des Armées, &c., par J. C. Chenu, Méd. Prin., Paris, 1865, page 2.

number of troops, nor how many of them were actually available for removal of the sick and wounded or attendance upon them, on any given date during the war. But when the strength of the French army in Italy on this occasion is remembered (the French field-states show that on the 24th of June the effective strength of the army in Italy was 118,019 infantry and 10,206 cavalry, in all 128,225 fighting men); when the number of wounded is taken into account (in the three battles of Montebello, Magenta, and Solferino, the total number of French wounded amounted to 12,322, excluding those returned as killed and missing); when the number of wounded Austrians that fell into the hands of the French army as prisoners of war is added to this number; when the large numbers of sick that had become inmates of the French hospitals are also remembered, it is obvious that the provision above mentioned of trained attendants for removing the wounded from the battle field and for ministering to their wants in the hospitals would be quite inadequate to meet the requirements of the army during even the campaign of 1859, comparatively brief as it was, unless largely supplemented by assistance from other quarters. The transport establishment (*Corps des Equipages Militaires*) large as was the number of vehicles and conductors which were sent into Italy during the war, was also quite inadequate to meet the wants of the sick and wounded. In explanation it is stated, in the official report before named, that the reductions of the personnel during the peace could not be suddenly compensated, and that the establishment was therefore not equal to the wants at the starting of the campaign;* and, again, when referring to the hospital supplies of means of dressing the wounded, it is stated:—"The privations of certain corps in respect to these things can only be explained by deficiency of transport vehicles, and the necessity for giving preference to the carriage, sometimes of subsistence, sometimes of artillery materials and shot, &c."†

Deficiency of means of sick transport.

Causes of these deficiencies.

The difficulties which resulted from the want of sufficient transport for the sick and wounded in the *Austrian* army were also very great. Professor Parkes, when referring, in a paper published in the *Army Medical Reports* in 1864, to the spread of hospital gangrene and typhus in the Austrian hospitals during the Italian war of 1859, remarks, on the authority of Dr. Kraus,‡—"After Solferino the influx of sick and wounded augmented still more; at the same time, especially at Verona, two great armies were in the neighbourhood; the police conservancy was bad, and the heat was excessive. As the railroad to the Tyrol could not be used for strategical reasons, the sick were sent on the route of Casarsa and Palmanuova to Nabresina; 1,200 sick and wounded daily traversed this road. The railroad, however, from Casarsa to Nabresina broke down, and the men were conveyed on bad

Means of sick transport in the Austrian army in 1859.

* *Op. cit.* p. 22.

† *Op. cit.* p. 34.

‡ "Das Kranken Zerstreuungs-System," von Felix Kraus, K. K. Ober Stabsarzt, Wien, 1861.

CHAP. I.
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Sick transport
during the war
of the Rebel-
lion in the
United States.

“country carts, and soon the cattle fell sick, and transport became still more difficult. At Palmanuova Kraus saw 1,300 men, almost all wounded, who had no shelter, and for whom nothing had been prepared; two surgeons only were available for this mass of patients, and there was want of material of all kinds. Only an eyewitness, we are told, could form any conception of the misery of these unhappy men.”

We find again that the Americans suffered severely in the early periods of their late civil war on account of the deficiency in numbers of the ambulance conveyances and the want of a trained ambulance corps for carrying the wounded off to the field hospitals. It has been sufficiently shown by some official correspondence which has been published that considerable loss of life, aggravation of suffering, and other evils were due to the above-named deficiencies. Subjoined is part of a letter on this subject from Surgeon-General W. A. Hammond to the Secretary for War, written in the year 1862, and dated August the 21st.

* * * *

“IN accordance with your verbal permission, I have the honour to submit the enclosed project for an hospital corps, and to ask your favourable consideration for the same. * * * *
“The need for it is most urgent. In no battle yet have the wounded been properly looked after; men under the pretence of carrying them off the field leave the ranks, and seldom return to their proper duties.

“The adoption of this plan would do away with the necessity of taking men from the line of the army to perform the duties of nurses, cooks, and attendants, and thus return 16,000 men to duty in the ranks. In view of these facts, and many others which could be adduced, I respectfully ask your approval of the inclosed project.”

In another letter, dated September 7th 1862, written just after the battle of Bull’s Run, the Surgeon-General, still urging the speedy formation of a regularly organized army hospital corps, refers to “the frightful state of disorder existing in the arrangements for removing the wounded from the field of battle. The scarcity of ambulances,” he states, “the want of organization, the drunkenness and incompetency of the drivers, the total absence of ambulance attendants, are now working their legitimate results.” “Up to this date * 600 wounded still remain on the battle field, in consequence of an insufficiency of ambulances and the want of a proper system for regulating their removal in the army of Virginia. Many have died of starvation, many more will die in consequence of exhaustion, and all have endured torments which might have been avoided.”

* The battle of Bull’s Run, to which this refers, was fought on the 30th August, eight days before the date of this letter.

Dr. Agnew, a member of the United States Sanitary Commission, estimated that 500 lives were lost from want of proper transportation at the battle of Antietam alone.*

As is well known, the suffering and loss of life which resulted from the want of an efficient ambulance organization in the early part of the war of the Rebellion in the United States, so strongly attracted public attention that the most energetic efforts were made to remedy the defect. In the course of the war the ambulance system of the northern armies became thoroughly organized, and both the matériel and personnel were established on a footing proportionate to the great demands made on this branch of the military service. The system adopted will be hereafter noticed.

It will here be not out of place to glance at the aid which it is proposed to bring to assist the regular ambulance corps in removing the wounded from a battle field, and in the field hospitals, by means of trained volunteers. The fitness for service of volunteer hospital attendants in hospitals remote from the scene of active hostilities is not now alluded to.

Proposed aid by volunteers in removing the wounded from fields of battle and in the field hospitals.

The attention which was attracted by M. Dunant to the great amount of suffering and loss of life resulting from the deficient means of transportation for the wounded in time of war, and from insufficient hospital care after the battle of Solferino in 1859, led to the formation of a society at Geneva, which undertook to try and obtain a remedy for the evils described. This society, which was under the honorary presidency of General Dufour, the Commander-in-Chief of the Swiss army, called together an international conference to consider the subject in all its aspects. This conference took place in October 1863, and lasted several days. It was finally resolved that the best means to assist the wounded in time of war, so as to meet the case of the regular military establishments being inadequate to the demands on their service, would be to establish in each country a central as well as sectional committees for organizing a system of volunteer aid. All these national committees were to keep up communication with the International Committee at Geneva, and through it to make known to each other their respective proceedings and progress. Each national committee, according to the plan suggested, was to place itself in communication with the Government of the country to which it belonged, and was in time of peace to occupy itself in devising improvements in ambulance transport for time of war, as well as in organizing and instructing volunteer hospital and field attendants. In time of war the central committees of the belligerent nations were to furnish assistance according to their means to the armies of their respective countries, and to arrange, in accord with the military authorities, for the disposal and distribution of the volunteer assistants to attend on the wounded. They were also to ask aid from the committees established in neutral nations. The volunteer infirmiry attendants were to transport the wounded from the field of battle, if called upon to

Geneva International Conference of 1863.

* Amer. Med. Times, Oct. 4th, 1862, p. 193.

CHAP. I.

Volunteer associations for aiding wounded soldiers in time of war.

Question of volunteer aid in time of war considered.

do so, under the direction of the regular military authorities, and to serve in the field hospitals. The necessary maintenance and equipment of these volunteer attendants were arranged to be provided through the agency of the central committees, so as to relieve their respective Governments of all charge in these respects.

Numerous national associations for assisting wounded soldiers in time of war have been formed in response to the resolutions of the International Conference of 1863. Each of these associations has its own particular set of rules, although, in general principles, they all accord with the conclusions come to at the conference just mentioned. No such association has, however, as yet been established in England.

Objections have not been wanting against the plan of organizing volunteer aid just described. It has been argued that it is equally questionable how far such a voluntary system is either desirable or practicable, so far as an army in the field is concerned. Desirable,—for may not, it is said, the greatest evils result from the mere facts of removing from the Governments which contract wars the responsibility of providing for the wants of the sick and wounded produced by them? Practicable,—for is there not a reasonable doubt whether any voluntary organization can possess those elements of certainty which are absolutely necessary in order that dependence may be placed upon its assistance in the time of supreme need; and also whether, if forthcoming, corps of volunteers, such as have been contemplated, could be incorporated with the military organization of armies, or would submit to the strict rules of discipline enforced in war time so as to carry out their proposed work efficiently?

And again, in campaigning, in what way can any body of men attached to an army provide itself, as proposed, with food, transport, forage, and its other daily wants, excepting through the military administration of that army? Such are the chief arguments and objections that have been urged against the proposals of the Genevese International Committee for affording voluntary aid to wounded in time of war in the field itself, and they are not without importance.

It is an admitted fact that the hospital establishments maintained in time of peace, whether as regards the personnel or the matériel of those hospitals, even though furnished on a liberal scale, must be always inadequate to meet the necessities of time of war. If the establishment be very small, the system of arrangement must be one which admits of expansion in any given section without inconvenience to the general working of the whole. Then, on the breaking out of war, additions will be made in each section wherever required, according to necessity. Each increase will be intimately blended with the previously existing nucleus, and the same machinery will continue in operation, only on a larger scale.

But presuming that the additions when required can be obtained, the doubt remains whether there will be then time and opportunity for that training which is so absolutely necessary for men who will

have to discharge the delicate and responsible duties of carrying wounded and of hospital attendance upon the sick,—duties which, if executed without knowledge and practice, are fraught with serious dangers to disabled patients, just as they are with benefit to them when they are performed with skill and intelligence. This is an anxious question, but, after all, it must be acknowledged to be the *duty* of the Government of each country that embarks in war to provide for all the necessities which the war calls into existence, and for the right execution of this duty the Government is, as it ought to be, generally held responsible. The conferences at Geneva, the national committees which have been formed, have done and are doing good service to humanity by directing general attention to the wants of the wounded in battles, and of the sick who always accumulate in time of war, as well as by their endeavours to effect improvements in the field hospital conveyances and appliances of all kinds for their benefit. It is also beyond doubt that volunteer surgeons, nurses, and attendants have done invaluable service to sick and wounded collected in hospitals to which they have been removed from the scene of military operations, and, in some instances, have assisted in the field itself; but it is obvious to all who have considered the subject that the volunteer system will have to rest on a more assured basis than it at present does before reliance can be placed on it for assistance, so far as its action with an army *on the line of march in a hostile country, or in the hour of battle*, is concerned.

But whether the proposed system of introducing volunteer aid for the wounded in the field in time of war be brought into practical operation or not, there can be no question that by whatever Government a regular army is maintained, whether it be for defensive or offensive purposes, that Government must also provide and keep ready for use some means of transport for sick and wounded. Economy as well as good order demands that a certain amount of this transport shall be maintained in time of peace, so that the best system of transportation may not merely be theoretically considered, but that the vehicles themselves when devised and constructed may be subjected to the test of experience; improvements which may be found desirable effected; conductors practised in their management; and thus difficulties and losses be avoided which would inevitably be created on war breaking out if no such forethought and experiments had been instituted. It is not desirable that the full amount which would be required, or even that proportion which may have been determined to be allotted to individual regiments, in time of war, should be kept up in time of peace; for, not being required for service, such a plan would entail a constant unnecessary loss from disuse and decay, and the establishment would prove an incumbrance as well as an expense. If a certain amount of ambulance transport be maintained in camps of instruction, general hospitals, and garrison towns, where the vehicles can be employed in a manner similar to that in which they would be employed in campaigning, and to a certain extent subjected to similar tests of fitness for their special purposes, the transport vehicles so used will serve for patterns which,

Provision of sick transport by Government must be maintained.

Its maintenance in time of peace.

Amount of sick transport to be maintained.

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Importance of specially studying the best forms for ambulance transport in the British service.

on war arising, can be rapidly multiplied to any required number. By such a method economy in expense is maintained, at the same time that due regard for present and future efficiency is not neglected. This is the system which is now ordered, and is to some extent in operation in Great Britain.

It is especially important that the best forms and kinds of field transports for use in the British military service should be thoroughly tested, so that, as far as possible, all questions connected with the subject may be settled on a satisfactory basis. It is also important that the supply available for use as soon as possible after the need is rendered apparent should be sufficiently ample. No dependence can be placed upon finding means of transport in any country against which British troops are directed; for, from their having to cross water, and for the most part to effect a landing on the shores of a hostile country, all available transport vehicles will very probably be removed by the enemy before the troops arrive at their destination. And even if such casual conveyances were to be obtained, it could scarcely be expected that they would be found to have the special qualities necessary to fit them for carrying sick or wounded men, however suitable they might be in construction for the carriage of ordinary stores. Without possessing such special qualities, or without some means, which do not at present exist, being devised for supplementing the qualities which are deficient, as will be shown hereafter, every vehicle, whatever its kind, must be regarded as a most imperfect and undesirable substitute for a regular ambulance conveyance.

Peculiar description of transport vehicles required for British military service.

The insular nature of the kingdom, moreover, prevents an English army from being able to use and carry on with it the ordinary carts and means of conveyance used by the population of its own country, as may be done to a great extent by nations on the continent when they are at war with each other. Means of transport for the sick and wounded have therefore to be devised which are not only well fitted for their immediate objects, but which, in addition, shall be themselves easily carried on board ship, and easily rendered available for use immediately that the forces have landed and are in movement, or serious inconveniences to the troops may be expected to result.

Sick transport in the British Colonies and in India.

The extent of the outlying dependencies of the empire, and their varieties of climate, involve other subjects for consideration if a kind of transport adapted for general use be sought for; but, as will be remarked hereafter, it is questionable whether any kind of transport available for universal use is attainable.

The problem of properly constructing sick-transport vehicles a very difficult one.

The subject of the construction of transport vehicles suitable for use in campaigning is involved in many more difficulties than might be at first imagined. It is like many other military matters which are rendered difficult owing almost entirely to circumstances which are inseparable from the organization and moveable character of armies. The means for accomplishing almost any mechanical object may be well understood, and easily carried into operation under circumstances which admit of the employment of any appliances, however complicated or varied they may be in their nature; but it is evident that the conditions

become altogether changed when the problem to be solved is how to provide for these very requirements under circumstances where the same, or similarly varied and complicated appliances are quite inadmissible, and where, therefore, a system of taking the mean of advantages and disadvantages, of compromise as it were, can alone be resorted to. Yet this is the problem which has to be solved as regards ambulance transport. Let us briefly glance at the principal subjects which have to be taken into account in designing and constructing a suitable field conveyance for wounded men, to whatever class of transport vehicles it may belong. It is at once evident, on first consideration, that such a conveyance will require the combined ability of:—

Subjects to be taken into account in designing and constructing a sick-transport conveyance.

Firstly. A surgeon acquainted with the requirements of the wounded who are to be carried.

Secondly. Of some one experienced in the circumstances of campaigning as regards stowage, liability to damage, opportunities of repair of the conveyances, protection and maintenance of the bearers, the transport animals, &c. And

Thirdly. Of a mechanic who shall be capable of appreciating the surgical objects sought for, as well as the military circumstances and limitations already alluded to, and then be skilful enough to construct the conveyance in accordance with them.

All of these must be forthcoming in order to obtain a good field conveyance. I have placed the skilled judgment of the surgeon first, because it is manifestly the most essential. However ingeniously a transport vehicle may be contrived, and however well adapted to meet the military exigencies of field service, if, after all, it be unsuitable for the support and carriage of a sick or wounded man, it is useless so far as regards the purpose which it was designed to fulfil. But still even the surgical exigencies cannot be permitted to over-rule the military, any more than they can the mechanical limitations; and the practical army surgeon will never fail, therefore, to consider the whole together when weighing the merits of any contrivance for the carriage of sick or wounded in time of war which may be submitted to his professional judgment.

Surgical and military exigencies must be mutually subordinate.

The surgeon's part in this combined work is by no means a simple one; on the contrary, for the reasons named as soon as he enters upon the undertaking he finds it beset with obstacles. Just as the mechanic is restrained by the requirements of the surgeon and the combatant, so the surgeon is restrained by those of the mechanic and combatant also. He must consult the ability of the mechanic to fashion the conveyance according to his wishes; he must respect, just as much as the mechanic, the limits of bulk and weight prescribed by military arrangements; the necessity for contrivances to ensure portability of the conveyance itself on board ship; for unity and simplicity, so that parts may not be separated or lost; for strength, so as to resist the shocks and accidents it will be liable to meet with in campaigning, and other necessities of a similar nature. At the same time he

The surgeon's province in the construction of an ambulance conveyance.

The mechanic's part in its construction.

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A sick-transport vehicle perfectly free from objections unattainable.

must devise, in one and the same conveyance, fitness for the reception and transport of soldiers labouring under injuries differing greatly in their natures, and almost equally different as regards their requirements for proper support, and for the precautions necessary to guard against the ill effects of motion during the act of transportation.

It is not possible to comply thoroughly with all these demands by any one contrivance. The mode of carriage which will be best adapted for one set of injuries during transport, will be in some respects more objectionable than some other arrangements as regards another set of injuries. The mechanical contrivances to enable the conveyance to be folded up, to be separated into several parts, or otherwise to be adapted for occupying diminished space when stowed away on board ship, will to a certain extent interfere with its strength and simplicity. Hence the surgeon must content himself with trying to obtain a mode of transport which shall meet the greatest number of wants, and, at the same time, offer the least number of objections in any respect. A sick-transport conveyance may be likened to the soldier's knapsack. Under any circumstances the knapsack must be an incumbrance; but, as military exigencies determine it to be a necessary one, the object in respect to finding a good knapsack is to seek for such an one as shall least injuriously affect the soldier's strength and health. So in regard to an ambulance conveyance, however it may be contrived, the removal of wounded in it over ground which is usually rough and uneven, must always be attended with a certain amount of pain and of other objectionable circumstances; and the object, therefore, should be not to strain after the total removal of these, which is unattainable, but to seek for that kind of transport which shall answer the purpose of conveying the greatest number of wounded in the shortest space of time to a place of shelter, or post appointed for surgical aid, at the same time that it reduces the risk of injury to those who are being carried by it, whatever the nature of their injuries, to the lowest limits. This is what the practical field surgeon will try to attain in devising proper ambulance transport.

No single form of conveyance can be adapted to meet all the wants of field service.

Three forms of conveyance employed in almost all civilized armies.

Indeed, the idea that these objects can be attained by any one kind of transport has been now almost universally abandoned. In European warfare, at least, it is not advisable to employ the same kind of conveyance for short distances as for long distances. On the field of action itself, and along made roads, a certain limited number of varieties of conveyance, designed for the purpose of meeting these several conditions, are now authorized for use in the British service, and are generally employed in all armies. Certain forms of hand conveyances, of conveyances on the backs of animals, and of wheeled transport vehicles drawn by animals, form portions of the ambulance equipment of nearly all civilized armies.

In the preceding remarks I have given a sketch of the considerations which are demanded from the surgeon who attempts himself to devise ambulance conveyances, or who is called upon

to give advice in respect to their construction. Before concluding this chapter, I will say a few words as to the knowledge of the subject which is required from the surgeon whose duty it becomes to superintend the use of ambulance conveyances on actual service from the surgeon who happens to be placed in charge of the sick transport.

A good field surgeon will not permit himself to remain contented with knowing merely the principles on which the particular vehicles for transport which are placed under his charge are constructed, but he will also make himself acquainted with the details of their construction, and the purposes of each portion. Although it is not his province to assist in carrying a wounded man under ordinary circumstances, he should be capable of practically showing the use and application of every part of the conveyance on which he is to be carried, and, if necessary, of demonstrating to bearers the purposes of each part, should they fail to understand these by description. In a moment, without such precise supervision and direction a set of careless bearers, in lifting a stretcher with a wounded man upon it into the carriage which is designed to receive it, may convert an injury of comparatively simple nature into one which places the very life of the patient in jeopardy.

It is to the surgeon that the wounded officers and soldiers, as well as the bearers who are to carry or otherwise transport them to the place where their wounds are to be treated, must look for directions and instructions in regard to every minute circumstance of the transport. The position of the wounded man or of an injured limb, the mode of progression of the bearers, the steps to be taken in case of the occurrence of a variety of accidents to which each particular kind of injury may be specially liable, are to be determined and prescribed by the surgeon. At a moment which to the patient is one of alarm, suffering, and anxiety—when, among the bearers, are too often awkwardness and ignorance, and, in consequence, an objectionable amount of rough handling, confused and confusing talk, and useless suggestions, the surgeon should be self-possessed and unfailing in decision, and these qualities can only result from previous study and thorough acquaintance with the duties and responsibilities he has in hand. To be cool and determined under such circumstances, he must feel that he is thoroughly acquainted with the mechanical qualities and proper use of the conveyance by which the wounded man is to be conveyed, and by what arrangements the inconveniences connected with the conveyance itself may be most diminished by concerted action of the bearers. He must be acquainted with the evils attending untrained or careless carriage (and here not merely the torture, sometimes almost intolerable, of the wounded man is referred to, but the ulterior ills which bad transportation is liable to produce), and be ready at once to give the necessary directions to obviate them should he perceive a necessity for doing so. No single point that has relation to the manner in which a wounded man is carried from the field should be regarded as trifling;

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A field surgeon's duties as regards ambulance conveyances.

He should understand their construction as well as their general principles.

Responsibility of the surgeon who is placed in charge of wounded during their transport.

No single point in the mode of carrying a wounded man unimportant.

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nothing is trifling if regard be had to future as well as to immediate results. And, in addition to the direct benefits resulting from the application of this knowledge and experience, there will be also this important indirect advantage,—the wounded as well as the bearers will not fail to observe the surgeon's calmness and decision; will not fail to conclude this to be the result of superior knowledge; will in proportion have confidence in the propriety of his directions, and, therefore, with the more alacrity submit to his authority and obey his orders.

CHAPTER II.

HISTORY OF THE MODERN SYSTEM OF TRANSPORTING THE SICK AND WOUNDED OF EUROPEAN ARMIES.

I PROPOSE in this chapter to briefly survey the history of the modern system of transportation of sick and wounded soldiers of European armies in the field, and more particularly to notice the successive improvements which have been made in this branch of service in the British army. In taking this retrospective glance, and noting the interest which has been gradually excited towards the discovery of the speediest and most efficient means for removing the wounded from a field of action to the places appointed for the administration of surgical aid, and for effecting their subsequent transport as well as that of the sick to the intermediate or other hospitals in the rear of the army, it necessarily happens that both the personnel and the matériel engaged in the performance of the duties referred to are brought together into notice. Not only the conveyances employed in the transport, but also the arrangements made for carrying the wounded to them and for safely conducting their subsequent removal, have to be considered. The two divisions, the personnel and the matériel, on which the transportation of the sick depends are, in fact, so intimately associated that it is scarcely possible to review the one without marking the progress of the other. A good organization of the corps to which the administration and conduct of the sick-transport system is confided, thorough acquaintance on the part of the men of the corps with their duties, a conscientious discharge of them, perfect discipline and subordination, activity, bravery, and other soldierly qualities are as essential for accomplishing successfully and satisfactorily this very important branch of service in the field, as the provision of the right kinds of carriage for effecting the transport itself. The rise and progressive improvements of the personnel and matériel employed for ambulance transport are therefore glanced at together in the remarks which follow.

SECTION I.—ACCOUNT OF LARREY'S AND PERCY'S
AMBULANCE SYSTEMS.

I do not propose to give a history of the particular systems of transport and ambulance arrangements adopted by the several leading powers of Europe, but two eminent French army surgeons, Baron Percy and Baron Larrey, are so conspicuous as the originators of the modern plan, which prevails in all armies, of removing wounded soldiers from the field of battle by trained attendants in conveyances specially designed for their transport, that it is impossible, consistently with the objects of this chapter, to avoid giving a short history of the systems which they intro-

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The personnel and the matériel must be considered together, in reviewing a system of ambulance transport.

Qualities required in the personnel of ambulance transport.

A personnel having these qualities as necessary as proper conveyances for efficiently conducting ambulance transport.

Baron Percy and Baron Larrey, founders of the modern system of ambulance transport.

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The influence of the improvements effected by these surgeons.

The ambulance conveyances of Baron Larrey.

The litter-bearers of Baron Percy.

The introduction of fire-arms necessitated a more efficient system of transporting the wounded of armies.

Origin of Larrey's improvements in ambulance arrangements.

duced. The circumstances of the revolutionary period in which these surgeons lived, the disruption of established systems and ideas which took place at that time, the scope consequently afforded for setting forth fresh views and inaugurating new methods of action, together with the remarkable series of warlike operations in which their country was constantly engaged, sufficiently explain how it happened that the personal energy and character for enterprize which distinguished Barons Larrey and Percy came to be directed into the channels of invention with which their names are now so intimately associated. The improvements which they effected in the French service have more attracted notice among English surgeons than the systems adopted by other European powers for effecting the same objects, owing to the frequency with which French and English armies were opposed to each other in the field on the continent of Europe subsequently to the period of the French revolution. It seems not improbable also that the observations which were made during the Peninsular campaigns have ever since had an influence on the views which have been held by English surgeons in reference to the subject of transportation of wounded in time of war. Each of the eminent surgeons before named gave rise to a separate special feature in ambulance organization. On the one hand, it was Baron Larrey who first introduced the use of light ambulance conveyances specially fitted for following the movements of the advanced guard of an army, and so constructed as to be capable of rapidly transporting the wounded from the place of fighting, as soon as the first dressings had been applied, to the hospitals in rear of the scene of conflict. On the other hand, it was Baron Percy who first introduced into any army a regularly trained corps of field litter-bearers, soldiers regularly formed and equipped for the duty of picking up the wounded during the progress of an action, and of carrying them on stretchers to the place where the means of surgical aid were provided.

Notwithstanding that the introduction of fire-arms had caused the occurrence of fractures of bones and of extensive mutilations with so much greater frequency than they had been met with when wounds were chiefly made by such weapons as swords, spears, and arrows; notwithstanding that these injuries, from their nature, had rendered the wounded much less able to assist themselves and less capable of being readily assisted by others; yet no fresh system had been introduced for the transport of these helpless men from the scene of action until the period of Larrey's innovation. Either their comrades assisted them from the field, carrying them in the best way they could on their backs, in sashes, great-coats, or on extempore stretchers during the action, or they remained unaided where they fell till the fighting was over, when they were carried to the field hospitals which were stationed at a distance in the rear.

The introduction of Baron Larrey's system of flying ambulances preceded that of Baron Percy's system of trained stretcher-carriers. It was in September 1792, when Larrey was serving as an aide-surgeon-major in the French army of the Rhine, under General

Custine, that, he tells us, he first conceived the idea of a new system of ambulance arrangements for active service in the field. In December of the same year he made a formal proposition through the proper channel to General Custine for the establishment of a field hospital capable of active service in *front* with the advanced troops of his army, so that the ordinary field hospitals, and the heavy hospital carts employed with them, all of which were stationed at a considerable distance off in the *rear* of the army, might no longer constitute the first line of surgical assistance. The requisite authority was given, and Larrey was ordered to organize his proposed ambulance at once. Larrey has himself recorded in a few words the state of the field hospitals and ambulance transport at the time, and the views which led him to effect the change mentioned. "At the time I proposed my plan," Larrey writes, "the military regulations ordered that the ambulances" (moveable field hospitals) "should constantly be posted at one league distance from the army. The custom was to leave the wounded on the field of battle until after the combat, and then to gather them together in a favourable place to which the moveable hospital establishment was brought as quickly as possible; but the quantity of military carriages which were placed between the ambulance and the army, and other difficulties, retarded its movement to such a point that it never reached the place in less than twenty-four hours, so that some of the wounded perished from want of assistance. The capture of Spire having given us a rather large number of wounded, I had the distress of seeing several die, victims of this inconvenient arrangement; and this gave me the idea of establishing a new system of ambulance for carrying prompt aid to them on the field of battle itself.

"My proposition was accepted, and I was authorized to organize this moveable field hospital, which I named the flying ambulance (*ambulance volante*). I then conceived the idea of a system of carriages (*voitures d'ambulance*) suspended on springs, which should combine solidity with speed and lightness. This institution created a sensation among the soldiers; they now all felt confident that they would receive succour at whatever moment they might be wounded."*

Larrey was not able to complete the entire organization of his ambulance system at that time; but, imperfect as it was, the prompt relief which the surgeons were enabled to afford to the wounded by their presence in the immediate neighbourhood of the scene of conflict, and the services which were rendered by the light ambulance vehicles in rapidly carrying them away to the hospitals, were considered to be most important, not only by the troops, but also by the General in command. In consequence, Larrey was sent to Paris to organize similar flying ambulances for the other armies of the republic which were then in the field. Various other employments, however, arose to occupy the time of

Regulations of the French service for transport of the wounded previous to Larrey's invention of "ambulances volantes."

Larrey's *voitures d'ambulance volante*.

Benefits derived from the use of these flying ambulances.

* Mém. de Chirurgie Mil., par Baron Larrey. Tome 1., p. 64.

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this distinguished surgeon after his arrival in Paris, so that it was not till 1797 that he was able to give his attention again to the subject. In the spring of that year, while engaged as Professor of Anatomy at the Military Medical School of the Val de Grâce, he received orders from the Minister of War, at the demand of General Buonaparte, to proceed to Italy to form and direct a system of flying ambulance for the army in that country, like that which he had established with the army of the Rhine in 1793. It was on this occasion that he perfected the organization of his ambulance system, not only in respect to the vehicles for transporting the wounded, but also by the formation of an ambulance corps organized for rapidly carrying surgical aid to the wounded in all parts of the field of action.

Organization of
Larrey's ambulance system.

Larrey's ambulance establishment was now composed of three divisions. Each division comprised 12 spring vehicles for the transport of severely wounded men, four store waggons, and a personnel of 113 officers, non-commissioned officers, and soldiers, under the command of a surgeon-major of the first class; the whole being under the direction of the principal medical officer in the field. Fourteen surgeons of different grades, all mounted; a lieutenant and sub-lieutenant for maintaining order and discipline; paymaster; quarter-master and clerks; 12 mounted ambulance orderlies and 25 orderlies on foot, with their proportion of non-commissioned officers, and 25 conductors and others for the service of the vehicles and horses, constituted the personnel of each division. A trumpeter among the mounted soldiers, and a drummer among the infantry ambulance men, acted also as carriers of surgical instruments. The officers and men of the ambulance wore special uniforms, which not only distinguished their different classes of occupation and grades among themselves, but also served to indicate the common service in which they were all engaged. The distinctions were generally made by means which had the additional advantages of serving some useful purpose in the duties for which they were specially organized. Thus the uniform of the ambulance surgeons differed from that of the army surgeons generally by the addition of a shoulder belt and pouch, the latter containing some portable instruments and some few objects essential for the first relief of wounded on the field of battle. Both the mounted and foot orderlies carried a red woollen waist-scarf, which in case of need would serve to carry a wounded man; the foot orderlies carried a leathern knapsack, divided into compartments (*sac d'ambulance*), and containing the materials for dressings. So also, fixed to each saddle of the mounted officers and orderlies, was a leathern valise, arranged to be opened without detaching the straps by which it was fastened, and destined to contain also apparatus and materials necessary for dressing wounds.

The 12 spring conveyances for the wounded were of two sorts. Eight were two-wheeled vehicles drawn by two horses, and arranged for carrying two men at full length; and four were four-wheeled, destined for carrying four men, all lying down. The 12

carriages were capable of removing 32 men at one time. These vehicles will be again referred to in the chapter on wheeled hospital transport.

From the description given it will be seen that Larrey's ambulance volante, when completed, combined two principles: the first being that of a flying field hospital organized for affording instant attention and applying the first dressings to the wounded on the field of action itself; the second being that of systematic vehicles with trained conductors, for rapidly and properly transporting them to the field hospitals of the first line after this primary attention had been given. The conveyances were so constructed, and the personnel so instituted, that the whole was capable of following the movements even of an advanced force, however rapidly the movements of that force might be made. Each division, moreover, was capable of being sub-divided and sent into a dozen directions, thus affording aid over a wide area; for each medical officer, being mounted, could take one of the spring vehicles and a mounted orderly with him, and thus ensure both the presence of all that was necessary for administering the necessary surgical attention, and of subsequent transportation to the rear, for two or more wounded men. A special code of regulations determined the order of march when the ambulances were moving with the army, the internal economy of the corps, and the functions of each individual belonging to it. The ambulance orderlies were daily exercised in their duties, so as to be expert and dexterous in giving the assistance to the surgeons which was required from them when assisting the wounded.

Larrey's system combined two principles; one that of a light field hospital; the other, that of a field conveyance corps.

Shortly after the establishment of this corps in Italy peace was made with Austria, and Larrey was then chosen to accompany Buonaparte to Egypt and Syria.

While Larrey was absent in Egypt another system of ambulance carriages, differing entirely in their principles and objects from those of Larrey's system, was organized in another army of France. This army was known as the army of the North; it was under the command of General Moreau, and Percy was the chief medical officer.

Percy's system different from Larrey's.

It was in the year 1799 when this distinguished surgeon,* under the auspices of the general commanding, devised a light kind of conveyance capable of rapid movement from place to place, and carrying with it all the requisites of a field ambulance, including hand-litters, surgical dressings and apparatus, surgeons and hospital attendants. This conveyance consisted of a long carriage on four wheels, built in many respects like the carriages of light artillery, and was drawn by six horses. It was commonly known by the name of a "wurtz,"† after the German

Baron Percy's moveable ambulance.

The peculiar construction of Percy's ambulance vehicles.

* Histoire de Percy, par Laurent, p. 161, &c.

† The word spelt in French writings "wurtz," is spelt "wurst" in its original German. When used alone in the German language it signifies a thick and short sausage, a cylinder, but when joined to the word "wagen" signifies a long wagon somewhat similar to it in form, an omnibus. The French word is therefore an abbreviation as well as corruption of the German "wurst-wagen."

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The objects of
Percy's ambu-
lance system.

Its mode of
operation in
the field.

wagon, to which it bore a general resemblance, and is still referred to by this name; but at the time of its use it was also sometimes spoken of as a "char de chirurgie," or surgical cart. Along the body of each of these carriages was a long narrow case containing surgical materials, and of such a form externally that eight persons could sit astride on it. This was intended to carry eight surgeons of different grades. In front and rear of the carriage were also two smaller chests, and on these four *infirmiers militaires*, or hospital corps men, sat, two on each box; while four other attendants sat on the four leading horses. Eight surgeons and eight attendants were thus carried, as well as a driver; and, further, the chests on the wurtz contained dressings calculated for 1,200 wounded. Supplies of stretchers were carried under the long case on the body of the waggon.

In the language of M. Percy, the intention of this carriage was that by its means "the art of preserving life should contest in activity and celerity with the art of destroying life." It was to obviate the necessity of soldiers leaving the ranks to attend on the wounded, because it was prepared for distributing assistance on all points of the field of battle.

Its mode of action was the following:—Each wurtz was to keep up as close as possible with the division to which it belonged. As soon as the action had begun, and some of the soldiers were wounded, the attendants took their stretchers, ran and picked up the fallen men even though still under fire, and brought them to the wurtz. The surgeons then applied the first dressings, assisted by some of the other attendants. If from changes in the movements of the combatants, the wounded become numerous at other parts of the field, too distant for their rapid removal on the stretchers then the wurtz itself was despatched to their assistance, and the same plan of aid repeated as far as its capabilities admitted.

Each division of the army of the North in the year 1800, had its moveable corps of surgical assistance of this kind, and there was a reserve of the same establishments at the head quarters. This institution seems to have well answered its intended purpose at the time it was employed, and to have given great satisfaction to the officers and troops. It was spoken of with praise by general officers on several occasions. In April 1800, General Lecombe published a general order and reported to the General Commanding-in-Chief. "We all give a tribute of praise to this new institution created by Citizen Percy—the moveable corps of surgical aid. The medical officers of these corps have succoured the wounded on the field of battle itself, and have so distinguished themselves by their zeal and devotion that the soldier reverences them and consoles himself when he is wounded because he sees that assistance is given to him with a rapidity hitherto without example."

From the description just given it will be seen that the ambulance carriage of Baron Percy did not supply transport for

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the wounded,* beyond the conveyance on stretchers from the places where they fell to the place where the wurtz was stationed and where their wounds could be dressed. It was solely a flying hospital, or means of affording speedy attention to the wounded, but not intended for removing them to the rear.

Distinguishing
features of
Percy's ambu-
lance system.

The wounded after being dressed at the wurtz would have to remain grouped on the ground around it until other steps were taken for their removal. It was thus constructed on principles altogether different from the light transport carriages used in the ambulance volante of Baron Larrey. As before described, Larrey's ambulance vehicles were accompanied by the means of affording the necessary first dressings and surgical assistance, but were themselves built only for the purpose of quickly carrying the wounded away from the scene of conflict, so that they might not be left long lying on the field of action, or be liable to fall into the hands of an enemy.

In Percy's system the quickness of movement of the medical officers and attendants, and the certainty of their having at hand what they required for professional use, were provided for by their being carried on the same conveyance that carried the surgical appliances and dressings; in Larrey's system the same object was attained by the officers and attendants being mounted on horseback, and by their carrying on their own persons, or on their horses, the necessary surgical appliances and materials. One obvious disadvantage in Percy's system was that a casual shot or other accident which disabled one carriage would place out of active service for the time, at least for such service as could not be accomplished on foot, sixteen officers and orderlies; while, by Larrey's system, the effects of a similar accident would be limited to disabling the means of carrying a few wounded, or else to disabling an individual officer or orderly. It is evident that Percy took his idea of the wurtz from observation of the artillery carriages; and, as these were constructed to carry not only guns and ammunition, but also the men who were to use them, so, in like manner, Percy not only made his carriages to carry the materials of surgical practice, but the officers and men also who were to employ those materials in use.

Comparison
between Percy's
and Larrey's
ambulance
systems.

The *surgical conveyances* of Percy fell into disuse after peace was declared and the army of the North was broken up, the support and influence of the general officers under whose direction

* Sir George Ballingall has described the ambulance of Baron Percy as a "four wheeled carriage of a very simple construction, consisting chiefly of a sort of ridge-pole raised upon the framework of the carriage, upon which the wounded are placed astride as if on horseback, and here they sit protected by a sort of canopy." This curious error as to the intended use of the carriage has probably arisen from the surgeons, who are represented in the drawing of the vehicle at the end of the first volume of Larrey's memoirs as sitting upon the wurtz, having been mistaken for soldiers. A consideration of the drawing is sufficient to show how entirely unsuited the position would be for wounded men, and a full account of the objects the carriage was intended by its inventor to fulfil may be found in the life of Percy, by Laurent, already quoted.

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Percy's brancardiers or litter-bearers.

Principles on which Baron Percy organized his corps of bearers.

they had been employed was then lost, and they were never again resorted to. His institution of field attendants for carrying the wounded on stretchers from the places where they fell to the surgical carts was also discontinued at the same time, and when peace was once more at an end, and war again declared, the custom of the wounded being carried to the rear by their comrades in any available way again came into use. The "soldats d'ambulance" of that period only served in the hospitals. Subsequently, when Percy was with the French army in Spain, he again turned his attention to providing a special field corps of stretcher-carriers for removing the wounded from the scene of action. He no longer advocated the use of the wurtz-wagons, no doubt from the system of the "ambulance volantes" of Baron Larrey having been found so much more generally efficient for field hospital purposes in the armies in which it had been employed (for Larrey's system continued in use until the time of the restoration); but Percy now confined himself to forming, equipping, and training a corps of foot soldiers, whose particular duty was to pick up the wounded on the field and to carry them to the field hospitals on stretchers, and afterwards to assist the surgeons in attending upon them. This was the commencement of an institution which has continued to the present time; indeed, a combination of this institution with the use of light spring ambulance carriages similar to those first introduced in the ambulance system of Larrey, though variously modified, essentially constitutes the plan on which the ambulance arrangements of all modern civilized armies are now organized.

The principles on which Baron Percy, who was then Surgeon-in-chief of a Corps d'Armée, founded and organized his trained corps of bearers, and the circumstances by which his attention was first turned to the subject, are briefly related by himself. He remarks on the necessity for the men of the corps being skilful and practiced in their duties, and these remarks are equally applicable to the men composing the army hospital corps instituted for service in our own or any other army.* "Tired of the ceaseless disorder," writes Percy, "caused by assemblage of undisciplined hospital attendants; distressed at seeing the deaths on the field of battle of so great a number of soldiers whose lives might have been preserved and limbs saved if they had had the help of a commodious and well-organized mode of transport; having seen, moreover, the necessity of having as near as possible to the line of battle men specially destined to carry off the wounded instead of leaving them to the care of soldiers who too often seized this opportunity for leaving the ranks; I took upon myself to organize a regular corps of army hospital attendants (soldats infirmiers) to whom I gave the name of Companies of Brancardiers (bearers of stretchers).

"I selected a hundred soldiers from among the bravest, strongest, and most adroit, and, as soon as they were completely equipped,

* Laurent, Vie de Percy, Part II., p. 391.

"I put them on duty. The service of the sick and wounded, so neglected and abandoned before, soon changed its appearance." CHAP. II.

"Companies of ambulance bearers," again says Percy, "must be composed of chosen men, uniting in their characters courage, strength, and address. A certain skill is necessary for raising a wounded man, for placing him upon a stretcher, and for carrying him; it is not so much by strength as by address that these objects are successfully accomplished, and this address can only be acquired by practice." Character of men to be selected as bearers for ambulance purposes.

"The bearers of stretchers, if they march unevenly, painfully jolt the wounded lying upon them, and if these men place the wounded roughly upon the stretcher instead of laying them down skilfully and gently, what torture they may inflict! and much worse again, if no stretchers being at hand, they have to carry the wounded across muskets, or by their clothes, to the ambulance, as I have frequently seen done. One cannot too often repeat, the chief consolation, and the assistance of first importance, to a wounded man is for him to be carried promptly and properly away from the scene of conflict." Evils arising from want of skill in bearers.

The principles on which the institution of litter-bearers by Baron Percy was founded were adopted by an imperial decree for the whole French army in 1813.

SECTION II.—HISTORY OF THE AMBULANCE SYSTEM OF THE BRITISH SERVICE.

Until a comparatively recent period no ambulance system corresponding either with that organized by Baron Larrey or by Baron Percy, existed in the British military service. At the close of the last century, when troops were on active service, if a man fell wounded the officer commanding his company ordered one or two of his comrades to take care of him to the rear, or, if the troops were actively engaged, he remained unheeded on the ground until the fighting was over. It was not only in the field that no regularly trained men were provided for meeting the wants of disabled soldiers, but no special corps until recently existed for ministering to the wants of the sick or wounded, or for assisting the surgeons in attending upon them, even in the stationary military hospitals; the only plan was for a certain proportion of soldiers from the ranks to be sent, as occasion might require, to act as attendants upon the sick. While engaged in this duty the soldiers were styled "hospital orderlies," and this name still retains a hold in military hospitals. There was no efficient system of hospital transport, no specially constructed vehicles for the surgical and medical stores, nor any practically trained servants to take charge of them had they been provided; no regular ambulance conveyances for the removal of the troops who fell sick or became wounded to the hospitals in rear. The Peninsular campaigns, which commenced in the year 1808, produced so many battles, created so many hospital establishments, and were of so long duration, that amendments in the care and management of the sick and

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Arrangements of the sick and wounded transport during the Peninsular war in the British service.

Organization of the Royal Wagon Train.

Change in its organization during the Peninsular war period.

Peninsular ambulance conveyances defective in several respects.

wounded, the want of which became demonstrated by experience, necessarily grew up in many directions. These amendments were however, chiefly confined to the interior economy and administration of the general and regimental hospitals; the organization, personnel, equipment, and general character of the ambulances, or field hospitals, underwent scarcely any change. Sir James McGrigor made attempts to get an ambulance establishment sanctioned, based on similar principles to those on which the ambulance system in the French army was framed, but his endeavours did not meet with success.

During the latter period of the Peninsular war the wounded were carried from the field on stretchers by the bandsmen of regiments or by some of their other comrades to the first line of surgical assistance, and afterwards were transported to the hospitals of the second line or further in rear, either in return carts of the commissariat train,* or in hired bullock cars, or in spring wagons. The regular wheeled transport on the establishment of the army at that time was under the management of a corps designated the Royal Wagon Train. This corps had been organized in the beginning of the war for conducting the whole of the transport service of the army, and formed a branch of the Quartermaster-General's Department. It had been supplied with several distinct kinds of carriages, each kind being constructed for a specific service. But in a short time it was found that the wagon train was so constituted as to be unequal to supply the transport which was required even for its own support, that is, for the conveyance of its baggage, the rations consumed by the officers, men, and horses of the corps, and its other daily wants. The constitution of the corps was then changed; its store transport was reduced to one store wagon per troop, and its own supplies were ordered to be furnished by the magazines, and to be conveyed by the commissariat cart train and hired transport of the army; at the same time all other carriages under its charge were changed to spring wagons, and these were strictly prohibited from carrying anything whatever but sick or wounded men. There was still no ambulance corps corresponding with the Army Hospital Corps of the present time, or with the French "Brancardiers," on service with the British army, nor was any formed during the whole period of the Peninsular war.†

The three kinds of transport referred to in the previous paragraph were defective in several respects. The stretchers consisted of two poles, between which a piece of canvas ticking was fixed. But they were very faulty,‡ inasmuch as they were without

* Organized in 1812.

† The late Director-General Dr. Andrew Smith mentioned in a note to a departmental memorandum, dated 20th June 1854, referring to the personnel and matériel of the Medical Department with the army ordered to Turkey, that his predecessor "Sir James McGrigor, Bart, K.C.B., made while he was chief of the Medical Department of the army in the Peninsula repeated efforts to have an ambulance corps, similar to what he saw in use with the French, attached to the British force, but without success."

‡ Millingen's "Army Surgeon's Manual," p. 21.

traverses. The weight of a wounded man caused him to sink down in the yielding canvas between the poles, and in consequence of this, when the bearers became fatigued and laid the stretcher on the ground to rest themselves, however hard and uneven the ground might be, the canvas and body of the wounded man came into direct contact with it. Looped blankets were occasionally substituted for regular stretchers, the pikes which sergeants then carried being employed as the side-poles. These presented the same objections as the canvas stretchers.

The stretchers, carts, and spring wagons used in the British service during the Peninsular war.

The return commissariat carts were ill-fitted for carrying sick and wounded, being constructed without springs, and the supply of them was uncertain. The hired bullock cars were still more unsuited for ambulance purposes.* They were only employed, however, when a sufficient number of spring wagons were not available for use.

The spring wagons were calculated to carry seven or eight men sitting, or two men lying. They were drawn by four horses, and were conducted by two drivers. They were chiefly complained of on account of their weight, and of being so broad as not unfrequently to lead to encumberment and blocking up of the roads. The several kinds of field conveyance just named will, however, be more particularly considered hereafter.

In the year 1825, Veterinary-surgeon Cherry published an able pamphlet,† founded on his experience during the Peninsular war, as well as in Holland, the Netherlands, and other countries, on the subject of field transport. The object of his work was to suggest a remedy for what had been found to be defective in the organization of the wagon train.‡ Mr. Cherry's plan was to substitute an establishment of general staff transport, under the superintendence of a director of military transport, who was to be under the orders of the Quartermaster-general. He also advocated the use of a peculiar description of one-horse carts invented by himself. These carts were so arranged as to be fitted, either for the conveyance of commissariat and hospital stores, the springs with which the carts were fitted being then not employed; or, the springs being used, for the conveyance of sick and wounded. One of Mr. Cherry's carts was sent to Chatham for trial, and a committee ordered to make a report upon it. The construction of this cart will also be more particularly described in a future chapter.

Veterinary-surgeon Cherry's suggestions.

The experience of the British Legion, which was raised by Sir De Lacy Evans and others to assist Queen Isabella of Spain

Ambulance transport of the British Legion in Spain in 1835.

* Inspector-General Wm. Fergusson, whose long and varied army services in the Peninsula and other parts of the world between 1794 and 1817 give great weight to his opinion, in his "Notes and Recollections of a Professional Life," has recorded, "Our means of transporting sick and wounded have ever been deficient and cruel, as all can testify who attended the bullock cars of the Peninsula." London, 1843, p. 62. In Major General Bell's "Rough Notes by an old Soldier," London 1867, the manner in which the transportation of the wounded was carried on during the Peninsular war is equally shown to have been extremely defective.

† "Observations on the defective State of Army Transport; with suggestions for its improvement," by F. C. Cherry, Veterinary-surgeon in the army. London, 1825.

‡ The wagon train was broken up in the year 1833.

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Observations
of the principal
medical officer
with that force
regarding it.

Transport of
sick and
wounded in the
Crimea.

The "Hospital
Conveyance
Corps."

First brigade of
hospital con-
veyance ve-
hicles.

General de-
scription of
these convey-
ances.

against the Carlists in 1835, added somewhat to our knowledge of the qualities necessary for ambulance transport in European warfare. It also served to test practically the efficiency of Cherry's system of transportation of wounded under the actual circumstances of campaigning; twelve of Cherry's carts having been employed with this force in the field. Sir Rutherford Alcock, who acted as principal medical officer of the Legion, published in 1838 a volume of "Notes on the Medical History and Statistics of the British Legion in Spain," and in this work discussed at some length the advantages and disadvantages he had observed in the construction of Cherry's carts. He also made suggestions on the best method of organizing the most rapid and effective mode of withdrawing wounded from the scene of action to the first line of surgical assistance, and of afterwards conveying them to the field hospitals. Some of the improvements which were effected in the system of ambulance transport in the course of the Crimean war, and which still form part of the authorized system of the present day, accord with the plan recommended in this work.

The outbreak of the Crimean war in 1854 found this country with not even the nucleus of an ambulance transport establishment in existence. Both conveyances and drivers had, however, to be procured without delay. Accordingly an "Hospital Conveyance Corps"* of drivers in some respects resembling the Royal Wagon Train as it existed at the latter part of the Peninsular war, when all the wagons under its charge were spring wagons for the use of the sick and wounded, was hastily formed for the occasion. The Director-General of the Army Medical Department, Dr. Smith, had advised that able-bodied soldiers should be selected for the men of the ambulance conveyance corps; but objections were made to taking from the ranks effective fighting men, and military pensioners were therefore employed instead. The corps was under the orders of a captain as commanding officer, having an adjutant-quartermaster as an assistant. At the same time a brigade of hospital conveyance vehicles† was formed under the direction of the Quartermaster-general, by Lieutenant-Colonel Tulloh, R.A., and the eminent Peninsular surgeon Mr. Guthrie. This brigade was despatched to the expeditionary army in the East. It consisted of 20 carts, each drawn by two horses, five store wagons, each drawn by four horses, one forge cart, and one portable forge, each drawn by two horses. Ten of the carts were made to carry each 16 persons sitting inside; and ten others to carry two men lying on stretchers, nine men sitting before and behind, while a twelfth might be added lying on a bearer slung from the roof. The store wagons were spring vehicles, and on occasion of necessity could be used for ambulance purposes and made to carry ten persons. This brigade was

* For a history of the corps, see p. 194 of "Appendix to the Report of the Commission of Inquiry into the Supplies of the British Army in the Crimea."

† For a description of this brigade see a pamphlet published on the subject in 1854, entitled "Some Account of the Brigade of Hospital Conveyance Carts, &c. formed on Improvements suggested by Lieut.-Col. Tulloh, R.A. and Mr. Guthrie."

calculated for two divisions of the army, and was sent complete in every way for duty in the field.

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Another brigade of hospital conveyance vehicles, of a different construction, was at the same time despatched as additional means of transport of the sick and wounded with the army in the East. This brigade consisted of 20 spring wagons on four wheels for carrying men, and nine Flanders wagons for carrying hospital stores. These vehicles were built according to plans recommended by the Director-General of the Medical Department, Dr. A. Smith. The spring wagons were each capable of carrying six slightly wounded men sitting, and four badly wounded lying. The Flanders wagons, though intended for the carriage of bedding and other stores for the field hospitals, were also capable of being used in case of necessity for carrying wounded. They were placed in springs. In the same way, the spring wagons were so built, that the parts on which the wounded were to be placed could be removed when they became available for supplying any deficiency that might exist in the means of transporting stores.

Second brigade of hospital conveyance vehicles.

General description of these conveyances.

It would appear strange without some explanation that the War Department should despatch at the same time vehicles very differently constructed, yet intended for precisely the same purposes, for service with the army under the command of Lord Raglan. But the explanation is sufficiently given in a circular memorandum signed by the Director-General, Dr. Smith.* These various conveyances were sent not only to meet the immediate necessities of the war, but also with a view to test practically the respective merits of the different forms of vehicles themselves. A brief quotation from the memorandum referred to will afford a full justification of the course pursued. "Special attention," writes the Director-General, "is requested to the carts and wagons which have been furnished for the conveyance of sick and wounded. No doubt many defects will be discovered in both; therefore the medical officers serving with the army will, in all probability, have an opportunity of improving upon appliances that are known *theoretically* only to the British army, though *practically* to the French since 1792, when a supply of light wagons, accompanied by a corps of disciplined attendants, was sent into the field on the recommendation of the late renowned Baron Larrey. But notwithstanding the French have used so long what we are now only beginning to employ, still there is reason to believe much must yet be effected before we shall be able to consider the object in view to have been satisfactorily attained.

Explanation of two sets of differently constructed vehicles having been despatched to the seat of war.

"Medical officers will therefore be pleased to report, through the Inspector-General of Hospitals, whatever defects they may discover in the vehicles which have now been supplied, and also to suggest whatever alterations, additions, &c. they may think calculated to make them more suitable and efficient."

The organization of the "Hospital Conveyance Corps," the corps of pensioners who were sent at the commencement of the

Organization and duties of the Hospital Conveyance Corps.

* Departmental memorandum, dated 13 St. James's Place, 20th June 1854, by the Director-General, on the subject of the carts and wagons sent to the Crimea.

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Crimean war to have charge of the transportation of the sick and wounded during the campaign, underwent several modifications while the war was in progress, and has undergone still more important changes since that period. The duties of the men of the Hospital Conveyance Corps comprised both what have been before described as the duties of the "brancardiers" organized in the French army by Baron Percy, and those of the soldiers of the "ambulance volante" of Baron Larrey. They were, in case of action,* "to carry the wounded as soon as possible from the field of battle to the nearest eligible place of safety;" to supply the general hospitals, if possible, with non-commissioned officers and orderlies, so as to prevent the necessity for efficient soldiers being retained from their regiments for these services; to take care of the carts and horses necessary for the conveyance of the sick and wounded; and to furnish servants for the officers of the general medical staff of the army.

Failure of this corps.

This establishment proved a failure, as might well have been anticipated. It failed owing to the total want of training of the men of the corps for such varied service; to their not having been accustomed to work together; to their loss of activity from age, and their general drunken and disorderly habits; partly to overweight and other imperfections which were found to exist in some of the conveyances; and lastly, to absence of the necessary tools and of skilled workmen in the corps for repairing ordinary injuries at the time of their occurrence, for want of which a carriage was often rendered useless by damage of the most trifling character. Neither the men nor the conveyances of the Hospital Conveyance Corps were much employed in the Crimea itself. None of the carriages moved with the army to Sebastopol, and those which were landed at a later date, subsequently to the opening of the siege operations, were quickly rendered useless by the state of the roads, as well as by the causes before mentioned.

Causes of the failure of this corps.

On the occasion of the Crimean war sufficient time elapsed before hostilities actually commenced, and the war, when begun, just as had happened in the Peninsular war before, was sufficiently prolonged to admit of the ambulance arrangements being altered, fresh men being enrolled, and a new system organized. Had the army been put early in movement, and a campaign been rapidly conducted, no regular means of transporting the sick and wounded would have been available, owing to this collapse of the Hospital Conveyance Corps.

The "Land Transport Corps."

From the time that the Hospital Conveyance Corps broke down, the removal of the sick and wounded and the conveyance of medicines and medical comforts depended on the "Land Transport Corps." Originally the duties connected with the general transport of the army had been performed, together with those of supply, by one body, viz., the commissariat department, though without any organized train of vehicles or drilled drivers; but

* See the pamphlet before quoted by Lieut.-Col. Tulloh, R.A., and Mr. Guthrie, page 3.

during this campaign the two duties were separated, and the whole of the organized transport service was placed in the charge of combatant officers under the orders of a distinct head, called the Director-General of Transport. In the beginning of 1857 the "Land Transport Corps," as it had been called, was re-organized, and a still more military character given to it, it being in many respects assimilated to a cavalry corps. It then received the name of the "Military Train." The organized transport for the sick, as well as that for the warlike stores and supplies immediately accompanying the army, was placed under its charge. The "Military Train" has continued to have, among its other duties, that of providing the wheeled conveyances and all transport animals for the ambulance and hospital purposes of the army, as well as the non-commissioned officers and drivers who are to conduct and have charge of them. One of the functions of the men of the Hospital Conveyance Corps which was raised at the beginning of the Crimean war has thus devolved upon the Military Train; the other functions of those men, viz., those of conveyance of the wounded from the field of battle on stretchers, and of attending to the sick and wounded in the hospitals, remained to be provided for in other ways.

The "Military Train."

After the Hospital Conveyance Corps was disbanded, the ambulance duties, as well as the nursing in the intermediate and general hospitals in rear, were entirely performed, as they had always been prior to the institution of that corps, by soldiers taken from the ranks of the regiments of the army. Now the "hospital orderly" system, although in individual cases often providing most kind and considerate nurses, men who felt as comrades as well as who acted from motives of a conscientious discharge of duty, was generally acknowledged to be, as a whole, faulty and inefficient. On the one hand, the commanding officer was deprived by it of a number of men from the ranks of his fighting force, and the worst of it was that, the more his force was weakened by wounds or sickness, the more it was still further weakened by the abstraction of the men who were taken from the ranks to attend upon them. At the general hospitals in rear, soldiers who had recovered from sickness or slight wounds were detained to act as hospital attendants, who, under other arrangements, might have been sent back into the field to increase the fighting strength of the army. The evil was further increased by the extra labour which was thus thrown upon those who remained at their regular duty in the ranks. On the other hand, the surgeon too often found his hospital attendants deficient in those qualities of intelligence, tenderness, and activity which were essential for the well-doing and comfort of his patients. As Sir G. Ballingall has remarked,* "It is not indeed to be expected that commanding officers of regiments, upon whom the surgeon is dependent for this kind of assistance, should be disposed to part with that description of men best qualified for the duties we have in view. The num-

"Hospital orderly" system.

Its defects.

* "Outlines of Military Surgery." Edinburgh, 1838, p. 87.

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The "Medical Staff Corps."

The functions of this corps.

Its organization.

"ber of men often withdrawn from the ranks by duties of fatigue, and casualties incident to the service, is materially increased by the number necessarily employed in attendance upon the sick, an attendance which should not be left to be provided for on the spur of the moment, but should be established and organized on a liberal scale." To obviate the evils which were experienced in the working of this system a "Medical Staff Corps," consisting of nine companies, each company being 78 strong, was organized in June 1855,* "to be employed in any way that may be required in the performance of hospital duties." Each company was calculated for attendance in a hospital of 500 patients. The duties of this corps included not only those which belonged more particularly to the surgeon's department, such as the superintendence of wards and the duties in the wards, but also those which were afterwards transferred to another, the purveyor's department, such as the charge and issuing of stores, the cooking, washing, and all other non-professional occupations appertaining to hospital service. All the men of the corps were under the direction of the Director-General of the Army Medical Department, and were detailed by him or his officers for the different hospital duties. There was scarcely any military feature whatever in their organization. The larger proportion of the men who were enlisted into it came directly from civil employments, without any of the previous drill and training in discipline to which all soldiers are subjected. No provision was made that the orderlies of the corps should be employed in field duties. The men were liable to be discharged from the service at any time the authorities might think fit, and without any claim to pension until after a service of 15 years. In September of the same year a second warrant was published,† increasing the strength of the corps to 10 companies, and the strength of each company from 87 to 120 men. By this warrant an attempt at a military character seemed to be given to the corps, for it ruled that every man enlisted into it was "liable to be sentenced for misconduct by court-martial to be reduced to the ranks of the army and to be sent to any regiment of the line, to serve therein with the rank and pay of a private sentinel." Practically it was found, however, that this provision could not be carried out, on account of the majority of the men not having been previously enlisted in any regiment of the army.

Practical defects in the organization of this corps.

The Medical Staff Corps as thus organized did not prove satisfactory. In a somewhat doubtful and anomalous position in respect to their relations with the combatant authorities, and acting, as the men of the corps for the most part did, in hospitals under medical officers who were not invested with military authority, and had no power of awarding punishment for offences; being, in a considerable proportion of their numbers, undrilled and untrained in the strict requirements of discipline, and this not only as regarded the men of the corps, but also the

* See the Royal Warrant, 157,717/1 of June 11th 1855.

† Royal Warrant, No. 157,717/145, September 1855.

stewards and wardmasters under whose supervision they immediately performed their duties, and who, though having the relative rank of non-commissioned officers, neither wore the ordinary distinction of those ranks on their uniforms nor had corresponding powers of command; under such circumstances it is hardly to be wondered at that the rules for the conduct of military hospitals were constantly infringed by the men of the Medical Staff Corps, and that absence from duty, insubordination, and drunkenness on their part were frequent sources of neglect of the sick and vexation and trouble to all concerned.

In consequence of these difficulties and irregularities the Medical Staff Corps was disbanded, and in the year 1857 a new corps of attendants for military hospitals was organized in its stead, under the name of the "Army Hospital Corps."* To this departmental corps a completely military constitution was given. Its ranks were ordered to be filled as a general rule by soldiers volunteering from the combatant ranks after a certain length of service in them. At least two years' regimental service was to be insisted upon under ordinary circumstances; men who had not so much regimental service were only to be enlisted into it as exceptional cases, on account of some particular qualifications and by special authority of the Secretary of State for War. The volunteers were moreover required to be men of good character, to be recommended by their commanding officers, and were not to be transferred to the Army Hospital Corps until after a period not exceeding three months passed on probation in an hospital. It was also provided that misconduct or incapacity, even after enlistment in the corps, would render them liable to be re-transferred to the combatant ranks by proper authority. The ranks of the corps were assimilated to those of the line, the non-commissioned officers and men being designated sergeant-majors, sergeants, and privates, instead of stewards, wardmasters, and orderlies. The non-commissioned officers were to take rank with those of the non-commissioned officers of other corps, to wear the same distinctions on their uniforms, and both they and the privates were made subject to all the rules and regulations affecting other parts of the army, with the exceptions of a few points having reference to their particular duties, rates of pay, and pension, provided for in the warrant above quoted.† In this warrant it was expressly defined that, in addition to the performance of all hospital duties, the non-commissioned officers and privates of the corps "when on duty with an army in the field will be liable to be attached to the ambulances, and to attend on the wounded, carrying them off the field, and performing any such like duties."

The Army Hospital Corps formed in 1857 has continued to exist, with some modifications in its organization, until the present time. The modifications referred to have not altered the essential principles on which the corps was constituted. They were made in accordance with the recommendations of a committee appointed

Medical Staff Corps disbanded.

The "Army Hospital Corps."

Its military organization.

Duties of the Army Hospital Corps on field service.

* See Royal Warrant, No. 128/157,717/883, 1st August 1857.

† Warrant before quoted, clause 10.

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Change in constitution of the Army Hospital Corps in 1861.

Attendants of regimental hospitals.

The Army Hospital Corps divided into two branches, a medical branch, and a purveying branch.

by the Secretary of State for War in the year 1860,* to consider and report upon the working of the regulations as they then existed, and to suggest such amendments as might appear calculated to increase the efficiency of the corps. At the time the corps was originally constituted it was intended to supply trained and efficient attendants not only for general but also for the regimental hospitals of the army. But after a time it was found unequal to accomplish this end from deficiency of numbers; and, for certain reasons, even had the establishment been adequate, it had come to be believed that such an admixture of the general and regimental system would not work smoothly and efficiently over the wide area which such a mixed service would cause the men to be distributed. The principle of attaching non-commissioned officers and men of another corps to regiments for hospital duty was very unsatisfactory to the commanding officers, medical officers, and patients of regiments; while the men of the Army Hospital Corps themselves felt a dislike to being separated so completely from the officers of their own corps, to whom they had to look for the advancement of their interests, and upon whom they had to depend for the rewards of good conduct and efficiency. For these and other reasons the committee were led to recommend that the attempt to draw the entire supply of attendants for service in all military hospitals, including regimental hospitals, from the Army Hospital Corps should be discontinued, and that the duties of the men of this corps should be confined to service in the general, dépôt, and field hospitals of the army. The hospital attendants for regimental hospitals, the committee recommended, should be taken from the ranks of the regiments themselves. They advised that they should continue to form an integral part of the regiments to which they belonged, and stated they should wear the same uniform as the other soldiers, with certain distinctive badges, but that they should in all cases be supernumerary to the *combatant* establishment of the corps, and, indeed, should be unarmed, except with a sword for self defence. These recommendations were approved and embodied in a warrant which appeared on the 27th of September 1861.† This warrant also so far reconstituted the Army Hospital Corps that it divided it into two branches with distinct duties and regulations, one for the medical, the other for the purveyor's department, the former being placed under the direction, so far as regarded distribution, of the Director-General of the Army Medical Department, the latter under the direction of the Purveyor-in-Chief. It also provided that serjeants in the medical branch, on passing a certain examination, might be employed in dispensing medicines, and that, like all others in the corps employed in any responsible capacity beyond the general duties in which the men were habitually employed,

* See "Report of a Committee assembled by order of the Right Honourable the Secretary of State for War, dated War Office, 26th November 1860, No. 20/Hospital Corps, &c./196. Colonel Clark Kennedy, C.B., Commandant Military Train, President." (This Report contains Draft Regulations for all ranks of both the Medical and purveying branches of the Army Hospital Corps.)

† Circular No. 715/Army Hospital Corps/211.

these serjeant-dispensers or "compounders," as they are called, should receive additional pay while so employed.

The constitution, pay, and general arrangement of the Army Hospital Corps having been settled on the basis just described, there remained still a most important feature to be arranged, viz., a code of regulations to define the means by which men taken from the ranks of the combatant part of the army were to be educated and inducted into duties requiring so much skill, trust-worthiness, knowledge, and dexterity as those connected with the care and transportation of wounded on the field of action, and with the watching and nursing of the sick and hurt in hospitals. This was a subject that was fully considered by the committee just now referred to. In accordance with their advice it has been decided that only men of a certain amount of previous acquirements, men capable of reading and writing, should be accepted for service in the corps. The committee moreover recommended that both regimental and general hospital attendants should alike in turn be sent to a general hospital for a course of instruction and training in hospital duties, and in the use of stretchers and other field medical equipment under especially appointed officers, so as to ensure an uniformity of system throughout the service. They also laid down a list of subjects on which instruction should be given.*

The army hospital attendants of the British service, therefore, now consist of two divisions, corresponding with the principal divisions in the hospitals themselves, viz., regimental hospital attendants and general hospital attendants. The latter are embodied together under the name of the "Army Hospital Corps," and specially officered. The purveying and the medical duties are performed by distinct branches of these attendants.† All, both regimental and Army Hospital Corps attendants, are assimilated as regards rates of pay and pension, are engaged to perform the field ambulance duties of the military medical service, including the transportation of the wounded from the field of action on stretchers, as well as all duties connected with hospitals of a more fixed kind, and, on the recommendations of the committee being carried out, will all be equally trained and instructed so as to fit them for the right execution of their varied and responsible functions.‡

SECTION III.—ON THE FITNESS OF THE ARMY HOSPITAL CORPS, AS AT PRESENT CONSTITUTED, FOR ACTIVE SERVICE IN THE FIELD.

The organization just described represents the final results of the successive changes which the personnel of the "Hospital Con-

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Army Hospital Corps "compounders."

Training and education of the men of the Army Hospital Corps.

* See Report before quoted, p. 3.

† See Appendix, note 1.

‡ The internal economy of the Army Hospital Corps has been modified in some particulars by the Royal Warrant of the 3rd of February 1866, "for the pay and promotion of Her Majesty's British forces serving elsewhere than in India." By this warrant the Army Hospital Corps has been assimilated in the division and style of its rank, and in other details, to the Commissariat and Military Store Staff Corps. The ranks are now styled as follow, viz., serjeant-major, colour serjeant, serjeant, corporal, second corporal, private and bugler. The duties and training of the men of the corps have not been affected by this warrant.

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"veyance Corps," formed at the outbreak of the Crimean war, has undergone since that date.

How far the Army Hospital Corps will meet the wants of time of war.

Difficulties in the way of expanding the corps suddenly.

Military organization of the corps defective as regards field service.

Many demands on the corps for other duties, besides field duties, in time of war.

The employment of bandsmen as aids to the Army Hospital Corps objectionable.

Great progress has been made in the improvement of this branch of hospital administration, but the question may still be entertained how far the Army Hospital Corps, thus organized, will be competent to meet all the exigencies it is designed to meet in case this country should again be engaged in a great war. Its numbers are very limited*, and they are not capable of rapid expansion, for, in case of war, there would be more difficulty than ever in getting the proper stamp of men from the ranks of the army, from which alone the corps is recruited, and, even if got, a period of training of some months' duration under the present system is absolutely necessary to make them efficient as hospital attendants; the only officers of the corps are the Commanding-officer, and the adjutant and quartermaster, at head-quarters, so that if a sufficient number of men could be spared from their hospital duties and brought together for performing the duty of picking up and bearing the wounded from a field of action, the necessary military organization for maintaining discipline and ensuring a regular and systematic performance of this duty is wanting. The non-commissioned officers and men of the medical branch are trained and habituated to the duties of attendants in the wards and dispensaries of fixed hospitals; they are also to a certain extent trained in field ambulance duties, and in the proper modes of transporting wounded men from the field of action, duties which the terms of their engagement require to be fulfilled by them. But there the preparation for a state of war ceases. It does not appear how, if the pressure of war came, the knowledge which has been imparted to the trained men can be advantageously applied. Supposing a force of 30,000 men be ordered to take the field, where are the men who are to act as collectors and bearers of the wounded, on what plan is the first surgical aid on the field arranged to be given, and on what system is the transportation of the sick and wounded to be conducted? These are questions which will doubtless be asked by the officer in chief command, when he is informed that there is an Army Hospital Corps, one of whose special functions it is to perform these duties. It will be difficult to give a satisfactory reply. The existing strength of the Army Hospital Corps would hardly suffice for the pressing and permanent duties of the general hospitals, hospital ships, and sick transport, and could not certainly supply any number of bearers adequate to meet the wants which would arise in case of a general action. If the bandsmen are to be employed as bearers as heretofore, then it must be remembered they are not trained for the duty, and if trained there would still be wanting the organization to ensure the duty being performed. Com-

* The strength of the corps in October 1867 was—officers 1, non-commissioned officers and privates, medical branch, 454. Of this number 345 non-commissioned officers and privates were on duty in the United Kingdom, distributed among 43 stations, 109 non-commissioned officers and privates on duty abroad, distributed among 21 colonies and foreign stations, including the expedition in Abyssinia.

batants cannot, or ought not, to quit the ranks to aid the wounded during an action, and after the excitement of an action is over they are usually too exhausted to give that immediate attention, and bestow that proper care which the condition of the wounded men, who are waiting to be gathered and carried to the field hospitals, requires. If there are no trained bearers, or not a sufficient number of them to perform the duty, it must, however, be done by untrained soldiers, as it has hitherto for the most part been done in the British service, and which it was part of the design in forming the Army Hospital Corps to avoid. The inevitable consequence will be the perpetuation of a great amount of suffering and injury which might be prevented by systematic and trained execution of the duty. So far then as concerns the means of effecting the removal of the wounded while an action is in progress, or of collecting and removing them as soon as an action is over, notwithstanding the training which some of the men of the Army Hospital Corps have had, without a further development for the purpose, the arrangements will be nearly as defective as they were in the unprepared state in which the military service found itself in this respect at the outbreak of the Crimean war. Fortunately on that occasion, as already shown, time was afforded to make many improvements while the war was in progress. Things, however, have greatly changed since that time. If we may take the Italian war of 1859, the German war of 1866, as indicative of the suddenness with which military operations will be commenced, and of the uninterrupted rapidity with which they will be carried on in the future, it is evident there will be no opportunity when once war is declared, either of devising and manufacturing the necessary matériel, or training the men in the special knowledge and manipulation which are essential for an efficient execution of the duties of this department of field hospital service. There will be no time, even though all other means may be available, for creating an effective establishment in such a case. It appears therefore to be more than ever important now that there should be no repetition of the defective condition and want of preparation as regards the removal of the wounded from the field of action and their subsequent transportation to hospital, which notoriously existed at the beginning of the last great war in which this country was engaged.

Urgent need of settling the most effective mode of carrying on the hospital transport duties on active service.

SECTION IV.—EXISTING AMBULANCE TRANSPORT ARRANGEMENTS IN OTHER ARMIES.

Seeing then how incomplete the ambulance system still is in some respects in this country, and how much remains to be done so that it may be depended upon for efficient service in time of war, it may be useful to take a glance at the existing ambulance arrangements, especially those which relate to transportation of the wounded in time of war, in the armies of some other countries. It will be seen that the organization differs very materially in some of them, both as regards the constitution of the personnel by whom the transportation is carried out, and the duties and responsibilities of the medical department in superin-

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Field-hospital
transport ar-
rangements of
the French
army.

Training of the
"soldats-infir-
miers."

Plan on which
the transport
of wounded is
effected by
them.

Relative duties
of the medical
officers, the in-
tendance, and
train, in this
operation.

tending and carrying out the professional duties connected with this service, as well as in the matériel by which the conveyance of the wounded is effected. Special peculiarities as regards this last division of the service, the particular construction of the transport matériel, whether stretchers, mule, or wheeled conveyances, will be more particularly noticed when the conveyances themselves are described. Only the general features of the system on which the transportation and other ambulance duties are ordered to be carried out will be described in the few remarks which now follow.

French Army.—The organization of the ambulance service in the French army so far as refers to the care and transportation of the wounded in the field is as follows:—Young soldiers of the annual contingent, and steady soldiers selected from the men in the ranks, who must be intelligent and robust in frame, are trained by medical officers to act as attendants and carriers of the wounded. These soldiers are designated "soldats infirmiers." Their duty is to collect and remove the wounded from the field of battle under the direction of the officers of administration of the hospital service, and under the surveillance of the deputy military intendants. The stretchers for carrying the wounded form part of the contents of the field hospital store wagons (caissons d'ambulance). Seats (cacolets) and litters fixed on pack saddles borne by mules, with conductors, are also provided for carrying the wounded from the field of battle to the ambulances. These are supplied by the train at the requisition of the intendance. When a soldier falls in the ranks he is led or carried by the soldats infirmiers to the rear, where the medical officer attached to the regiment to which the wounded man belongs pays the first attention to his wounds. He is then, if his wound be severe enough to require it, carried to the provisional post where the panniers of the regimental ambulance are established, or else to the ambulance of the division. If the wound be such as to render a horizontal position necessary he is transported on one of the mule litters, if not of this nature he is carried on one of the mule chairs. When the wounded are discharged from the ambulances to the stationary hospitals in rear, the caissons, or military wagons, are generally employed for the transport. The medical staff in the French army have nothing to do with the organization or administration of any of the matériel, transport or other, of the ambulances or hospitals. The surgeons only attend on the sick and wounded, and help to train the infirmiers militaires for the subordinate duties of attendance which devolve upon them. The dispensers who make up the pharmaceutical prescriptions, and the officers of administration who direct the employment of the surgical materials and carry out the alimentary prescriptions comply with their directions within certain regulated limits, but are in no way subordinate to the surgeons' authority. The duties of the inspectorial ranks of the medical staff are limited by the rules of the French service to inspecting only as to professional matters and conduct. The superior officers of the French medical service neither direct the movements of the hospital staff, make

arrangements for the transportation of the wounded from the field to the flying hospitals, nor assign the position or arrangements of the first lines of surgical assistance, nor direct the removal of the wounded from the flying to the stationary hospitals. All these movements are made by orders from the superintending military officer (*officier de l'intendance militaire*), or his subordinates. In short, according to present arrangements, the officers of the Medical Department have no part in the transportation of the wounded in the French army beyond the instruction of the *infirmiers* by whom the removal is effected; they only look after the wounded when they are brought under their care, and then apply such curative means as the limits of the regulations allow.

From what is mentioned above it is obviously essential in the interests of the sick and wounded that the *infirmiers*, who have to collect and carry them without any direct surgical supervision, should be well instructed in the proper manner of performing this vitally important professional duty. Great pains are taken that the French *infirmiers* shall be well instructed. Their professional tuition is given to them at the Val de Grâce by the *Médecin-en-chef* and the surgeons under his direction. The instruction is both theoretical and practical, and lasts two months. The first month is devoted to explanations and exercises in classes, the second is practical work in the wards of the hospital. While under class instruction the *infirmiers* are taught, among other matters, the proper modes of lifting up wounded men according to the special nature of their several injuries, the first assistance to be given in the case of dangerous bleeding, the nature and regulated arrangement of the contents of the field equipment wagon (*caisson d'ambulance*), the practice of rapidly unpacking and packing it, mode of distributing its contents for the establishment of a flying field hospital, the plan of proceeding for bringing in on the stretchers the wounded in case of an action, the application of splints to fractured limbs, the application of dressings and bandages, and other such matters. When this month of instruction is over the *infirmiers* pass into the wards of the hospital, where they attend on the surgeons at their visits, execute the ordinary bandaging and dressing under their observation, note down the daily prescriptions and diets ordered, assist at surgical operations, and perform any subordinate professional duties which the surgeons may assign to them. Minute regulations are issued for their guidance. The *infirmiers* thus become very reliable aids to the Medical Department both in the fixed and field hospitals. The proportion of non-commissioned officers in the corps is large, there being one sergeant *infirmier* to six soldier *infirmiers* (*infirmiers soldats*), and one corporal *infirmier* to three soldier *infirmiers*.

Austrian Army.—Special arrangements are made in the Austrian army, so far as the personnel is concerned, to provide for the duties of transporting and assisting the wounded on the field of battle. These duties are not performed by the class of men who act as dressers and attendants in the fixed military hospitals, but by an establishment distinct from the nursing staff. The wounded are transported by soldiers formed into sanitary, or

Instruction of the French *infirmiers* as regards carriage of wounded men.

Field-hospital transport arrangements of the Austrian army.

The nursing staff not employed in transporting wounded in time of war.

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Constitution of
the Austrian
sanitary, or
bearer, detach-
ments.

Bearers of
wounded.

Bandage car-
riers.

Plan of per-
forming the
field duties.

bearer, detachments. All the soldiers thus detached are specially trained to carry wounded men systematically, as well as to be competent to attend to their first necessities before a surgeon can be reached; but they are taken from the general ranks of the army.

The plan of organizing, and mode of training, the bearer detachments is as follows:—In time of peace each company of an infantry regiment is required to have at least one corporal and four privates under sanitary instruction. The original course of training lasts for six weeks, and during this period they are supplied with the equipment issued to sanitary detachments on field service, so that they may become practically acquainted with it. This training is rehearsed from time to time subsequently. The men thus become qualified either (*a*) as bearers of wounded from the line of battle to the brigade dressing station; or (*b*) as bandage carriers to be about the persons of the surgeons with the necessary apparatus and appliances, ready to assist at the surgical operations which may have to be performed. Under ordinary circumstances these men remain with their respective corps. In time of war and in the field a detachment of these bearers is formed from each brigade of infantry, and placed under the command of a subaltern officer, who is told off for this service by the Brigadier-General from the strength of one of the battalions. The detachment is thus formed of one officer per brigade, one corporal per battalion, and two privates per company.

Whenever an engagement is expected the detachment falls in together as a distinct body, separate from the combatant troops. An Austrian brigade consists of six infantry battalions and one rifle battalion of six companies each battalion, and 250 men each company; so that when thus assembled the strength of the brigade sanitary, or bearer detachment, is, one officer, seven non-commissioned officers, and 84 privates. Of the privates 70 are intended for transporting the wounded, and 14 as bandage carriers.

The uniform and accoutrements of the men of the bearer detachments are the same as when they are on duty with their respective corps, excepting that they all wear a band of the national colours (black and yellow) on the left upper arm as a distinguishing badge, and that in the case of the privates no fire-arms are carried. The non-commissioned officers are armed with their rifles; the privates only wear a sapper's sword. The privates have to carry a second havresack filled with bandages, and a large pattern canteen with water for the use of the wounded.

These arrangements ensure a proportion of bearers of wounded being with every single battalion, or even a smaller body in case of such a small force being engaged independently; and at the same time provide for a systematic and orderly removal of the wounded in case of a general engagement. After having been concentrated, as soon as their functions with the brigade are terminated, the detachment breaks up, and every man returns to his respective corps. If military or strategical reasons necessitate the detachment being kept together for a longer period, the Brigadier-General, by whose order only it is concentrated, has to make the

necessary arrangements for the pay and rations of the men to be drawn at the head-quarters of the brigade.

The system just described comprehends the ordinary plan adopted for the transportation of the wounded from the field of battle; but over and above these special bearer detachments there are the regularly organized sanitary corps of the army, one company of which is attached to every corps d'armée in the field. These sanitary companies are part of the permanent hospital staff of the Austrian army.

The "Sanitary Detachments" not to be confounded with the "Sanitary Corps" of the Austrian army.

*Prussian Army.**—Up to the time of the recent campaigns between Germany and Austria the first transportation of the wounded from the field of action in the Prussian armies was ordered to be effected solely by men of the regularly organized Kranken-Träger, or sanitary bearer companies of the army trained for the duty. Each corps d'armée, consisting of three divisions of about 10,000 men each, had one bearer company attached to it. This company was divisible into three sections corresponding with the divisions of the corps d'armée. It consisted when united of 1 captain, who remains at the head-quarters of the corps d'armée; three subaltern officers; 3 assistant-surgeons; 17 non-commissioned officers; 16 lance corporals; 156 privates; 8 train soldiers acting as officers' servants; and 6 buglers: in all 210 persons. Forty-five hand litters are attached to the company. The personnel just enumerated of this bearer company is altogether independent of the regimental surgical staff or the medical staff dressers and attendants told off for duty in the field hospitals.

Field-hospital transport arrangements in the Prussian army.

Constitution of the sanitary bearer companies of the Prussian army.

Regimental auxiliary sanitary bearers.

On the outbreak of hostilities with Denmark in 1864, and again recently with Austria in 1866, some modifications were introduced in the sanitary field arrangements, chiefly with a view to increase the means of transport and assistance for the wounded on the field of action. The chief modifications were the following:—firstly, every regiment and troop was supplied with several common stretchers, which were carried on the regimental medical store cart; and, secondly, each battalion of infantry was ordered to tell off, at the commencement of an engagement, 20 privates and one non-commissioned officer to aid as auxiliary bearers for wounded. Both the personnel and the matériel necessary for carrying off the wounded were thus considerably augmented. Since the conclusion of peace, however, it has been decided to increase the number of the regular bearer companies. According to a warrant issued in 1867 there will be in future a bearer company of 120 men, under the orders of a major, to each division of a corps d'armée. It is not expected,

Change in Prussian arrangements since the campaign of 1866.

* A very complete description of the whole hospital system of the Prussian army is given in the interesting and valuable "Report on the Medical and Sanitary Services of the Prussian Army during the Campaign in Bohemia in 1866;" by Surgeon-Major J. A. Bostock, Scots Fusilier Guards, in the 7th volume of the "Army Medical Reports." The short account given in this notice of the Prussian arrangements for ensuring the proper care and transportation of the wounded in battle chiefly derived from information given to me by my friend Dr. W. Roth, Surgeon-Major of the Prussian army, in the autumn of 1867. Since that date, 20th February 1868, a Royal Warrant has been issued, affecting in an important degree the status and administration of the medical officers and hospital service in the Prussian army. It does not appear to have caused any changes as regards the matters referred to in the text placed above.

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however, that even this number will altogether do away with the necessity for taking private soldiers from the ranks to act as auxiliary bearers on extraordinary occasions.

The men composing the bearer companies are only so far hospital attendants that they assist in carrying the wounded from the field to the field hospitals. They do not perform the duties of hospital attendants in time of peace; they are then in the ranks of the army. But though in the ranks, they are regularly trained in the proper modes of picking up and transporting wounded men. The course of instruction lasts from the 1st of January to the end of March, two hours every week being devoted to it. If in a garrison where there are several battalions, the instruction is given by a surgeon and two assistant-surgeons selected by authority for the purpose. If only one battalion is present the battalion medical officer is the instructor. In the month of May all the instructed bearers of every corps d'armée are brought together at head-quarters and remain concentrated for ten days; during this time they are drilled and employed together in practical exercises as bearers. There are nine regiments and a battalion of rifles in each army corps, and each regiment contributes two non-commissioned officers and 36 privates, and the rifle battalion one non-commissioned officer and 12 privates to this gathering; the whole number of instructed men assembled forming a body of 19 non-commissioned officers, and 336 privates. The bearer companies in time of war are made up of these instructed men, whether from the active army or from the reserve.

Annual course
of instruction
of the sanitary
bearer com-
panies.

Surgeon-major Bostock in his report before quoted, supplies the following additional information respecting the Kranken-träger companies of the Prussian service. To each company are attached four mounted orderlies from one of the cavalry regiments of the corps, to assist in searching for the wounded and to carry orders. The company is divided into three sections, one to each division of the corps, and these sections are attached to the flying detachments of the three light hospitals. When an action is about to take place the section of the company, accompanied by the four ambulance carriages for the severely wounded, proceeds to the bandaging place of the hospital to which they belong. During and after an engagement it is their duty to search for the wounded, to give them water or other restoratives and to assist them in every way. They take charge of their arms and accoutrements, lift those who are unable to walk on to the litters, place them into the ambulance carriages, and accompany them, if possible, to the nearest hospital. In addition to these special duties, other very important objects are gained. They prevent combatants leaving the ranks during an action for the purpose of carrying their wounded comrades to the rear, and they protect the wounded lying on the ground from the attacks of thieves and marauders. On the long marches that precede active operations, they are of great use in supplying water and refreshment to men who fall out. For the efficient performance of these duties they are carefully trained in peace; they are instructed by the medical officers in a few important points of anatomy and practical

surgery, in the readiest method of restoring suspended animation, in the application of the tourniquet and other means of arresting hæmorrhage, how to handle fractured limbs and to bandage wounds, in the safest manner of lifting wounded men from the ground, and the easiest positions in which to place them on the litters. Their uniform is that of the military train, a dark blue tunic, dark trousers, and grey great coat. They wear the badge of the Geneva Convention on the left arm, and are armed with a short carbine, an infantry pouch, and short Roman sword. Each bearer carries a knapsack and is provided with a water-bottle. All officers unite in praising these companies.

The transportation of the wounded from the battle field, and their distribution among the field hospitals, is under the general direction of the chief medical officer who is on the staff of the General commanding the army corps. His orders are countersigned by the General, and therefore in force throughout the corps. There are three superior staff surgeons in charge of three divisional light or flying hospitals in each corps d'armée, and the first aid to the wounded on the field, as well as their removal by stretchers or by the ambulance wagons, is carried out under their directions. The bearers, and the detachments of the train, are placed under their orders for this purpose, equally with the regular hospital attendants. The wounded are removed when necessary from the light hospitals to three corps hospitals in rear. The only authorized conveyances for transporting the wounded in the Prussian service are stretchers, hand-wheel litters, and two-horse wagons. Mule litters and cacolets do not form part of the Prussian ambulance transport. Hand-wheel litters have only been introduced partially, viz., in the regiments of the guards, their general adoption is still under consideration. The Prussian is the first army in which these conveyances have been used. Four-horse wagons as well as two-horse wagons were employed until lately, but the former are now abolished. All horse vehicles are four-wheeled. In addition to the regular ambulance transport, a portion of the transport common to the whole army may be employed for the conveyance of sick and wounded under unusual pressure. The officers, men, horses and vehicles which are included in the composition of the transport all belong to the "military train." The material of the train of the whole army, like all other army stores, is under the custody and control of the "Intendant-General." When, however, a portion of the material of the train is issued and attached for service to a particular department of the army, that part of the army has entire charge of it.

Direction and mode of transporting wounded from the field to the field-hospitals in the Prussian army.

The Prussian conveyances for the transport of wounded.

Spanish Army.—In Spain a royal warrant was issued in November 1862 decreeing the formation of five companies of infirmiers, and establishing their organization. The constitution of this body is very similar to that of the army hospital corps in England; they perform the duties of attendants in hospitals in time of peace, and all the field hospital duties, including the transport of the wounded, in time of war. The head-quarters of the five companies were fixed to be at the head-quarters of the five military divisions into

Field-hospital transport arrangements in the Spanish army.

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The organization of the hospital attendants for home and field duties as settled in 1862.

Training of the hospital attendants in field duties.

Field-hospital transport arrangements of the Russian army.

Organization of the field hospitals in the Russian army.

which Spain is divided. Each company is subdivided into as many sections as there are military districts in the division; and consists of one captain, one lieutenant, for each section, one medical officer, and a certain number of sous-adjutants, 1st class and 2nd class serjeant practitioners, and privates or infirmiers. The numbers of these latter vary according to the size of the military division in which they do duty. The first company, the head-quarters being at Madrid, consists of two sections, and comprises 1 captain, 2 lieutenants, 1 medical officer, 4 sous-adjutants, 36 first-class serjeant practitioners, 40 second-class serjeant practitioners, and 58 soldier infirmiers. The men are selected from the ranks of the army, subject to certain conditions of strength, character, education, and aptitude for the service. The assistant-surgeon is charged with the professional instruction of the different classes of the company, as well as with the medical charge of the company. The instruction is ordered not only to meet the requirements of peace, but also those of armies in the field, and includes the mode of attending to the first necessities of wounded, the proper modes of raising them from the ground and transporting them to the ambulances, the names and uses of all the articles comprised under the term of hospital field equipment, and other such matters.

In time of peace the soldiers of the sanitary companies carry a sharp pointed sabre; in addition, on entering upon field service, they are provided with a revolver and the necessary equipment belonging to this arm.

Russian Army.—The following memorandum on the medical arrangements of the Russian army, and on the transport of the sick and wounded, is copied from the Appendix to the Report of the Committee appointed to inquire into the administration of the Transport and Supply Departments of the army. It was compiled by Colonel Hope Crealock, from information supplied to him by the Chief of the Staff of the Russian army, its date being the 10th of April 1866:—

Every fraction of the army, whether in peace or war, has an hospital supplied with wagons for the conveyance of the sick; the medical personnel and the number of wagons vary according to the number of troops.

A regiment of infantry of three battalions has four surgeons (a surgeon-major and three assistant-surgeons, according to the number of battalions), five aide-chirurgiens, one aide-pharmacien, thirteen hospital orderlies (or nurses, of which one is a superior), with six wagons and six stretchers.

A regiment of cavalry of four squadrons has two surgeons, three aide-chirurgiens, one aide-pharmacien, nine hospital orderlies, two wagons, with four stretchers.

A detached battalion has two surgeons, four aide-chirurgiens, one aide-pharmacien, nine hospital orderlies, two wagons, and four stretchers.

A brigade of artillery of three batteries has two surgeons, three aide-chirurgiens, one aide-pharmacien, seven hospital orderlies, one wagon, with three stretchers.

In addition to these sanitary means for each corps, an army on an active footing in time of war is followed by a certain number of moveable field hospitals; each hospital can accommodate 320 sick; the number of these establishments depends on the number of the troops. Their object is to give immediate attention to the wounded during an action, and after the battle to transport them to the temporary field hospitals. In order to be able to detach a portion of these hospitals to accompany either a brigade or division of the army, ordered to act separately, each moveable field hospital is composed of four sections, and consists of—

Forty-four large carriages (covered), drawn by four horses, to convey officers or soldiers seriously wounded.

Twelve light carriages, drawn by two horses, to convey soldiers, &c. less severely wounded.

Conveyances employed in carrying sick and wounded.

Four platforms with all the matériel necessary for surgery or medicine, each drawn by four horses.

Four moveable dispensaries, each drawn by two horses.

Twelve wagons for the conveyance of tents, stretchers, and the details of the hospital, such as linen coverlets, utensils, cooking apparatus, provisions, &c. &c., each drawn by four horses.

Four service forges, with all necessary matériel for the repair of the train.

All the matériel of these hospitals is taken charge of in the dépôts of the intendance in the time of peace.

Each moveable field hospital has a Surgeon-in-chief. The train is commanded by a captain, who has under his orders three officers. Each section of the field hospital has—

- 2 surgeons.
- 1 aide-pharmacien.
- 2 aide-chirurgiens.
- 50 hospital orderlies.

In all—

- 9 surgeons.
- 4 aide-pharmaciens.
- 8 aide-chirurgiens.
- 200 hospital orderlies.
- 100 stretchers.

During a battle these moveable field hospitals (or ambulances) are established behind the line of battle. Each regiment supplies them, according to the orders of the Director-General of hospitals, with a certain number of surgeons and assistant-surgeons; the hospital carriages, assisted by those belonging to the regiments, convey the wounded to the field hospitals. The hospital orderlies or attendants in common with those belonging to the field hospitals (or ambulances) give the first attention to the wounded, and carry them on stretchers towards the carriages and wagons. It is the Director-General of hospitals who makes all the arrangements and gives the necessary orders for the sanitary service of the army.

Arrangements for attending to the wounded during a battle.

In the rear of the army are established the temporary field hospitals, which are écheloned on several lines; their number is not limited, and must depend upon the number of sick and wounded.

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During the Crimean war there were 120 of these hospitals. They calculate generally on one sick man in eight soldiers.

There are three categories of these temporary field hospitals; hospitals for 200, 400, and 650 sick. They are generally established in towns or villages on the line of operations.

All the matériel of these hospitals, as also the personnel, form the Cadres; they are attached in time of peace to the different permanent hospitals of the empire. The matériel for forming these hospitals in time of war is sent to the various points decided on by order of the Commander-in-chief of the active army at the same time as the army is placed on a war footing.

All the temporary hospitals, as also the moveable field hospitals or ambulances, are under the orders of the Director-General, who is attached to the Etat-Major of the army. It is his duty to clear out the sick and wounded from these establishments as quickly as possible, and to cause them to be transported to the permanent hospitals. If the means of conveyance of the ambulances should be insufficient, or should be entirely wanting, recourse can be had to the wagons, &c. of the intendance for the transport of the sick, &c.; or the country in which operations are being carried on can be called upon to supply the necessary means of transport on requisition, whether it may be required for the conveyance of the wounded from the field of battle, or to transport them from the field hospitals to the permanent hospitals in the interior of the country.

The permanent hospitals are 44 in number, and are established in the different military arrondissements, principally towards the frontiers. Those which are established at the base of military operations are destined to receive the sick of the active army.

The permanent hospitals are classified in four categories.

			Sick.
The hospitals of the 1st class			for 200
"	"	2nd	" 400
"	"	3rd	" 650
"	"	4th	" from 800 to 1,200

Direction of the
field medical
arrangements.

The Director-General of Hospitals receives his orders from the Chef d'Etat-Major, who notifies all movements of troops to him, whether of the army as a whole or a separate detachment.

The Director-General is in immediate communication with the Minister of War for the supply of all medical wants. It is his business to establish new field hospitals, on being required to do so by the chief of the staff, to move others elsewhere, and to control and superintend the supplying and keeping in a state of efficiency the hospitals, and the care of the sick. He is assisted in his duties by the principal medical officer as regards the medical details. The personnel of the hospitals is under the orders of the Director-General, with the exceptions of the doctors, who are only subordinate to him as regards matter of discipline or administration.

Field-hospital
transport ar-
rangements in

Ambulance Transport System of the United States Army.—The proper organization of a regular system for the removal and

carriage of the wounded, including the establishment of a trained ambulance corps for attending to their wants on the field of battle, as well as of the proper distribution and management of the ambulance transport carriages, was a subject much considered during the late war in the United States. For a long time the ambulance service was in a very defective state, notwithstanding the great need for an efficient system to meet the wants of the enormous number of wounded which resulted from many of the battles. Different regulations were adopted in different armies, and sometimes even in different corps of the same army; the variations depending upon the views and orders of the several general officers in command and of the medical directors. At length, in 1864 an important Act was brought before the Congress by the War Department, and passed into law. This law settled the whole of the army ambulance arrangements on a definite and single plan. The Act was entitled "An Act to establish a uniform system of ambulances in the armies of the United States." It was published in general orders from the Adjutant-General's office at Washington, on March 16th, 1864. By these orders the constitution of the ambulance corps, and the number of efficient men comprising it, with rules for their direction, duties, instruction, and discipline were defined, as well as the kind and proportion of ambulance transport to be allotted to each arm and subdivision of the forces, and the rules to be enforced for its proper supervision and care. The noticeable features in the American system are the complete separation of the ambulance transport from the other transport services of the army. The men of the ambulance corps, the conveyances, horses, harness, drivers, and all appertaining to them in each corps d'armée are placed under the charge of a captain commandant, who is held responsible for their always being efficient and ready for service. Secondly, the whole of the ambulance establishment is placed under the direction of the head of the medical department, including not only the direction of the vehicles for the carriage of the sick and wounded, but also that of the officers and men employed to assist in their management, subject only to the general authority of the officer commanding the forces in chief. The medical director was by this Act made responsible to the commander of the forces to which he was attached that proper arrangements were made for the serious and onerous duty of the collection, transportation, and care of the wounded; and the Quartermaster-General's department, which on active service always has so many other important duties to occupy its time, was at the same time relieved of this additional work which had previously been imposed on it. The men and the material of the ambulances were not under the direct command of medical officers, but under officers specially appointed to take charge of them and to maintain their efficiency; at the same time, this charge was conferred under such regulations and orders as enabled the medical department to employ them for their legitimate purposes whenever required, and whether on the line of march, before or during an action, to procure and distribute them for the collection and car-

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the United States' army.

The ambulance arrangements of the United States army settled in 1864.

Constitution and command of the United States "Ambulance Corps."

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riage of the sick and wounded according to the necessities of the occasion. The Act of Congress referred to is brief, and fully explains the ambulance system finally adopted in the United States army on the occasion of the late Civil war. Its introduction by the War Department was the result of numerous reports from commanding officers on the subject, and lengthened field experience, and as an important document it is subjoined in a complete form for reference.

General Orders, No. 106.

War Department, Adjutant-General's Office,
Washington, March 16th, 1864.

Uniform System of Ambulances.

Copy of the
General Order
of March 1864,
settling the
amount of ma-
tériel and num-
ber of men of
the ambulance
corps to be
supplied to bo-
dies of troops
in the United
States' army.

The following Act of Congress is published for the information and guidance of all concerned :—

An Act to establish a uniform system of ambulances* in the armies of the United States.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled: That the medical director or chief medical officer of each army corps shall, under the control of the medical director of the army to which such army corps belongs, have the direction and supervision of all ambulance, medicine, and other wagons, horses, mules, harness, and other fixtures appertaining thereto, and all officers and men who may be detailed or employed to assist him in the management thereof in the army corps in which he may be serving.

Sec. 2. And be it further enacted, that the commanding officer of each army corps shall detail officers and enlisted men for service in the ambulance corps of such army corps upon the following basis, viz.: one captain, who shall be commandant of such ambulance corps; one first lieutenant for each division of such army corps; one second lieutenant for each brigade of such army corps; one serjeant for each regiment of such army corps; three privates for each ambulance, and one private for each wagon; and the officers and non-commissioned officers of the ambulance corps shall be mounted: Provided that the officers, non-commissioned officers, and privates so detailed for each army corps shall be examined by a board of medical officers of such army corps as to their fitness for such duty; and that such as are found to be not qualified shall be rejected, and others detailed in their stead.

Sec. 3.—And be it further enacted, that there shall be allowed and furnished to each army corps two-horse ambulances, upon the following basis, to wit:—three to each regiment of infantry of 500 men or more, two to each regiment of infantry of more than 200 and less than 500 men or more, and one to each regiment of

* The term "ambulances" in this Act appears to bear two meanings. The provisions in the several sections of the Act show that in the heading "uniform system of ambulances," the term bears its comprehensive meaning of flying or field hospitals, including the organization of the bearers or attendants on the wounded as well as of ambulance carriages, while in some of the sections the term is employed in the limited signification of a two-horse ambulance vehicle as distinguished from a four-horse ambulance wagon.

infantry of less than 200 men, two to each regiment of cavalry of less than 500 men, and one to each regiment of cavalry less than 500 men, one to each battery of artillery, to which battery of artillery it shall be permanently attached, to the head-quarters of army corps two such ambulances, to each division train of ambulances two army wagons, and ambulances shall be allowed and furnished to division brigades and commands not attached to any army corps upon the same basis, and each ambulance shall be provided with such number of stretchers and other appliances as shall be prescribed by the Surgeon-general; provided that the ambulances and wagons herein mentioned shall be furnished, so far as practicable, from the ambulances and wagons now in the service.

Sec. 4.—And be it further enacted, that horse and mule litters may be adopted or authorized by the Secretary of War, in lieu of ambulances, when judged necessary, under such rules and regulations as may be prescribed by the medical director of each army corps.

Sec. 5.—And be it further enacted, that the captain shall be the commander of all the ambulances, medicine, and other wagons in the corps under the immediate direction of the medical director, or chief medical officer of the army corps, to which the ambulance corps belongs. He shall pay special attention to the condition of the ambulances, wagons, horses, mules, harness, and other fixtures appertaining thereto, and see that they are at all times in readiness for service, that the officers and men of the ambulance corps are properly instructed in their duties, and that their duties are performed, and that the regulations which may be prescribed by the Secretary of War or the Surgeon-general for the government of the ambulance corps, are strictly observed by those under his command. It shall be his duty to institute a drill in his corps, instructing the men in the most easy and expeditious manner of moving the sick and wounded, and to require in all cases that the sick and wounded shall be treated with gentleness and care, and that the ambulances and wagons are at all times provided with attendants, drivers, horses, mules, and whatever may be necessary for their efficiency, and it shall be his duty also to see that the ambulances are not used for any other purpose than that for which they are designed and ordered. It shall be the duty of the medical director or chief medical officer of the army corps, previous to a march, and previous to and in time of action, or whenever it may be necessary to use the ambulances, to issue the proper orders to the captain for the distribution and management of the same for collecting the sick and wounded, and conveying them to their destination. And it shall be the duty of the captain faithfully and diligently to execute such orders. And the officers of the ambulance corps, including the Medical Director, shall make such reports from time to time as may be required by the Secretary of War, the Surgeon-general, the Medical Director of the army, or the commanding officer of the army corps in which he may be serving, and all reports of higher authority than the commanding officer of the army corps shall be transmitted through the Medical Director of the army to which such army corps belongs.

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United States'
General Order
of March 1864.

Sec. 6.—And be it further enacted, that the first lieutenant assigned to the ambulance corps for a division shall have complete control, under the captain of his corps, and the Medical Director of the army corps of all the ambulances, medicine, and other wagons, horses, mules, and men in that portion of the ambulance corps. He shall be the acting assistant-quartermaster for that portion of the ambulance corps, and will receipt for and be responsible for all property belonging to it, and be held responsible for any deficiency in anything appertaining thereto. He shall have a travelling cavalry forge, a blacksmith, and a saddler, who shall be under his orders, to enable him to keep his train in order; he shall have authority to draw supplies from the dépôt quartermaster, upon requisitions approved by the captain of his corps, the Medical Director, and the commander of the army corps to which he is attached. It shall be his duty to exercise a constant supervision over his train in every particular, and keep it at all times ready for service.

Sec. 7.—And be it further enacted, that the second lieutenant shall have command of the portion of the ambulance corps for a brigade and shall be under the immediate orders of the first lieutenant, and he shall exercise a careful supervision over the serjeants and privates assigned to the portion of the ambulance corps for his brigade, and it shall be the duty of the serjeants to conduct the drills and inspections of the ambulances, under his orders, of their respective regiments.

Sec. 8. And be it further enacted, that the ambulances in the armies of the United States shall be used for the transportation of the sick and wounded, and in urgent cases only for medical supplies, and all persons shall be prohibited from using them, or requiring them to be used for any other purpose. It shall be the duty of the officers of the ambulance corps to report to the commander of the army corps any violations of the provisions of this section, or any attempt to violate the same. And any officer who shall use an ambulance, or require it to be used for any other purpose than as provided in this section, shall for the first offence be publicly reprimanded by the commander of the army corps in which he may be serving, and for the second offence shall be dismissed from the service.

Sec. 9. And be it further enacted, that no person except the proper medical officers, or the officers, non-commissioned officers and privates of the ambulance corps, or such persons as may be specially assigned by competent military authority to do duty with the ambulance corps for the occasion, shall be permitted to take or accompany sick or wounded men to the rear, either on the march or upon the field of battle.

Sec. 10. And be it further enacted, that the officers, non-commissioned officers, and privates of the ambulance corps shall be designated by such uniform, or in such manner as the Secretary of War shall deem proper; provided, that officers and men may be relieved from service in said corps and others detailed to the same, subject to the examination provided in the second section

of this Act in the discretion of the commanders of the armies in which they may be serving.

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Sec. 11. And be it further enacted, that it shall be the duty of the commander of the army corps to transmit to the Adjutant-General the names and ranks of all officers and enlisted men detailed for service in the ambulance corps of such army corps, stating the organizations from which they have been so detailed, and if such officers and men belong to volunteer organizations, the Adjutant-General shall thereupon notify the governors of the several states in which such organizations were raised of their detail for such service, and it shall be the duty of the commander of the army corps to report to the Adjutant-General from time to time the conduct and behaviour of the officers and enlisted men of the ambulance corps, and the Adjutant-General shall forward copies of such reports, so far as they relate to officers and enlisted men of volunteer organizations, to the governors of the states in which such organizations were raised.

United States'
General Order
of March 1864.

Sec. 12. And be it further enacted, that nothing in this Act shall be construed to diminish or impair the rightful authority of commanders of armies, army corps, or separate detachments, over the medical and other officers, and the non-commissioned officers and privates of their respective commands.

Approved, March 11th, 1864.

By order of the Secretary of War.

(Signed) E. D. TOWNSEND,
Assistant Adjutant-General.

SECTION V.—SUGGESTIONS FOR IMPROVING THE MODE OF CONDUCTING THE AMBULANCE TRANSPORT DUTIES IN THE BRITISH ARMY WHILE ON ACTIVE SERVICE.

All the armies which have been mentioned comprehend in their organization a corps of men trained for the duty of collecting the wounded during or after an action and transporting them to the ambulances or flying hospitals for surgical aid. But they differ in their plan of formation of their corps of bearers, and also in the arrangements for the direction of the removal of the wounded.

In some armies the same men who form the nursing staff in the fixed hospitals are looked to for acting as bearers of wounded on the field of action; in other armies soldiers taken from the combatant ranks are trained in the duties of transporting the wounded, but not for those of hospital attendants, and they are only called upon to act in their non-combative capacity on special occasions when the need for their services as bearers arrives. A third plan is that by which all the ambulance transport duties are vested in the hands of a section of the same corps that has the charge and management of the vehicles comprised in the ambulance train. By the first arrangement the duties of collecting and bearing the wounded devolve upon a portion of the hospital staff; by the second arrangement they devolve upon a body which may be regarded as an auxiliary hospital staff borrowed for the occasion;

Remarks on
the ambulance
transport ar-
rangements in
the armies just
named.

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by the third they are made to devolve upon a special ambulance corps altogether distinct from the hospital staff, being under the same direction and command as the conductors and drivers, and, in fact, forming an integral part of the "ambulance train."

As regards the *general direction*, in most armies, the chief administrative medical officer with a given force is held responsible by the general officer in command that proper arrangements are made for the removal and first care of its wounded, officers subordinate to him being in direct command of the men by whom the transporting itself is executed. In the French army the Intendance Department has alone this responsibility.

Difficulties in the way of settling which plan of ambulance transport is most suitable for the British army.

These difficulties do not exist in countries where conscription is in force.

Many difficulties present themselves to notice when the organization most suitable for effecting the transportation, and providing for the first wants of the wounded of the British army, is considered. The formation of bearer detachments taken from the combatant ranks, or of sanitary companies, is a comparatively easy matter in an army formed by conscription; while, in a costly army of limited numbers, composed of men brought together by voluntary enlistment, the combatant ranks cannot be weakened by the abstraction of men for non-combatant duties without many inconveniences. The employment of bandsmen for the duties of ambulance transport, for reasons already given elsewhere, is a notoriously inefficient proceeding. There remains the formation of an ambulance corps in connexion with, or constituting part of, the Military Train, or the employment of the men of the now existing Army Hospital Corps, as already contemplated, for the ambulance transport duties. Several advantages are apparent in providing for the removal of the wounded by the ambulance train corps. Their discipline is at once provided for, they move with the wagons on which the stretchers are carried, and to which they will have to carry the wounded by the use of the stretchers; they necessarily become familiar with transportation of all kinds, whether by hand litters, wheeled vehicles, or by mule conveyances. But here again, owing to the limited numbers and costly constitution of the British army, an important objection against such a plan is sure to be urged; the institution would not be an economical one. Being in excess of the number required for driving the wagons, or tending and conducting the animals of the train, there would be little work for them to do when there was no occasion for their services in the transport of sick and wounded. Under ordinary circumstances there would be no field for their employment. Then there only remains the plan for making a section of the hospital staff act as stretcher carriers, viz., the men of the Army Hospital Corps. This plan offers least objection on the score of economy as their services can always be turned to account in peace, as well as in war time, in hospital duties. If, however, it be determined that the men of the Army Hospital Corps are to be relied upon for the proper transportation of the wounded from the field of action to the first line of surgical assistance, and thence to the flying hospitals, certain fresh arrangements will have to be made in order that the expectation of the

Under all circumstances the Army Hospital Corps seems best adapted for transporting the wounded.

proper fulfilment of this duty may not meet with disappointment. In the first place, provision must be made for the discipline of the men when assembled for the discharge of their field duties. They must know where they are to look for orders, and on the other hand, there must be the assurance that orders when given will be obeyed. Officers must be appointed to command them while on ambulance duty. Should a regular ambulance train be organized, perhaps the object just named may be obtained by attaching the men of the Army Hospital Corps for duty with this train. But such an arrangement would necessitate special orders and instructions on the subject. Secondly, the strength of the corps must be increased, so that the attendance in the general and intermediate field hospitals may be provided for, as well as the ambulance duties; and, further, a provision must be made for temporary hospital aids to act as substitutes for the men of the Army Hospital Corps, on their being removed from the fixed hospitals at home and elsewhere, to perform the ambulance duties in the field.

Further arrangements in the organization of the Army Hospital Corps necessary.

Having thus glanced at some of the circumstances which necessitate special arrangements in the ambulance system of the British service, there still remains the question of the proper authority for directing the operations of the ambulance establishment when a British army is engaged in the field. It will be admitted by everyone that, as the duty of clearing a field of action of its wounded and of providing for their first necessities during their transportation and in the flying hospitals is so vitally important, and at the same time demands such system in its execution in order that it may be accomplished speedily and with due care, the general direction of the operation should be under one head, responsible only to the officer in chief command for its due performance. It seems equally clear on reflection that the responsibility of this professional duty should be borne by the chief administrative medical officer of each given force, adequate means being placed at his disposal for its proper execution. These means necessarily comprehend an efficient ambulance train, controlled and commanded by its own officers, but at the same time with such regulations as will enable the responsible officer to direct the employment of the conveyances wherever and in whatever way they are most likely to serve the interests of the wounded and sick, for whose transport they have been constructed and are employed.

The duty of collecting, attending, and transporting wounded to the field hospitals should be under one general direction.

The principal medical officer should be responsible to the General in command for the due performance of these duties.

The subject of the proper arrangements for removing wounded soldiers out of action to the dressing places and hospitals has been to a certain extent examined by the Committee appointed by the Secretary of State for War to inquire into the administration of the transport and supply departments of the army, and in their report they have made certain recommendations on the subject. These are so important that a quotation is made of them. The recommendations refer both to the organization of an ambulance train, and also of the personnel to be employed in collecting and bringing the wounded to the train conveyances.

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Recommendations of the Committee on transport and supply on this subject.

Ambulance Train.—The “Ambulance Train,” the Committee report, should be formed of picked men and officers to be thoroughly trained and exercised in this very special and important service.

Ambulance Establishment.—Should the proposed changes in the peace establishment of the transport service be carried out there would be 24 four-horse ambulance vehicles, and 120 mules for cacolets, litters, and medical pack carriage available for work in connexion with the hospitals at home, should there be sufficient work for the amount of transport. At the present time there are 23 ambulance wagons and hospital cars horsed and driven by the Military Train at the principal stations in the United Kingdom. The number of mules estimated should form part of the peace establishment of the train.

Selection of Conductors.—The medical transport duty at home should be performed by the selection of steady experienced drivers and conductors, with horses, mules, and equipment detailed from time to time, in accordance with the requirements of the service, and with a due proportion of officers and non-commissioned officers at the larger stations, such as Aldershot and the Curragh, during the summer months, where they would be attached to and do duty with the Army Hospital Corps. There is not sufficient work at home during peace for a fixed establishment of the train, restricted solely to the performance of ambulance and medical transport duties throughout the year, but the selection of men to be employed as much as possible continuously on those duties at each station would give a trained and efficient nucleus for the formation of an ambulance train to be used in the field exclusively for that service.

Uniform, &c.—The uniform and personal equipment of the ambulance train should be that of the corps generally, with the addition of some distinctive mark, such as the red and white band, with cross to be worn on the arm, proposed by the Geneva Conference.

Evidence on Ambulance, &c.—The Committee having heard the evidence of Sir James Gibson, K.C.B., Director-General of the Army Medical Department, of Dr. J. Sutherland, Sanitary Commissioner in the Crimea, and now specially employed at the War Office, and of Mr. Robertson, Purveyor-in-Chief, relating to the supply of hospitals and transport of sick and wounded soldiers, and having also had the advantage of the opinion of General Lord Strathnairn, G.C.B., of Lieutenant-General Sir Hope Grant, G.C.B., and of Major-General Sir Duncan Cameron, K.C.B., on the practical working of those services in Ireland and in the recent campaigns in China and New Zealand, are confirmed in the vital importance of having these services thoroughly organized under one direction, both as regards providing the carriage and equipment and superintending the transport. The arrangements for removing wounded soldiers out of action and for the transport duties connected with the hospitals are, in the opinion of the Committee, in a very undefined unsatisfactory state as regards both

the responsibility for and the means and appliances of the service. The evidence referred to shows how ill understood and how imperfectly provided for by regulation are the relative responsibilities of these officers regarding transport of sick and wounded. The Committee have no doubt that, under the plan they propose, this objection will be obviated, and that the most important branch of the service will be placed on a footing which will admit of no misunderstanding or clashing of authority.

Litter Bearers.—The present practice of bandsmen carrying the wounded out of action is open to great objection, and the diversion of bandsmen from their duties should be avoided. Again, the practice of soldiers leaving the ranks to carry away wounded affects the efficiency of a regiment, and is open to abuses. The extension and thorough organization of a corps of litter bearers to form a part of the Army Hospital Corps is therefore strongly recommended.

Nucleus of Ambulance Train.—The general hospitals, at home and abroad, will provide useful employment and instruction in those duties for a portion of the Army Hospital Corps, and also for the nucleus of an ambulance train on a sufficient scale to train the men, and to afford opportunities of practically determining by experiment the best descriptions of carriages, litters, cacolets, &c.

CHAPTER III.

PROPORTION OF HOSPITAL TRANSPORT TO
STRENGTH OF FIGHTING FORCE.

CHAP. III.

I PROPOSE in this chapter to consider the proportion of hospital transport which has been estimated for the use of the British army since the date of the Peninsular war, and to indicate the general principles on which similar calculations will have to be based on the occasion of future wars.

SECTION I.—GENERAL REMARKS ON ESTIMATES FOR SICK
TRANSPORT WITH ARMIES ON ACTIVE SERVICE.

Various kinds
of sick trans-
port required
for an army in
the field.

The hospital transport which has to be estimated for on an army taking the field comprehends not only the transport which will be required for the removal of the wounded from the field of battle, but includes also the transport which will be required for the use of the sick in all parts of the line of operations, from the front to the base. The hand conveyances and their bearers for the transport of the wounded from the scene of action to the field hospitals; the mule litters and the cacolets, or the wheeled stretchers, for the transport of the wounded to hospitals, to ports of embarkation, or over country too broken for carts or wagons, when the distances are not very remote from the position of the army operating in the field; the wheeled conveyances drawn by animals for the carriage of sick and wounded along the roads in the rear;—all these have to be taken into account in the estimate, and the numbers required of each description of transport have to be separately calculated according to the nature of the military undertaking in which the troops are about to be engaged.

Difficulties in
the way of
forming accu-
rate estimates
of the sick
transport that
will be required
by an army on
active service.

There are so many circumstances which have to be taken into account in forming an estimate of the amount of transport matériel, and of the number of stretcher-bearers, required to accompany a force of any given strength that is announced to be about to proceed on a hostile expedition, that it seems doubtful whether anything beyond a rough calculation for all the wants of the army can ever be framed. Say that a force of 30,000 men is ordered to embark on a hostile expedition, and the question is put to the Medical Department what strength of carriers of wounded, and what amount of carriage accommodation for the sick and wounded, are required to accompany the force to provide for the casualties which may be expected to take place from disease and conflict with the enemy, on what basis is the answer to be framed? An answer at all approaching to accuracy can only be furnished after information is given which the military authorities will probably

decline for strategical reasons, or be unable, to furnish. The men of the Army Hospital Corps, whose duty it is to pick up the wounded on the field and to carry them on stretchers to the field hospitals, are also the men who attend upon the sick and wounded in the military hospitals. But it is not possible to say how many hospitals will be established along the line of operations of an army when the very line which the army may follow, like the numbers who may fall sick, is dependent upon a mass of circumstances the degree of potency of not one of which can be told beforehand. The fatigue to be endured, the loss of rest, insufficiency of shelter, exposure to vicissitudes of temperature, to miasmata, the occurrence of epidemics, and other influences affect the ratios of sickness and the numbers of hospitals necessary; and for every hospital established a number of men of the Army Hospital Corps will be required whose services may have been reckoned upon for the removal of the wounded from the field of action. On the very field of action itself the proportion of casualties is found to vary so much in different battles that it is hard to form an estimate of the amount of transport and transporters that will be required for any particular engagement. It is not an easy matter to ascertain with even an approach to accuracy the number of casualties, including wounded and killed, which have hitherto occurred in particular battles; and it is still more difficult to arrive at a knowledge of the number of the wounded who required to be carried to the field hospitals for treatment. On reference to the principal battles of the present century it is remarkable how frequently it is difficult to obtain information beyond the general fact that of a given number of troops such another given number were "killed or wounded;" and equally remarkable how discordant the accounts of these particular numbers are in the records obtained from different sources.* Again, the difficulty is increased on account of the numbers of the wounded of the vanquished force left on the field, who equally have to be transported for care and treatment with those of the conquerors. This difficulty will in part be removed if the terms of the Convention of August 1864 are carried into effect; for, by the articles of this treaty, it is provided that wounded prisoners may either be given up for care and treatment to the countries to which they belong, or surgeons and attendants belonging to their own country may be left with them to provide for their wants without being subject to the risks and penalties attached to prisoners of war.†

The most convenient mode of proceeding appears to be first to try and ascertain the average amount of transport for sick and wounded which is required to meet the wants of the army actually

Variations in the ratios of sickness in armies.

Variations in the proportion of casualties in actions.

Not only the casualties of a victorious army but the wounded left by the conquered, require hospital transport.

* See Appendix, Note 2.

† The terms of the convention are appended to this work, as the provisions contained in its articles refer in many ways to the subjects on which this and the succeeding chapter treat. (See Appendix, Note 3.)

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The sick transport with the active part of an army.

The sick transport for the use of the troops separated from the army by disabilities.

in the field, the amount of transport which is likely to be required at all times with a force prepared and likely to have to engage with an enemy; and, secondly, to ascertain the amount which will probably be necessary to meet the wants of the hospitals and convoys of sick and wounded in rear of the army. The former may be designated the *special ambulance transport* of the active part of the army; the latter the *general hospital transport* for the portion which has become separated from the active part by disabilities. This special, and this general, transport should be regarded as distinct from each other, and estimated for accordingly. As to the first of these two estimates, it is obvious that whatever *proportion* of transport may appear to be necessary for the first battle of a campaign will equally be necessary for a second battle. If the strength of the combatants be reduced by battle the amount of transport will probably be reduced at least in the same ratio by injuries and accidents; and if this do not happen the strength of the combatants which has been thus reduced, will probably be afterwards recruited by reinforcements, when the same proportion of transport will remain necessary as was required at starting. The wants, therefore, of the wounded who have resulted from the first engagement, and who have been removed to depôts in rear, must be separately provided for; the transport which may have left the front in order to convey them to the rear will return to the army, so as to be with it in case of further engagements. Thus while the special transport with the active force will have a constant ratio to the fighting force, the proportion of general hospital transport necessary will be a constantly variable quantity.

The calculations required to form an estimate of the wants of the army in the field will obviously be simpler than the calculations for the provision necessary to meet the wants of the hospitals and convoys in rear; for, subject to fluctuations as the wants of the army itself may be, these fluctuations are not likely to be nearly so great as those connected with the hospitals and sick in rear, because the sources of variation are less numerous.

Unfortunately, as it seems to me, the distinction I have indicated between the ambulance and the general hospital transport does not appear to have been made in the calculations hitherto formed on this subject. The transport for the army in front, and for all its dependencies in rear, have been included together in one and the same calculation; a general reserve being recommended to supply deficiencies in any part of the line from front to base.

SECTION II.—PARTICULAR ESTIMATES OF SICK TRANSPORT FOR USE WITH ARMIES ON ACTIVE SERVICE.

Dr. Millingen, guided by very extensive experience in the wars of the early years of the present century, published the following calculations on this subject:—

"The most able speculations I have met with," he writes, "agree in calculating at the commencement of an active campaign one tenth requiring hospital treatment, and one fifth subsequently standing in need of removal to the rear during its progress."

Dr. Millingen's calculations on the subject of field hospital transport.

"The means of transport for the sick and wounded will consist of—

"1. Two improved spring wagons for each brigade.

"2. One long car to each battalion.

"3. Bearers (stretchers) upon the plan of Baron Percy's, in the proportion of one to every two privates of the hospital corps.

"Thus we shall suppose a division of 10,000 men, divided into four brigades, and formed of 15 battalions, would take the field with—

"8 spring wagons.

"15 regimental long cars.

"100 stretchers."

The number supposed to be carried in the spring wagons is not mentioned, but they appear to have been intended for four men in a recumbent position. The regimental long cars are calculated to move to the rear from 10 to 12 men sitting.

In addition to the above divisional detail of transport "a reserve park of spring wagons and long cars, in the proportion of two of the former by division and two of the latter by brigade, should move in the rear of head-quarters, under the immediate eye of the field inspector and commanding officer of the hospital corps for the purpose of replacing deficiencies and assisting in the evacuation of the field hospitals." Dr. Millingen adds in a footnote that "the strength of this reserve must vary according to the nature of military operations; and if the march of an army is to be of considerable length, requiring the establishment of many intermediate passage hospitals, the means of transport in the rear must be increased."

Supposing the amount of transport thus estimated to be all present on the field on the occasion of an engagement with the enemy, it is evident that 100 wounded could be removed at the same time by the 100 stretchers from the ground to the position where the brigade spring wagons and regimental cars were in readiness to receive them; and that these conveyances, with the addition of the divisional reserve wagons and cars, making in all 10 spring wagons and 23 long cars, would be capable of carrying about 270 at a time to the field hospitals, or $2\frac{7}{10}$ per cent. of the combatants. The time occupied in the transport would of course vary according to the nature and extent of the ground moved over by the combatants, and the position of the several lines of surgical assistance. Supposing the wounded requiring removal to be at an average of about 10 per cent., 10 journeys would be required for the men of the Army Hospital Corps who were engaged in assisting the wounded from the field, and about four journeys for the wheeled conveyances.

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Recommendations of the late Director-General Alexander on this subject.

Principles on which the provision of sick transport in the Medical Regulations has been arranged.

The proportion of ambulance transport allotted by the Army Medical Regulations to battalions, brigades, and divisions is the same as was recommended by the late Director-General T. Alexander, in a memorandum concerning ambulance conveyance furnished by him to the Royal Commission for inquiring into the sanitary state of the army, of which the Right Hon. Sydney Herbert was president. The memorandum is published in the appendix to the evidence taken by the Commission. The concluding paragraph of the document states, with regard to the scale of transport above described, that it is "the minimum of transport compatible with efficiency, capable of expansion, but not of contraction; and drawn up with reference not merely to the wants of the medical department, but to facility of transport with an army moving in the field, and to the numerous requirements of other branches of the service, transport for which must be supplied as well as for the medical."*

It will be useful to mention the principles on which the transport for the sick and wounded has been ordered by existing regulations to be provided in the event of war, and to explain the authorized manner of proceeding to obtain this provision. The letter from the chairman of the committee appointed to draw up revised regulations for the army medical service, addressed to the Secretary of State for War, and dated 9th July 1858, which is inserted at the beginning of the code of Medical Regulations for the purpose of explaining the nature and objects of the changes introduced by them, contains the following passages in reference to this subject:—

"The experience of the late war having proved that the existing method of equipping and supplying field hospitals is defective, we have endeavoured to remedy this great evil by drawing up a new set of regulations for field hospitals.

"At present† * * * the Army Medical Department may or may not have transport for the sick and wounded and for the hospital stores. In a case where humanity would suggest that the greatest prudence and forethought should be exercised in alleviating human suffering, the necessities of the sick and wounded are left subject to the ordinary accidents and contingencies of the field.

"We propose, therefore, that in future, when an army takes the field * * * a fixed amount of transport for sick and wounded and for the military hospitals shall, on the requisition of the Director-General, be placed at the disposal of the principal medical officer, to be added to on the requisition of the medical officer, so far as the exigencies of the service may permit, in case of unforeseen deficiency.

* See Appendix to evidence taken before the Commission appointed to inquire into the regulations affecting the sanitary condition of the army, &c. London, 1858, p. 473.

† The asterisks indicate omissions of sentences not having reference to ambulance transport.

"We have in the same Regulations required that when an army takes the field in time of war, field hospital equipments, in the proportions laid down for a battalion, brigade, and division, shall accompany the troops, and we have further required that whenever a regiment embarks for the field its scale of hospital equipments shall be embarked with it."

The nineteenth section of the regulations referred to in the previous extracts defines the administrative arrangements for providing the transport for the carriage of the sick and wounded in detail. Each regiment of 850 men on embarking for the field is to take among its equipment one ambulance car, capable of carrying six or eight men, and 14 stretchers, to be drawn by two mules. Provision is thus made for the carriage of from 36 to 48 sick, with a division of six regiments = 5,000 men.

Independent of this supply of transport derived from the battalion equipment, it is ordered that the Director-General shall in time of war make requisition for a certain amount of wheel and other means of transport, and that this amount, subject to the approval of the officer commanding the forces, shall be allowed for the fixed and exclusive use of the medical wants of the army in the field. This transport is to be in charge of the Military Train, and is to be distributed by the principal medical officer of the army, in communication with the officer commanding the Military Train, in such manner as he may judge to be requisite for the service, and in accordance with the necessities of particular parts of the army. When a force is detached, such cacolets and litters are to be sent with it as the principal medical officer may direct.*

Although the precise amount of ambulance transport, wheel or other, to be allowed to the medical department of an army on taking the field is not laid down by the regulations, but is left to be decided by the Director-General, who will form his judgment in each case according to the probable exigencies of the campaign, the nature of the country expected to be the seat of war, and other circumstances, and make requisition accordingly; still the regulations indicate the transport which would be necessary

* Med. Regs., pp. 69 and 77. It appears to be from a misconstruction of the several articles of the code of army medical regulations, that a distinguished officer of the medical department has published that provision is made by them "for the transport of only 36 to 48 sick or wounded per force of 5,000 men, or from 0.7 to 0.9 of a man for 100 effectives." If that were the only provision he might well add in reference to this limited amount of sick transport "that in the event of a war with a western nation disasters must occur, unless a great and speedy remedy against such a circumstance takes place." *Army Hygiène*, by C. A. Gordon, M.D., C.B., Deputy Inspector-General, p. 183. The truth is that, according to the regulations, if the amount of transport which may be fixed to be appropriated to the use of the sick and wounded of an army on taking the field be not adequate to their necessities, the deficiency must be due to one of two causes;—either the Director-General has not made requisition for a sufficient amount of transport, or the supply of the amount required by him has not been sanctioned by the authorities, whose province it is to decide how far his requisitions can be complied with.

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—
Allotment of
transport in
the Army
Medical Regu-
lations.

for the conveyance of a certain rate of sick in the following article:—

“Assuming the sick required to be carried at the rate of 5 per cent., the following transport will be necessary for a division of 5,000 men:—

“128 sick in 16 carts, 8 in each.

122 sick in cacolets or litters.

—
250 sick.
—

or

“126 sick in 21 carts, 6 in each.

124 sick in cacolets or litters.

—
250 sick.”
—

As the regimental ambulance carts are calculated to carry 48 or 36 sick, according as they are made for the conveyance of eight or six each, the transport left to be required by the Director-General on the average named above, would be for—

80 sick in 10 carts, 8 in each cart.

122 sick in 61 pairs of cacolets or litters, carried by 61 mules.

—
202 sick ($202 + 48 = 250$ sick).
—

or

90 sick in 15 carts, 6 in each cart.

124 sick in 62 pairs of cacolets or litters, carried by 62 mules.

—
214 sick ($214 + 36 = 250$ sick).
—

At the same time that this indication is given the regulations state that some carts or spare mules would be required to remove the knapsacks of the men carried in cacolets, so that they might not be separated. The knapsacks of the men carried on the mule litters and in the carts could be carried with them. The regulations also state that in the event of the Director-General not having made requisition for sufficient transport to meet any emergency occurring in the field, then the principal medical officer with the army should make a requisition for the necessary additional transport on the Quartermaster-General. The 16 or 21 carts mentioned above in the calculated transport for sick at the rate of 5 per cent. would furnish 224 or 294 stretchers respectively for hand-carriage.

The calculations regarding sick transport in the Medical Regulations also closely accord, so far as the proportion of transport to

* Med. Regs., p. 76. In Inspector-General Alexander's memorandum concerning ambulance conveyance this passage is differently worded; thus, “Ambulance conveyances should be forthcoming when requisite in the proportion of five per cent. of strength. One half might be conveyed on wheeled carriages, and the other half in cacolets or litters.” Appendix, op. cit., p. 473.

strength is concerned, with the recommendations made by Sir John Hall, before the Commission, which may also be found published in the Appendix to the Evidence.*

Sir John Hall stated the following quantity of transport to be necessary for a division of 10,000 men:—

13 two-mule cars to carry six men each	78 men.
12 four-mule wagons to carry eight men each	96 „
13 one-mule Maltese carts, fitted with box litters - - - - -	26 „
100 pairs of cacolets - - - - -	200 „
50 pairs of mule litters - - - - -	100 „
	500 „

Sir John Hall's views on the amount of sick transport requisite for an army in the field.

This therefore was calculated to provide transport for sick and wounded, independent of stretchers, available at one and the same time, at the rate of 5 per cent. of the whole strength.

Sir John Hall also agreed in considering that each regiment should be provided with a two-mule car to be at the disposal of the surgeon of the regiment. The two-mule cars in the above list were designed for this purpose. He also proposed that each regiment should have in addition one mule with a pair of cacolets, and another mule with a pair of litières; and that a spare pair of each of these conveyances should also be carried in the regimental surgical equipment cart, to be employed in case of an emergency by substituting them for the pair of surgical panniers and pair of water skins carried by two other mules with each regiment. The rest of the transport equipment enumerated in the divisional scale above given was to be under the immediate control of the principal medical officer of the division, subject however, like the regimental transport, to the direction and disposal of the principal medical officer of the whole army, the care of the animals and the discipline of the drivers and conductors being under the Military Train.†

We find, as we might expect, that a rather larger proportion of sick transport than that recommended by Sir John Hall or Director-General Alexander is provided for the French troops on ordinary active service in Algeria. In that country all the materials of a given force have to be transported on the backs of mules, as well as the sick and wounded troops. In the case of a distant expedition, in which the troops are detached from communication with any base, for periods calculated at about *thirty days*, it becomes very important that sufficient means of sick carriage should be always at hand for use, and we then find that the proportion is still further increased. The following is the regulated amount of staff, and material for transport, of the active ambulance of Africa for a division of 10,000 men, when the troops

Amount of sick transport allotted by the French regulations to troops in Algeria.

* Op. cit., p. 470.

† Appendix, &c., ante cit., p. 471.

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Staff.

16 surgeons and dispensers.
7 officers of administration.
104 hospital attendants.

Transport Materials.

20 hand litters.
250 pairs of mule chairs.
24 pairs of mule litters.

It will be seen that this allotment provides means of carriage for 548 sick or wounded, or forty-eight more than 5 per cent. of the force exclusive of the 20 hand litters which could only be employed for the removal of the wounded for short distances. But if the troops are acting on a distant expedition and are likely to be away from any station at which sick or wounded can be left for prolonged periods, the number of cacolets is ordered to be increased one-fifth. In case of an accumulation of sick or wounded beyond this proportion of transport, the only resource would be to obtain and employ some of the means of conveyance used by the natives.*

Mule litters and cacolets of doubtful utility on the line of march.

Hospital store transport mules available for removal of sick in a standing camp.

As to the different kinds of transport which have been named, there can be little doubt, I think, that the plan ultimately adopted and authorized by the British regulations of limiting the fixed amount of regimental transport to the ambulance car and stretchers is the best. This description of transport must be always necessary in campaigning, whether on the march, in a standing camp, or in any other position. The mule cacolets and litters are not calculated to be of much use to troops under the ordinary circumstances of marching, though valuable near a field of action and in places where no wheeled transport drawn by animals can go. In a standing camp the animals employed on the line of march in transporting the hospital stores can be turned to account for transporting the sick. It is in this way that provision is made by the regulations for meeting the exigencies which arise under these, as under most other, exceptional circumstances. The ordinary number of mules told off for moving the regimental and divisional hospital stores and carrying the field medical panniers, would of course not be required to be employed in this particular work in a standing camp, and might, under such circumstances, be well made available for the removal of sick. With a division this would amount to 44 mules, these being altogether independent of the mules specially provided for carrying cacolets and litters, and which alone would be available when the army was in movement before the enemy or after an action. Were these 44 store-transport mules forthcoming for the sick-transport service of the division,

* "Système des Ambulances des Armées Française et Anglaise," par M. Boudin. Paris, 1855, p. 38.

allowing those for the panniers to be employed daily in bringing water, wood, &c. for the hospitals, there would remain 36 mules available to be employed constantly in the transport of sick. This would give, if wagons carrying eight patients be issued, the means of moving 144 sick daily, or as often as the distance to which the sick had to be transported would permit; or the same number could be carried if, in addition to the six regimental cars, 24 pairs of cacolets or litters were issued for this duty.

This supply would probably be sufficient to serve all the ordinary hospital transport wants in a standing camp, so as to keep the camp hospitals relieved from any accumulation of patients. The divisional ambulance mules with their cacolets and litters would during this time remain under charge of the Military train, and would be available to meet any emergency which the fixed establishment above named was not adequate to meet.

SECTION III.—CONCLUSIONS ON THE PLAN TO BE FOLLOWED IN MAKING FUTURE ESTIMATES OF SICK TRANSPORT FOR ARMIES PROCEEDING ON ACTIVE SERVICE.

From all that has been stated it is evident that a provision of sick transport, exclusive of stretchers, about equal to the carriage of five per cent. of the combatant force at starting has hitherto been considered to be a right proportion, including the special transport necessary for the army in the field, and the general transport for the sick of the hospitals in rear. But in case of the question arising in future, it may be useful to consider whether the principles on which, having due regard to economy on the one hand, and the necessities of the sick and wounded on the other, the investigations into the amount of sick transport necessary for an army have hitherto been conducted may not be modified with advantage, and the calculations rendered more precise. These enquiries will probably be capable of being made with greater approach to accuracy hereafter than they ever could have been made heretofore, owing to the greater attention which is now being given to obtaining and recording accurate statistics of the results of war.*

The following seems to be the best plan on which such attempts to determine the proper amount of sick transport for any intended campaign can be made:—

The casualties of recent campaigns must be examined and the experience gained in them, both as regards the numbers of wounded in battle and the average ratio of sick to strength during the whole periods of such campaigns, be carefully noted. The issues

The medical and surgical results of the most recent campaigns to be investigated.

* The statistics of the Crimean war have now been completed by the admirable work of Dr. Chenu, and there is every reason to expect even still more accurate information regarding the results of the Italian campaign of 1859, and the French campaigns in Mexico and Cochin China before long from the labours of the same indefatigable statist. The medical and surgical results of the late war of the Rebellion in the United States are also in course of publication in full detail under the direction of Surgeon-General Dr. Barnes. It is hoped that equally correct information will in a short time be available respecting the Prussian campaign of 1866.

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Campaigns in particular countries.

Standard proportion of special transport to start with the force.

Similar proportion to accompany all additions to the force.

Reserve transport to meet emergencies and replace losses in the special transport.

Provision of general hospital transport.

of this examination will form the bases of the future calculations. As a general rule, the most recent campaigns should be chiefly investigated, because in them we may reasonably expect to find the conditions which are likely to be repeated in future campaigns; but if the country over which the active operations of the army are to extend be known, then the investigation should particularly be made into campaigns which have previously taken place in the same country, allowance being made for the effects of altered weapons and the advantages to be gained from the improved state of sanitary and other science of modern time. The transport which may have been required to meet the casualties occasioned by battles or by sickness in the active part of each army under observation, should be separated from that which was necessitated by the requirements of the invalided portion of the army and the general hospital service in rear, and an average taken. In this way a standard proportion of the attendance and ambulance transport likely to be necessary for an army about to start on active service, to remain with it or in its immediate neighbourhood, may be deduced, and this should be the proportion to accompany the force at starting.

For every fresh body of troops despatched to increase the fighting strength of the army operating in the field, not bodies sent only to replace losses in the original strength, a corresponding increase in the number of attendants, bearers, and transport matériel should be despatched also, so as to maintain them at their original standard. After all, when recommendation on the subject is made, it should be plainly stated that the calculation is only an approximate one, and, therefore, to meet deficiencies, that a reserve force of hospital bearers and store of ambulance transport should be held in hand ready to meet casualties which had not been anticipated in the calculation, as well as to replace losses and disabilities among those already sent, so as to keep up the standard; the standard should especially not be permitted to sink as regards the army in front, for it will be the most difficult to reach in case of sudden emergency. This reserve should be partly kept at the general hospital at the base of operations, and partly at the training dépôt in England.

The transport wants of the sick in the general hospitals along the line of operations, and of the general hospital at the base, would still have to be provided for. As already mentioned, the proportion of general hospital transport required will vary with the circumstances of each occasion, and must be estimated accordingly. The means of arranging to meet the needs for transport along the line of military operations will be greatly facilitated if the use of vehicles common to the commissariat and medical departments be considered admissible, but this is a subject which will be discussed hereafter.

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.

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.

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SECTION I.—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.

Positions of
men with re-
cent wounds
during trans-
portation.

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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.

Its advantages to men severely wounded.

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

Kinds of wounds which necessitate a 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.

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.

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.

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

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.

The sitting posture.

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.

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

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

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

The semi-recumbent position.

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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.

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 patients 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

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semi-recumbent carriage.

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.

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

Examples in the French military service.

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

Proportion recommended by Sir J. Hall.

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.

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.

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

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

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 $35\frac{1}{5}$ 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.

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 $66\frac{2}{3}$ 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.

Proportions provided in the ambulance transport despatched to the Crimea.

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.

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.

Deficiency of bearers of wounded after actions.

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

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

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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

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Esmarch's
crutches for
aiding wound-
ed men from
the field to field
hospitals.

Their practical
utility ques-
tioned.

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.

SECTION IV.—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.

Such help
should be sys-
tematically
conducted.

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

* 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.

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 his body with the 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.

Assistance when only one bearer is available.

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

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.

With patients wounded in an upper or lower extremity.

Should the patient have to descend a declivity the attendant should take special 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.

Caution necessary in descending a declivity with such patients.

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

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

Example of Baron Percy.

* See p. 32.

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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 Rückensitz*) 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* :—

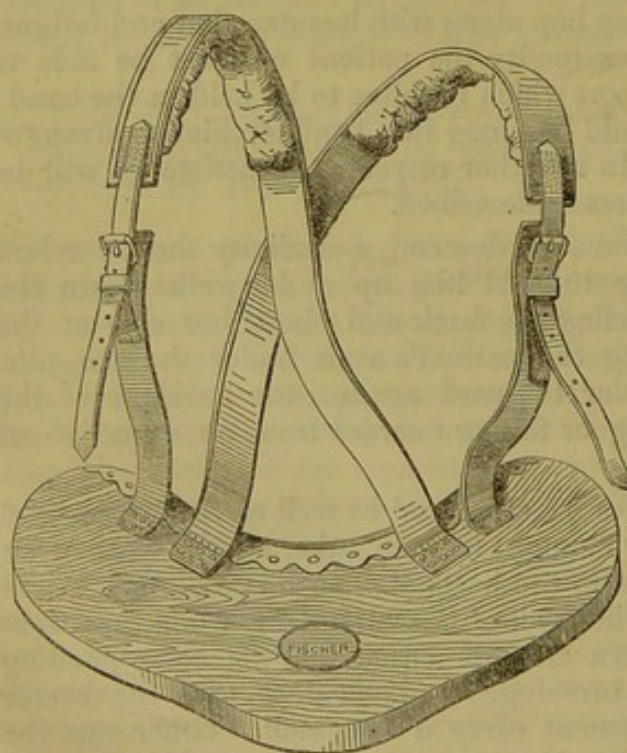


Fig. I.—Fischer's Apparatus for carrying a wounded man *en cheval* on a bearer's back.

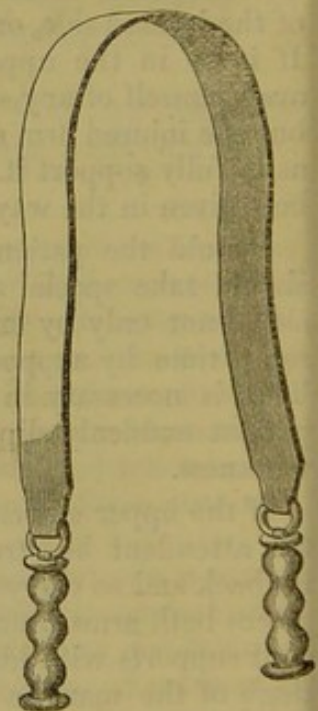


Fig. II.—Supporting Belt used with the same.

* 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.

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

Results of trials of the apparatus.

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. It 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.)

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.

Conclusions
regarding the
apparatus.

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

If more than
one attendant
available a

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substitute for
a litter to be
constructed.

Carriage by
two bearers.

First Method.
Two-handed
conveyance,
patient sitting.

Objections to
this mode of
carriage.

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

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.

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.

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.

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.

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



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

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.

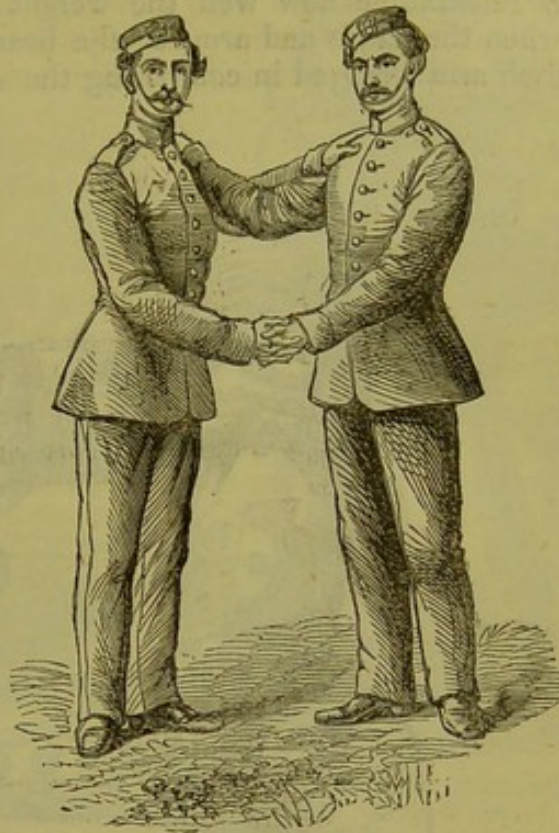


Fig. V.—Two-handed Support by two Bearers for carrying a Patient in a semi-recumbent position.

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Comparison between this and the former method.

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.

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

Objection to this mode of conveyance.

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

Fourth Method.
Four-handed seat with uncrossed arms.

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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

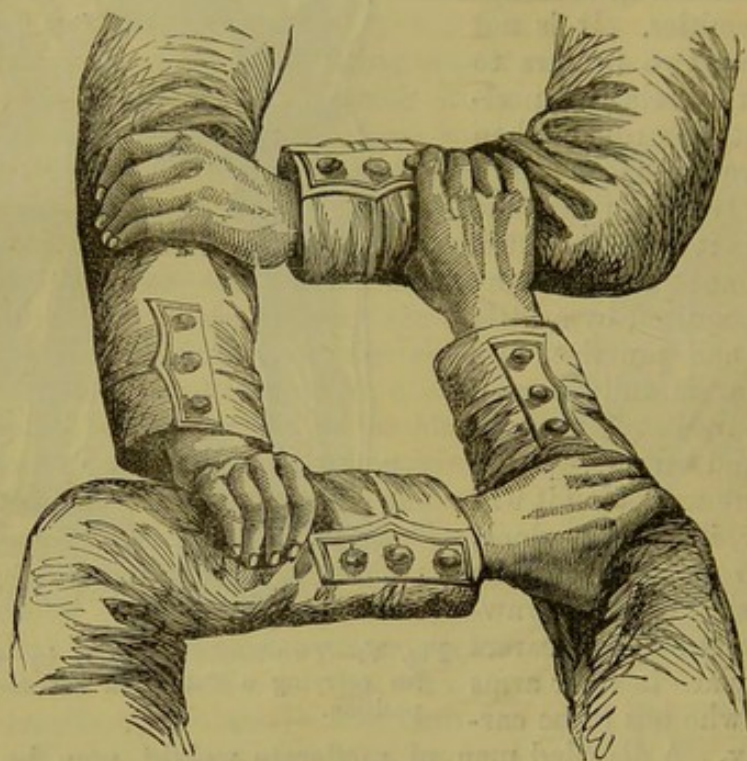


Fig. VI.—Four-handed Seat formed by two Bearers, the arms being uncrossed.

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

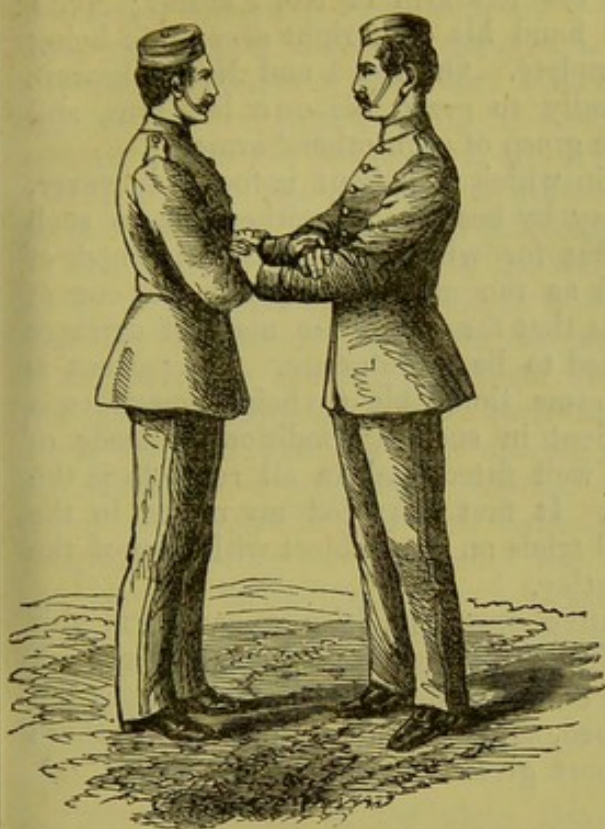


Fig. VII.—Position of the Bearers when forming the four-handed Seat with uncrossed arms.

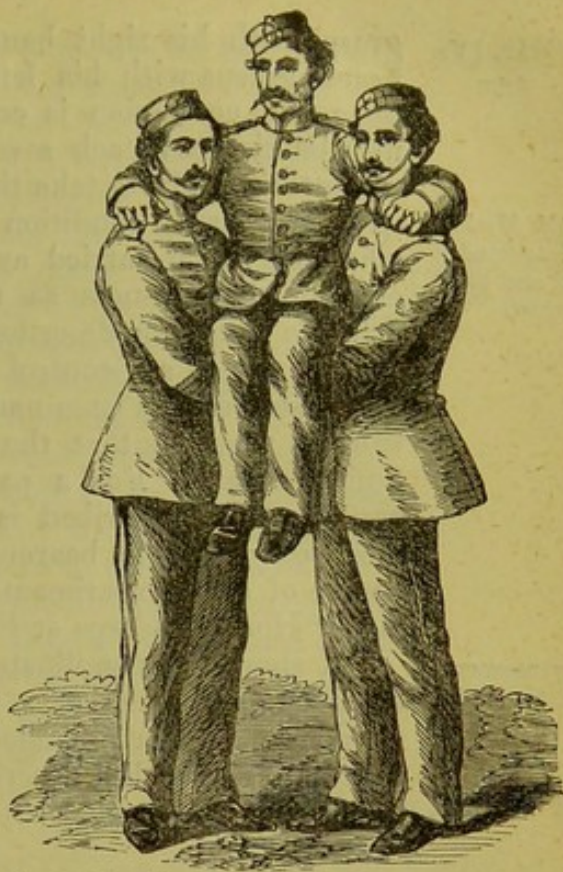


Fig. VIII.—The Bearers marching with Patient. Front View.



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

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Fifth Method.
Three-handed
seat and back
support.

Arrangement
of this method
of carriage.

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 left 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.

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.

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:—

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

Its advantages
over the four-
handed-seat.

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.

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.

Carriage of
wounded on
muskets, or
other conve-
nient articles,
held between
two bearers.

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 surgical
treatment of
field injuries
not discussed
in this work.

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—

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.

CHAPTER V.

SICK-TRANSPORT CONVEYANCES.

GENERAL CLASSIFICATION.

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.:—

- 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.

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

Five classes of conveyances.

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.

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.

Subdivisions 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

General principles of the first class of conveyances.

* 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 *lecticarii*, 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.

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

"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.

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 con-
veyances.

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

Distinction be-
tween the terms
"stretchers"
and "bearers."

Sometimes
indiscriminate-
ly used.

Probable
source of this
error.

* 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 want of discrimination 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 *dhooley* and *dhooley-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.

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.

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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 enemy, 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 long distances.

Manner in which weights are most easily sustained by bearers.

Manner in which Turkish porters carry very heavy loads.

CHAP. V.

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 sustentation 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 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 end in an iron ring, or *grummet*. When it is in use on board ship, a mattress 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 ham-
mocks.

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.

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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 transports which were to convey them to Scutari. The inconveniences chiefly experienced in their use in carrying wounded are the difficulty of giving a proper rest or support to any injured part or limb, from the rounded form of the canvas, and from its closely adapting itself to the general outline of the body; the pressure of the sides of the hammock against the person within it; the difficulty of maintaining a horizontal posture of the patient in moving over uneven or sloping ground; and the absence of all provision to act as a guard against the effects of placing the conveyance temporarily on the ground. These inconveniences equally exist whether the hammock be borne suspended from one pole or between two poles, though some of them are felt in a somewhat less degree in the latter case. Another inconvenience which results to the bearers when the hammock, blanket, or any other hand conveyance without cross-pieces is carried between two poles, is the constant tendency of the poles to approach each other, owing to the drag upon them from the weight of the person who is being carried. From this cause also the poles, when the conveyance is carried by hand, continually press against the thighs of the bearers, and interfere with their progress in walking.

Rationale of the advantages resulting from the suspension of conveyances of the hammock kind from poles.

Use of hammocks after the action at the Alma.

Disadvantages of these conveyances.

When a hammock is thus employed, the soldier's knapsack should invariably be placed so as to form a pillow for his head; it is not only useful for the purpose named, but in case of the absence of a mattress, or of one that is sufficiently unyielding, it is also useful in helping to keep the sides of the hammock apart. His firelock should be laid by his side, or, if this position be objectionable from any cause, it must be carried by one of the bearers.

These inconveniences may be to some extent counteracted by certain arrangements.

Turner's patent tent-hammocks, which are employed in his system of camp equipage for sleeping berths to keep the troops or other occupants of the tents off the ground, are also prepared and adapted for use as ambulance hand-conveyances. They are therefore only to be regarded, so far as the carriage of wounded is

Turner's patent tent hammocks.

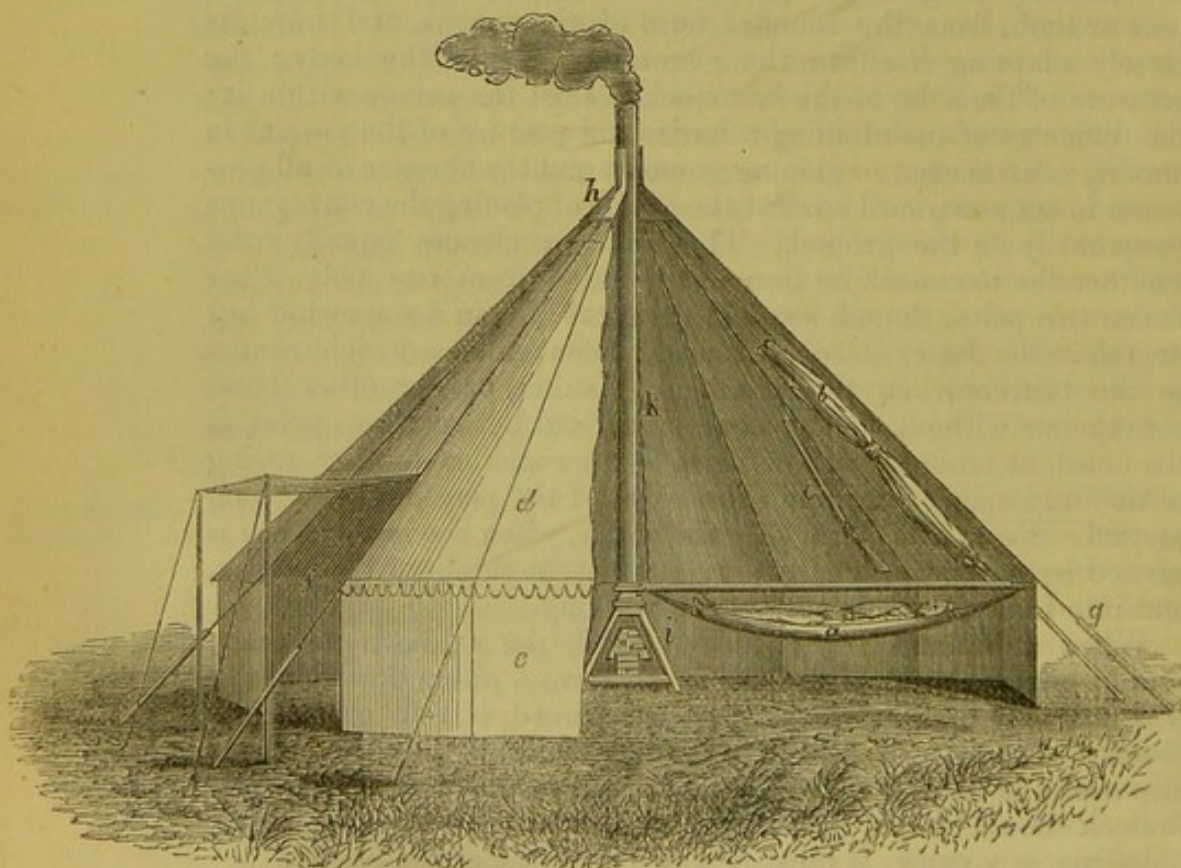
CHAP. V.

How suspended
when used for
carrying pa-
tients.

Position of the
pole from
which a Tur-
ner's hammock
is suspended
during trans-
port.

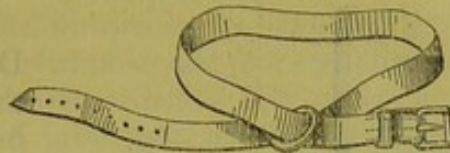
concerned, as an exceptional and temporary application of articles designed for other purposes under ordinary circumstances; just as the sailor's hammock, or soldier's great coat or blanket, may be used in the same way on occasion. When so employed, they are detached from the tent to which they belong 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.

Fig. XIII.—Turner's Patent Tent-hammocks.



Tent fitted with hammocks and fire-place.

- | | | |
|---------------------------------------|----------------------------------|---|
| a. Hammock as in use. | d. Cover of roof. | h. Ventilator. |
| b. Hammock as stowed when out of use. | e. Curtain to do. | i. Fire-place. |
| c. Method of stowing musket. | f. Door open to the full extent. | k. Tube forming flue to fire-place and support to tent. |
| | g. Tent lines. | |



Belt for Ambulance Litters.

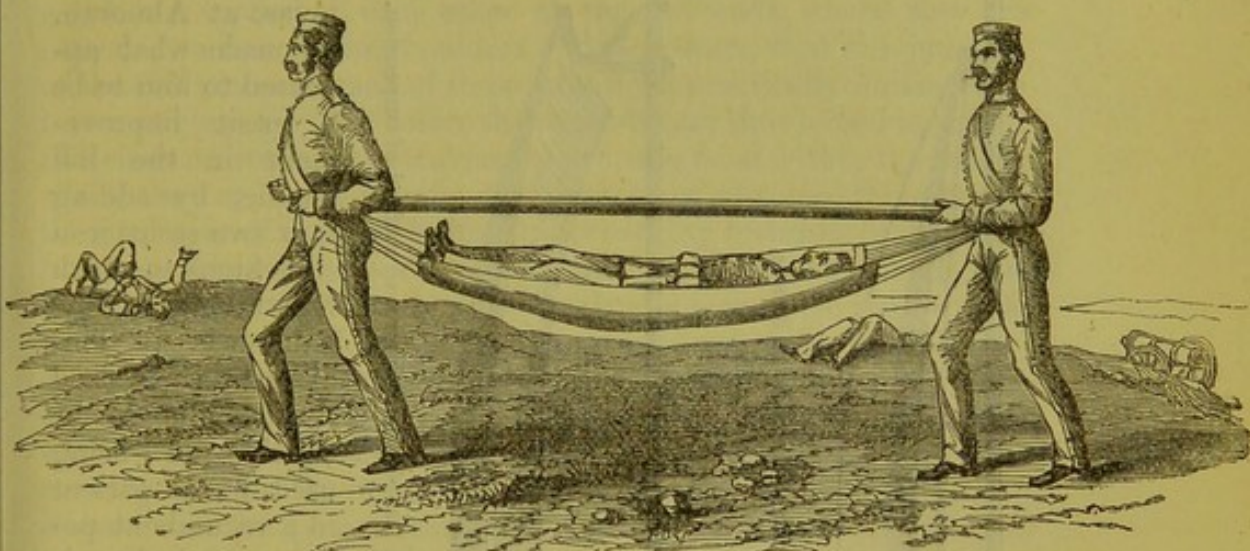


Fig. XIV.—Turner's Tent-hammock in use as a hand-litter.

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.

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.

Himalayan
"dandie."Its construc-
tion.Peculiarity of
the position of
the person car-
ried on it.

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McCosh's improved "Hill-Dandie."

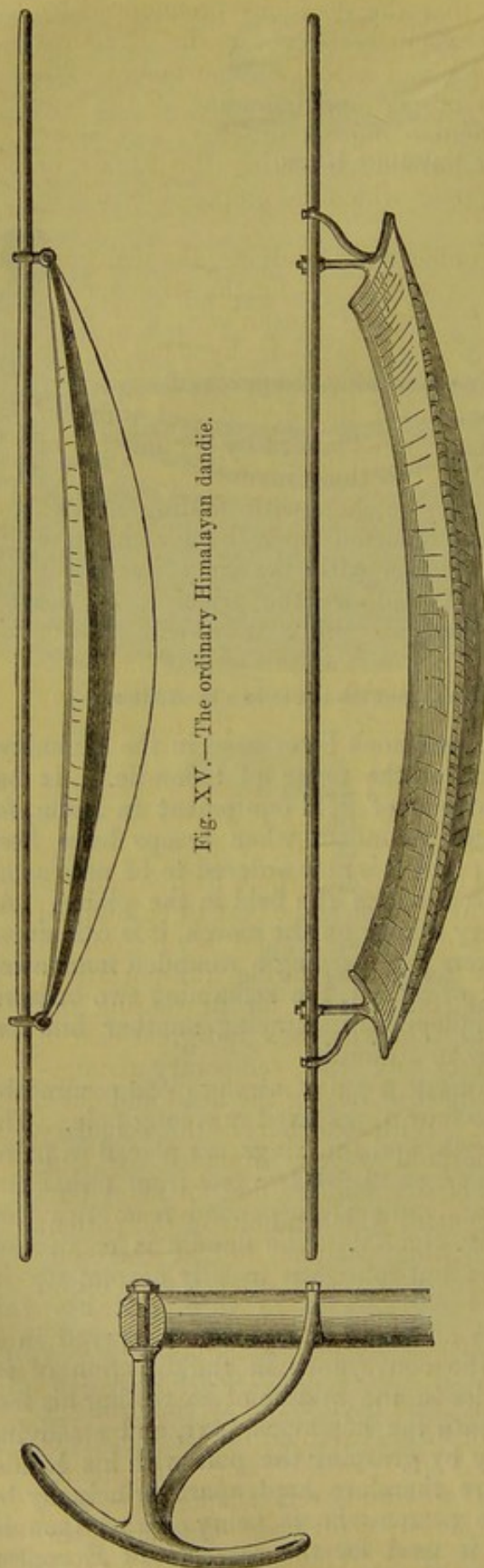


Fig. XV.—The ordinary Himalayan dandie.

Fig. XVI.—The Himalayan dandie with Dr. McCosh's improved method of suspension.

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

Staff Surgeon Dr. J. McCosh, of the Bengal Army, informs me that in 1847, when stationed in the Himalayas, at Almorah, he made what appeared to him to be a great improvement in the hill dandie, by adding to it two stout iron stanchions to which he attached the hammock. This alteration caused the dandie to be capable of being used for a patient in a recumbent position, and also allowed a small awning for protection from the sun or rain to be thrown over the person lying in it. Dr. McCosh 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 serve as a valuable addition to the usual mode of transport in the field in India, especially during an action.

The annexed drawings are copied from sketches given me by Dr. McCosh.

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 *jhampons*; 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 *jhampons*, to facilitate lowering or raising either end of the conveyance, for the

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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 at Netley. It was sent from India by Surgeon Franklyn, 7th Dragoons.

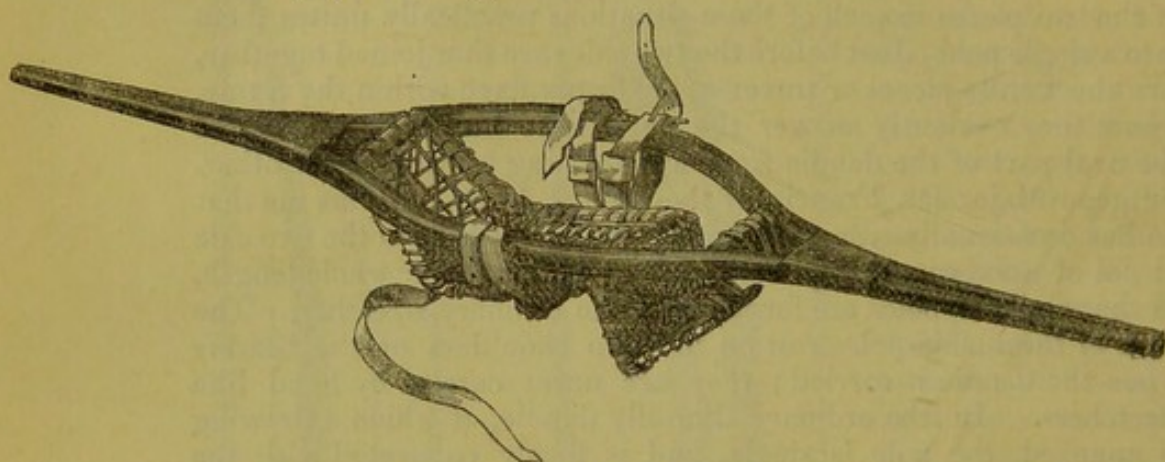


Fig. XVIII.—The Bareilly Dandie.

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

Its construc-
tion.

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.



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

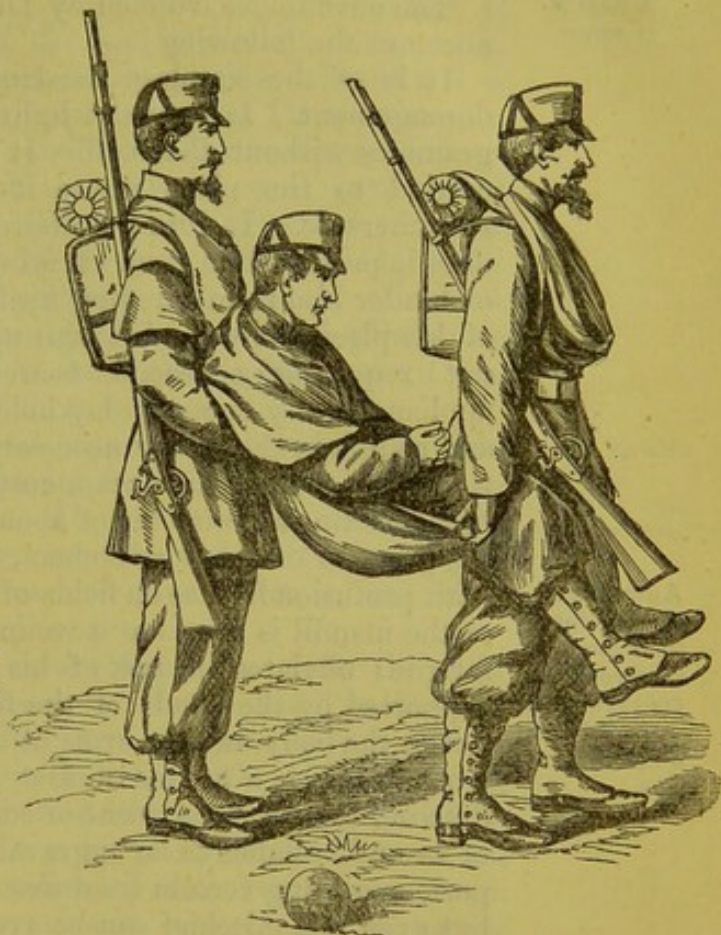


Fig. XX.—Manner of using the "Mandil de Socorro."

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.

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

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

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

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 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.

These alleged advantages considered.

Experimental trials of Landa's aprons at Paris.

Their results.

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

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.

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.

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

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.

Canvas seats, borne by two bearers.

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.

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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.

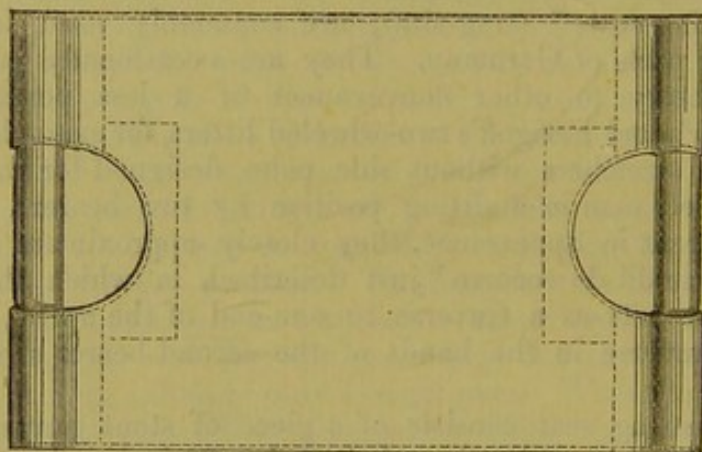


Fig. XXI.—The "Trag-sitz," or Bearing Seat.

Short canvas
litter, borne by
four bearers.

Canvas Body Litter.—This is a short litter, 3 feet in length and $1\frac{1}{2}$ in width, with two handles on each side, 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 by four bearers, 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

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.

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.

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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.

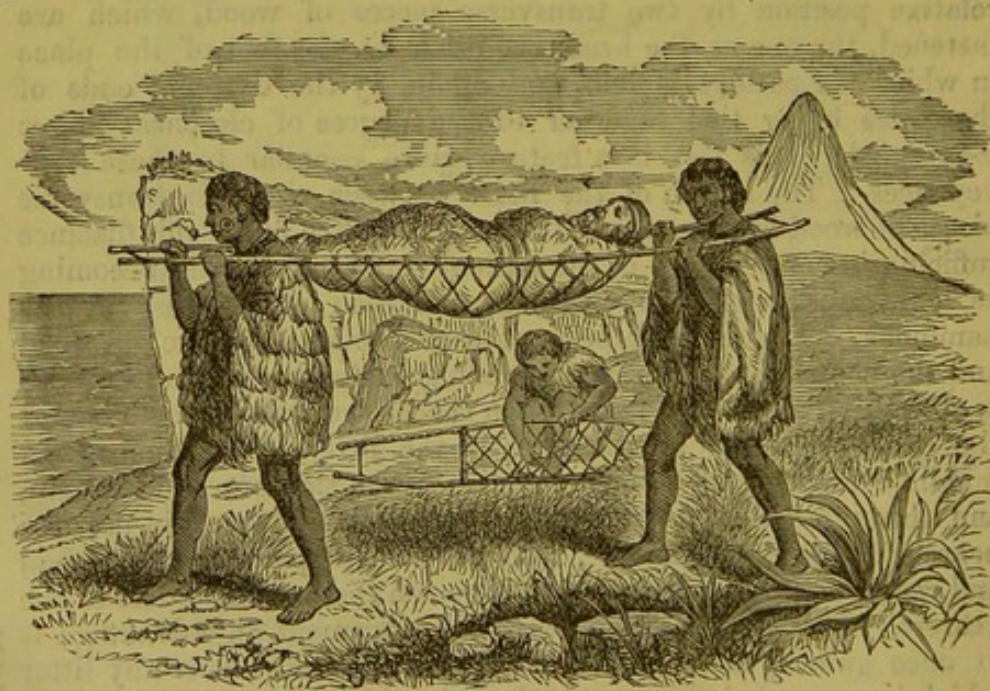


Fig. XXII.—The New Zealand Native Litter or Amoo.

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.

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

Derivation of the name “stretchers.”

Comparison with conveyances of the hammock-kind.

The stretching apparatus or traverses.

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General plan
of packing
stretchers.

Framed stretch-
ers.

Carriage of
stretchers.

Stretchers only
suited for Euro-
pean bearers.

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

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.

All field stretchers are made suitable for being carried by the hands of bearers, including those which have arrangements for adapting them to be carried in carts or wagons; hence, they are not unfrequently specially designated "hand-litters." This designation has no value, however, for it is equally applicable to all other kinds of conveyances for sick and wounded carried by the hands of 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

* 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.

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.

Various forms
of stretchers.

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.

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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.

Dr. Millingen's
plan for obviat-
ing the faults
of the Penin-
sular stretcher.

Dr. Millingen's
stretcher good
for surgical
purposes.

Practical ob-
jections to
Millingen's
plan.

The faulty construction and many inconveniences 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.

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.

* See page 34.

† Army Medical Officer's Manual, 1819, p. 22. Sketches of this stretcher are given on pages 135 and 136. 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 139.

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 movements 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.

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

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,

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 stations, 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.

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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. XXIII.) shows the under surface of the stretcher with the handles raised, the canvas being stretched by folding traverses; the second (Fig. XXIV.) shows the appearance of the stretcher with its handles lowered and fixed in position as feet.

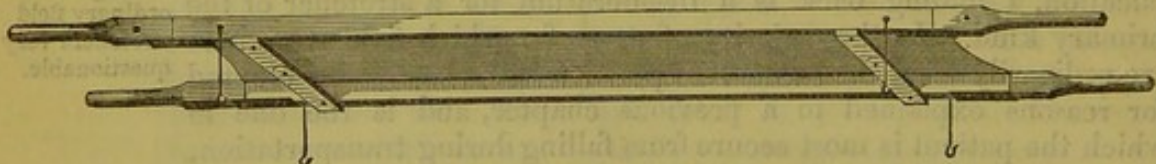


Fig. XXIII.—Under surface of United States Stretcher with its handles extended.

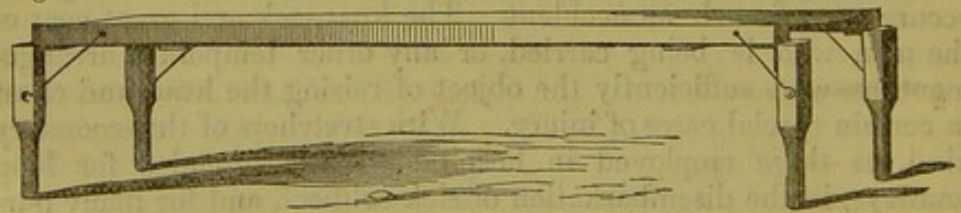


Fig. XXIV.—Side view of the same stretcher with its handles converted into feet.

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.

Bigg'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 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. 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.

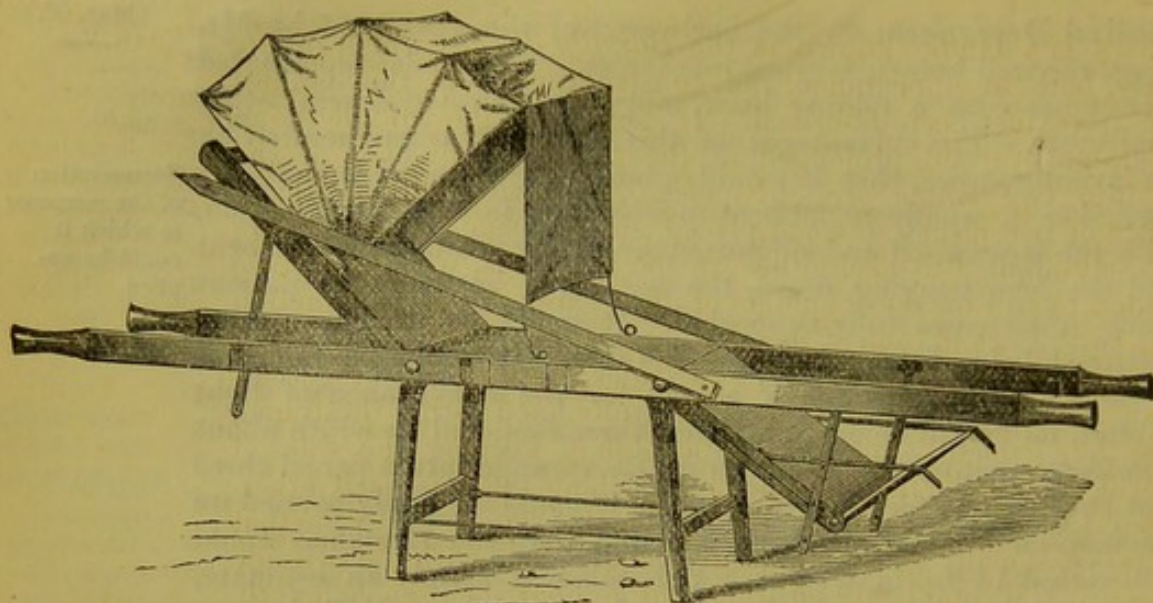


Fig. XXV.—Perspective view of Col. Clerk's Field Stretcher.

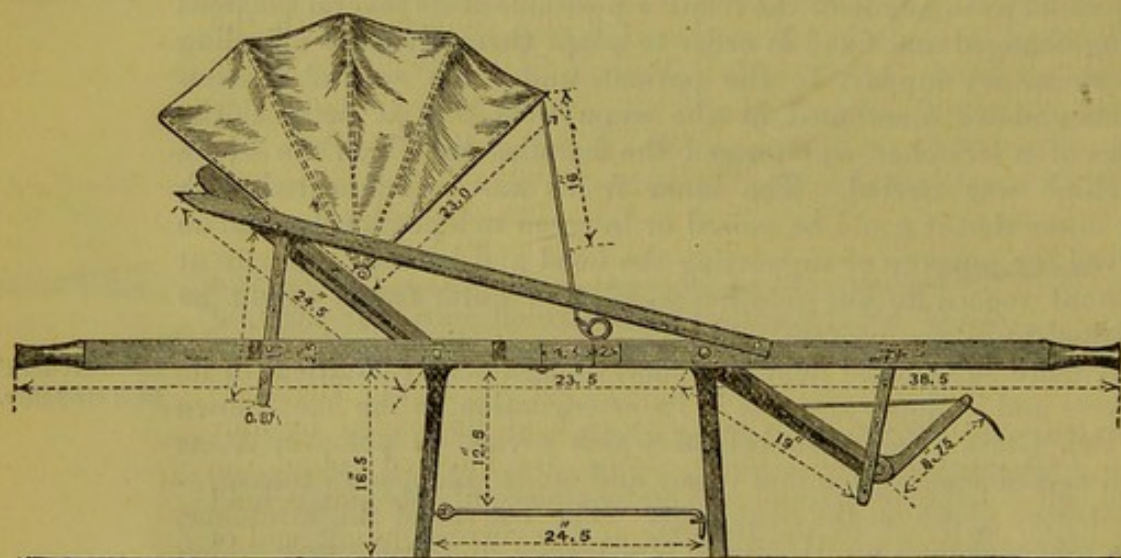


Fig. XXVI.—Side elevation of Col. Clerk's Field Stretcher, with measurements.

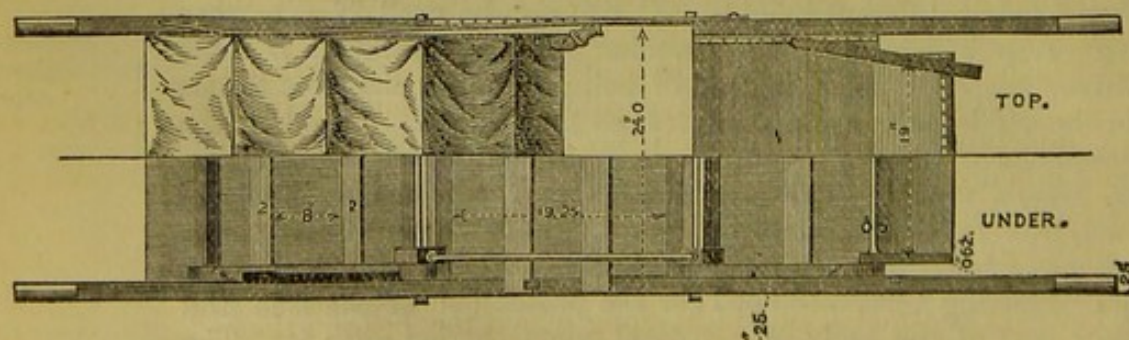


Fig. XXVII.—Upper and under plan of Col. Clerk's Field Stretcher, with measurements.

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

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," or 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.

M. Wahl's
"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 "Siège 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.

Another form
of "brancard
pliant."

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.

French hand-
litter for car-
riage of two
patients.

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.

Remarks on
models of pro-
posed convey-
ances.

Their use for
purposes of
illustration.

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

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.

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.

The field-stretcher authorized for general 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 made 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.

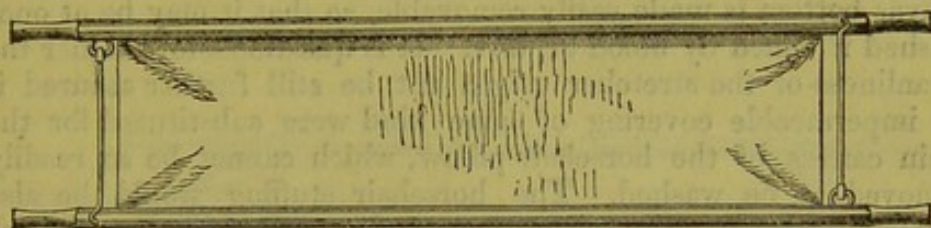


Fig. XXVIII.—Plan of British Regulation Stretcher, without pillow or straps, with traverses fastened.

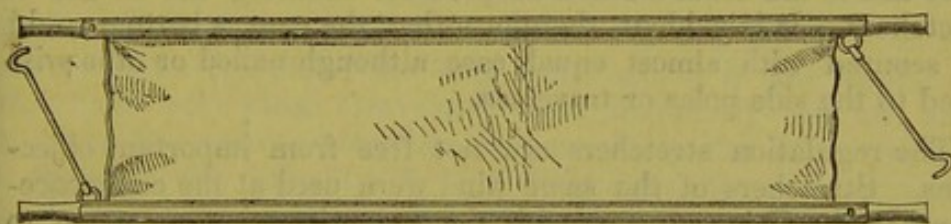


Fig. XXIX.—Plan of the same, with traverses unfastened.

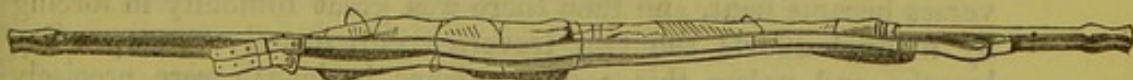


Fig. XXX.—The same, with pillow and straps packed for transport.

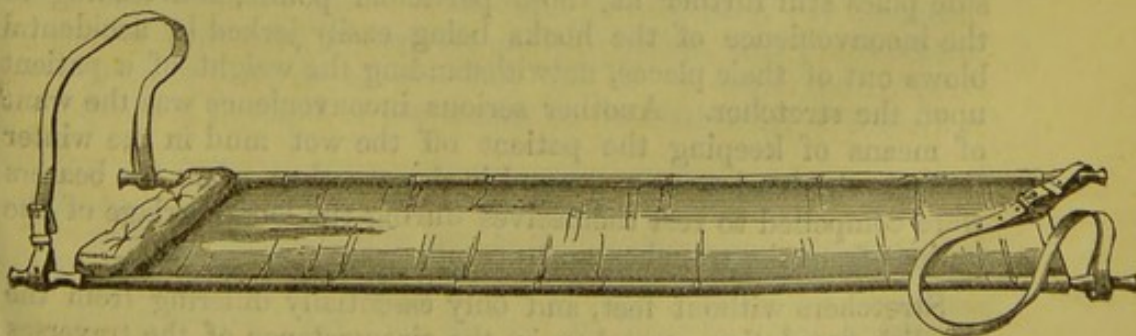


Fig. XXXI.—The same, with pillow and straps open for use.

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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-

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.

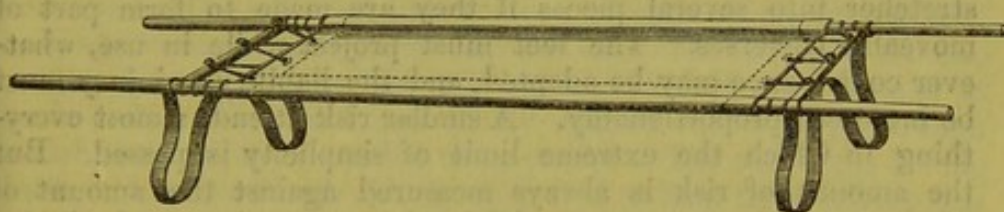


Fig. XXXII.—Stretcher of the old regulation pattern in the United States Army.

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.

† Dr. Chisholm, who served in the army of the Confederate States during the late civil war, has written, "Another objection to the framed litter, especially with feet, is "that they are often used as beds and lounges for officers, although this application "is expressly prohibited, and while thus used are frequently broken by persons "throwing themselves upon them, or sitting upon one of the sides. As the feet are "seldom required, it is an improvement to omit them in the construction of litters. Chisholm's Military Surgery, Columbia, 1864, p. 103.

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

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 counter-balance 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.

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.

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:—

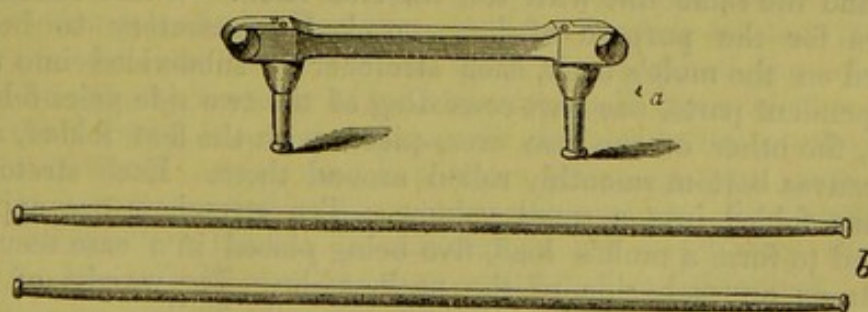


Fig. XXXIII.—(a) The traverse, and (b) the poles of the French Army Regulation Stretcher.

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

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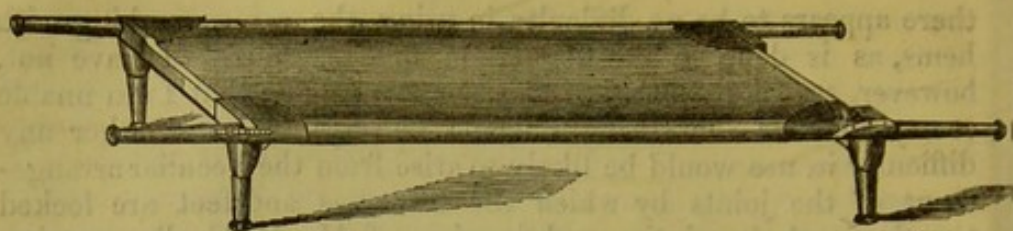


Fig. XXXIV.—The Regulation Stretcher of the French Army mounted.

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*."

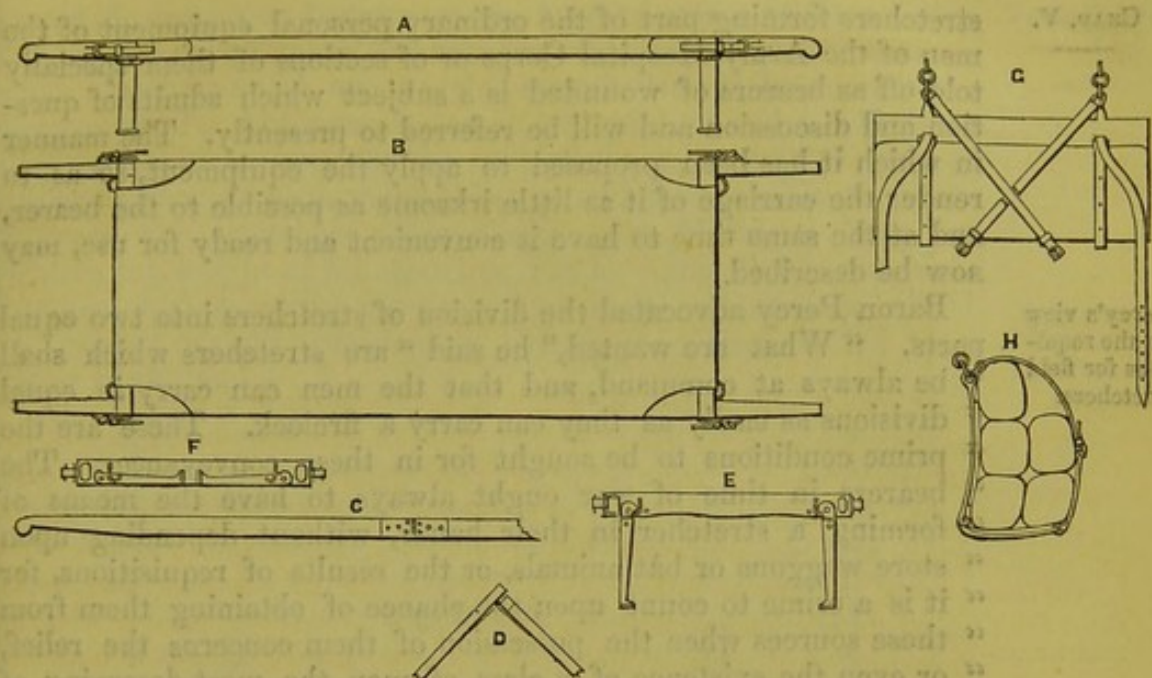


Fig. XXXV.—Portable Stretcher (Brancard à Hampes Brisées) adapted for carriage upon the back of a *bât* animal, for use in mountain warfare or under any circumstances where carriage in store wagons is not practicable.

- 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.

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 present arrangements 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

Stretchers with divided poles.

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

Stretchers carried by the bandsmen of regiments.

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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 requi-
sites 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.

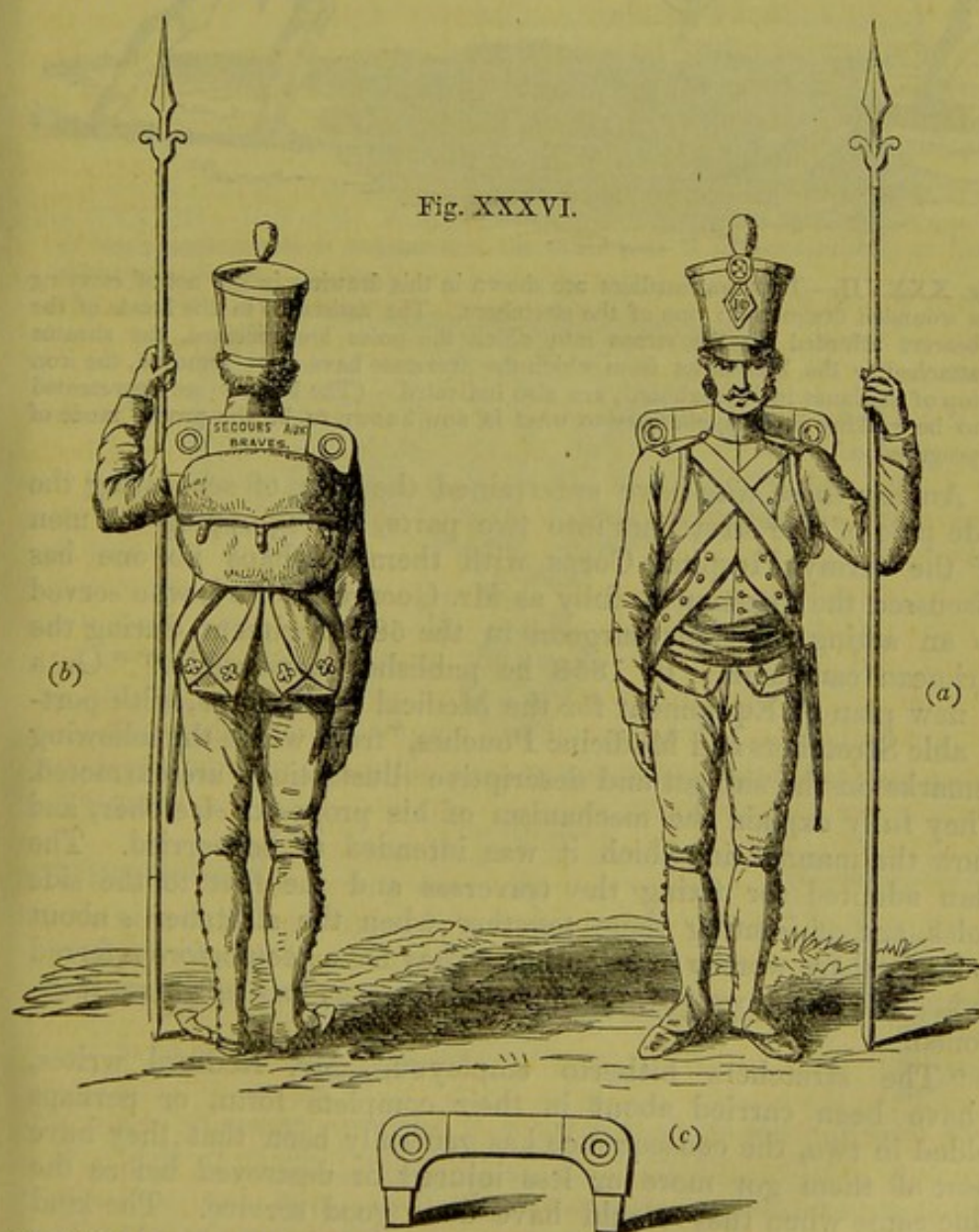


Fig. XXXVI.—(a.) Brancardier, equipped and armed. One of the traverses of the stretcher is carried upon the knapsack. Half the sacking of the stretcher is seen worn round the waist. The scabbard to receive the iron part of the lance when the latter is arranged for use as one of the stretcher poles is 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 portable 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 130.

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."

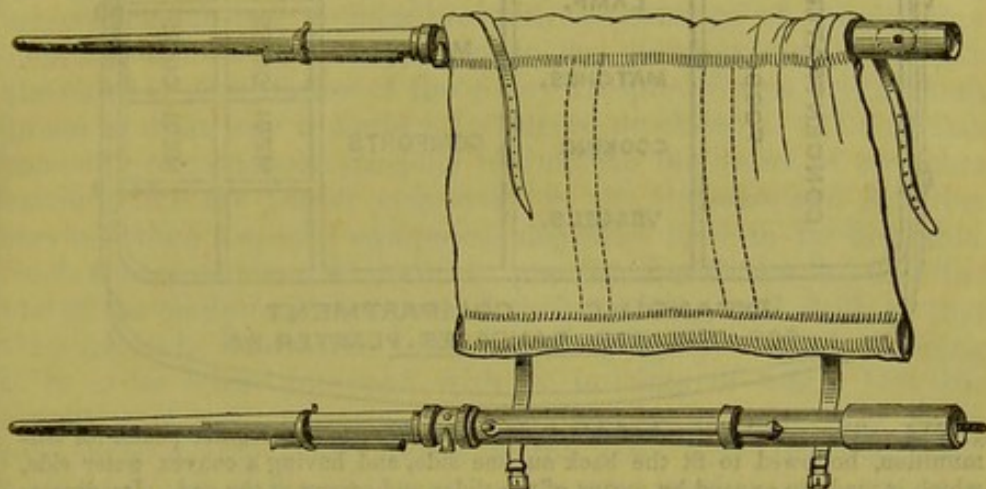


Fig. XXXVIII.—Half of Mr. Redford's Stretcher. This portion, however, is capable of being used should it happen that the other part is not immediately at hand, though this is not advisable.

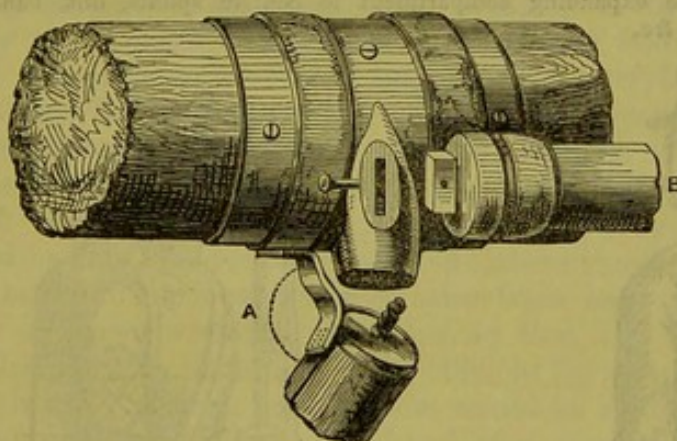


Fig. XXXIX.—The leg A, and cross-stay B, joints of the stretcher with the leather fittings.

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

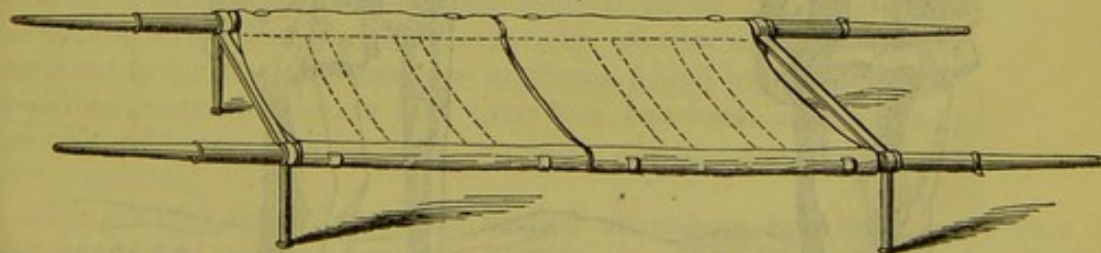


Fig. XL.—The stretcher complete. It is composed of two halves precisely alike, one of which is carried by every man, and any one half fits the other.

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.

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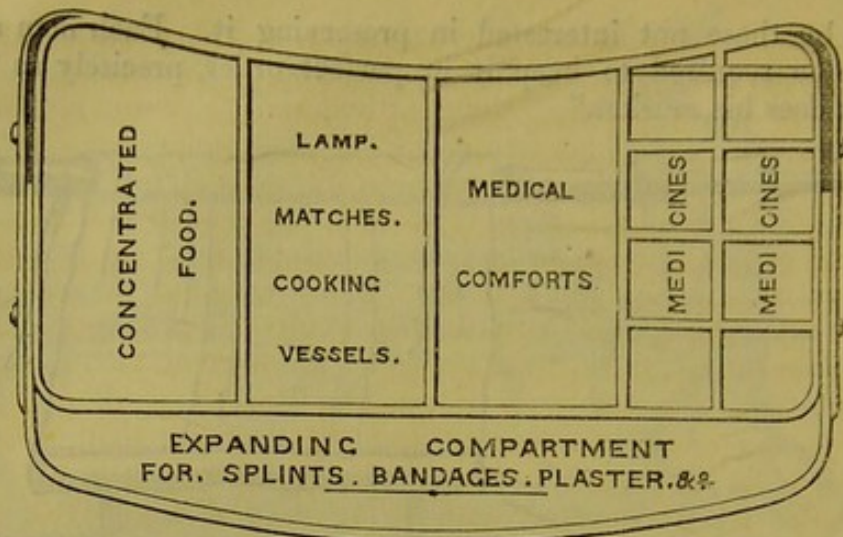


Fig. XLI.—The pouch formed of black leather similar to the regular pouch for ammunition, hollowed to fit the back on one side, and having a convex outer side, which is made to expand by means of the slides and screws at the end. Its dimensions are, 16 inches long, 8 deep, and 8 broad.

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 peak.

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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.

Propriety of special equipment for stretcher-bearers considered.

Objections to a system of special equipment for bearers of wounded.

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 inconveniences 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.

Framed stretchers.

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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 fold
ing 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 subjected."*

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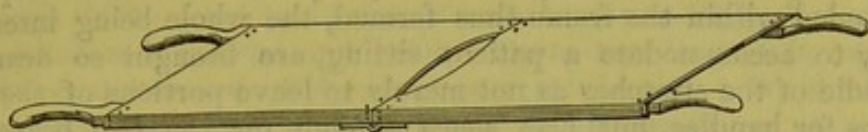


Fig. XLIII.—Halstead Stretcher.

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 pounds. 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.

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

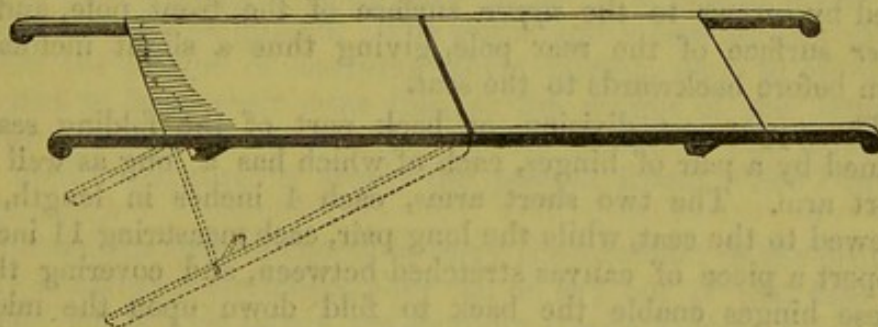


Fig. XLIV.—Framed folding Stretcher used by the Prussians in the war against Denmark in 1864.‡

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."

Framed stretcher for patient sitting.

* 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.

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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 girding for two bearers. All these parts are securely fastened together. The weight of the whole is 17 lbs. (See Drawing No. XLV.)

(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, $4\frac{1}{2}$ feet long, 1 inch broad, and $2\frac{1}{4}$ 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.

(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 employment 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.

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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.

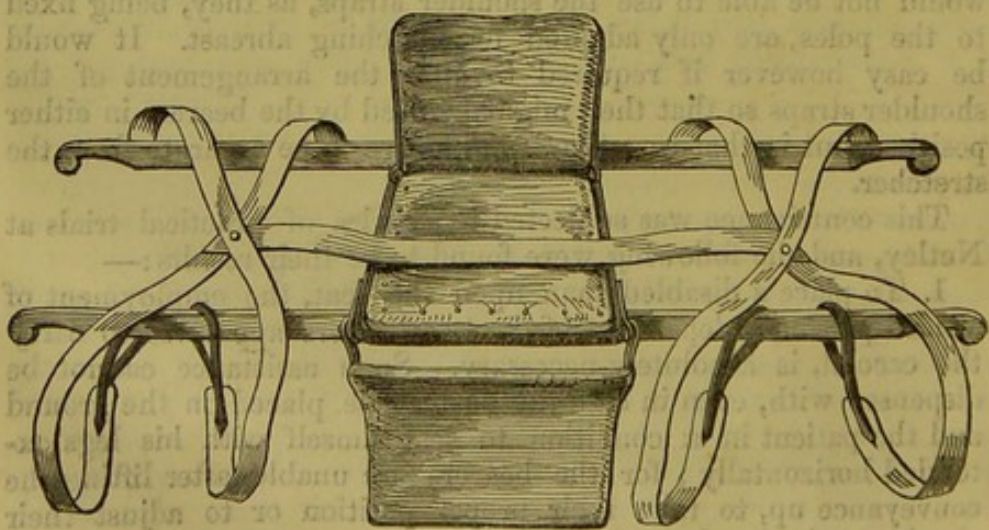


Fig. XLV.—Cacolet, or Chair Stretcher, for carriage by two bearers marching abreast, or in file.*

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

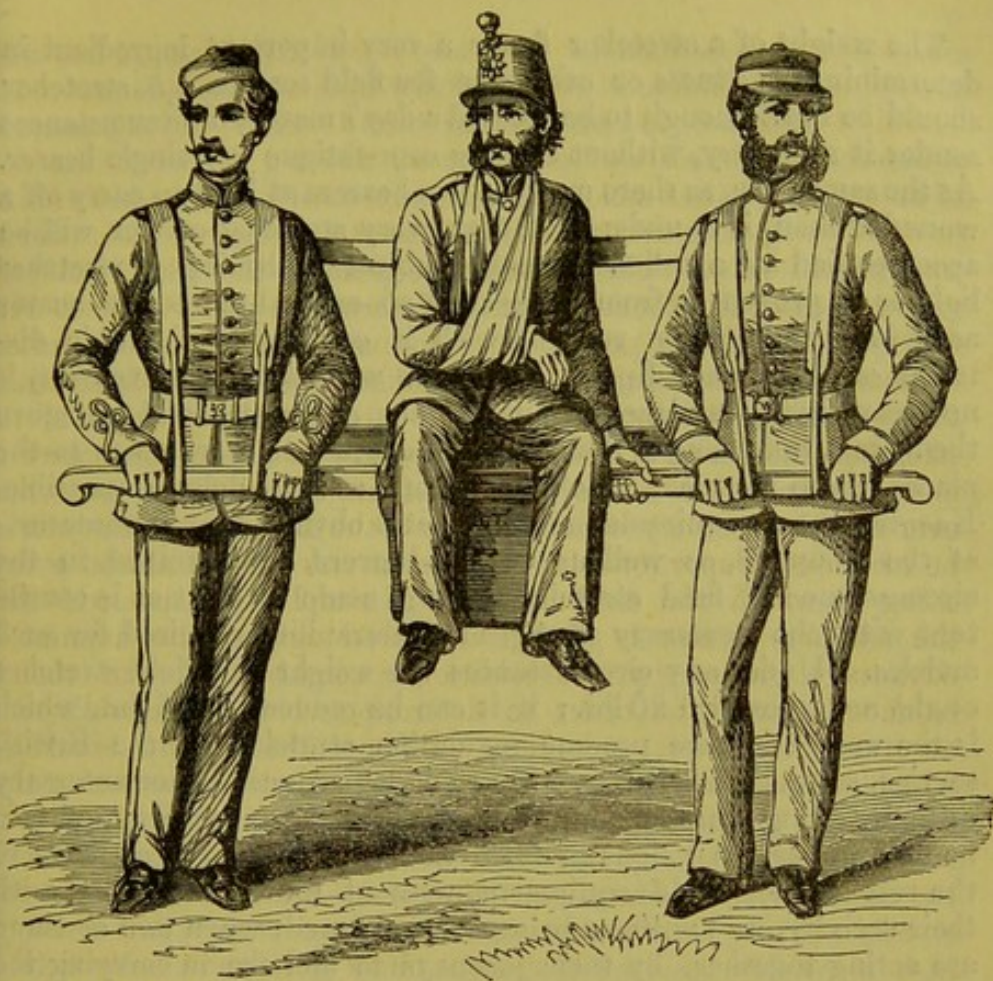


Fig. XLVI.—Chair Stretcher, with a patient, carried by bearers marching abreast.



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

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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.

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.

Berlin iron
net-work
stretcher.

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.

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

Iron-band
stretchers.

* 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.

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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 $2\frac{1}{2}$ inches broad and $1\frac{1}{2}$ 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.

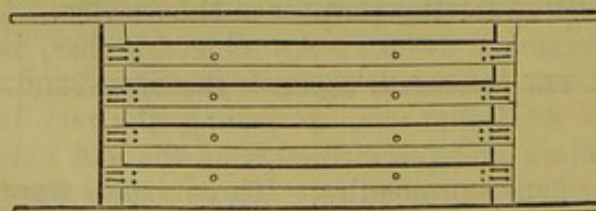


Fig. XLVIII.—Iron-band Ambulance Stretcher.

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.

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.

CHAP. V.

Arrault's
netting-
bottomed
stretcher.

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.

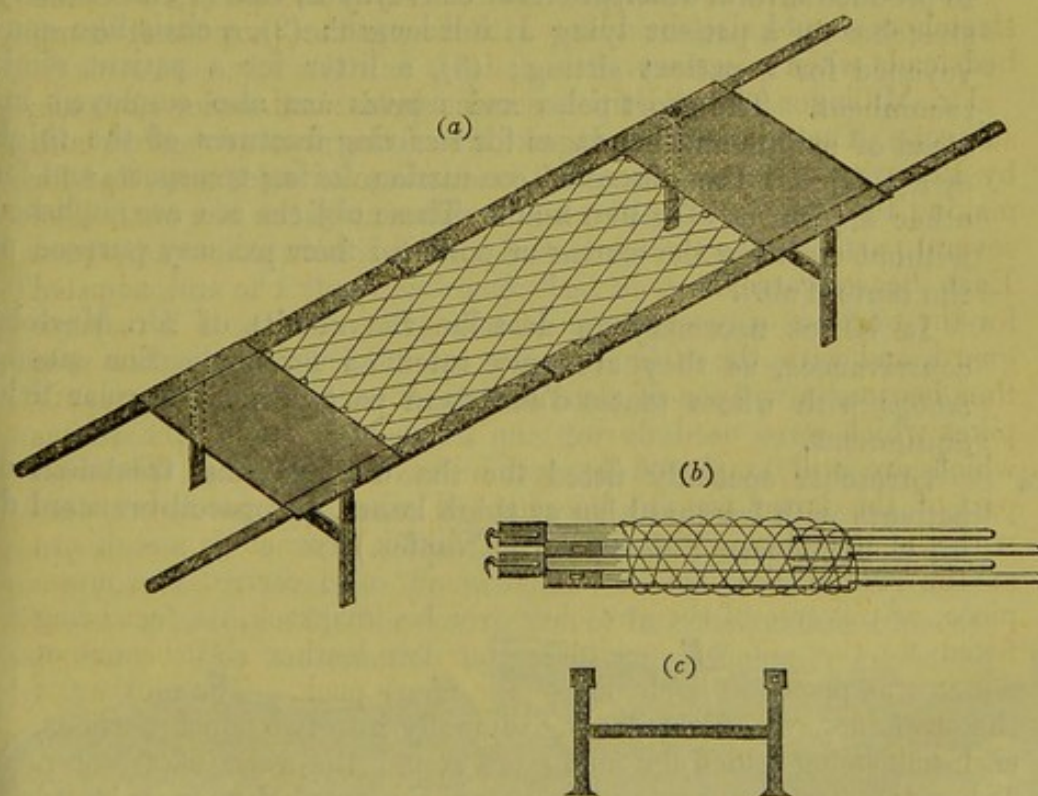


Fig. XLIX.—(a.) Arrault's Stretcher mounted and ready for use. The half-poles enter one into another and are fixed together by hooks.
(b.) The stretcher-poles, dismounted, and enveloped by the netting and canvas bottom.
(c.) Iron supports of the stretcher-poles, and feet of the stretcher.

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

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itself, often prevails among inventors to economize cost and material by making the same article not only capable for use as a stretcher, but also, when not required for this service, subservient to other useful hospital purposes. The general result of such attempts is, however, unsatisfactory, for the prime object of the conveyance becomes more or less interfered with. Either the stretcher is rendered too weighty or it becomes too complicated, so that it fails to meet the conditions which are essential to fit it for field service. A few of these special contrivances may be mentioned.

Brancard com-
presse.

This form of stretcher is an invention of Dr. A. Martrès, Médecin-Major of the French army. Its particular object is to utilize the tentes d'abri carried by French soldiers in campaigning by converting them into means of transport for the sick and wounded. By the addition of certain leather rings eight of the short poles of the tentes d'abri are joined so as to form the long poles necessary for carrying a patient recumbent, while the tente canvas is employed to form the litter.

By varying the application of these means Dr. Martrès contrives to produce several descriptions of conveyance, viz., (1), an ordinary stretcher for a patient lying at full length; (2), a chair-like conveyance for a patient sitting; (3), a litter for a patient semi-recumbent. The short poles and canvas are also employed instead of splints and bandages for securing fractures of the thigh or leg against the effects of concussion during transport, and for other appliances of a like kind. These objects are accomplished without unfitting the canvas or poles for their primary purpose of the tente d'abri.

It is not necessary to describe the details of Dr. Martrès' contrivances, as they are only intended for application among troops with whom tentes d'abri form part of their regular field equipment.

Palasciano's
stretcher.

Stretcher specially fitted for the carriage and treatment of patients with fractured leg or thigh bones. (*Appareil-brancard de M. le Professeur Palasciano, de Naples.*)

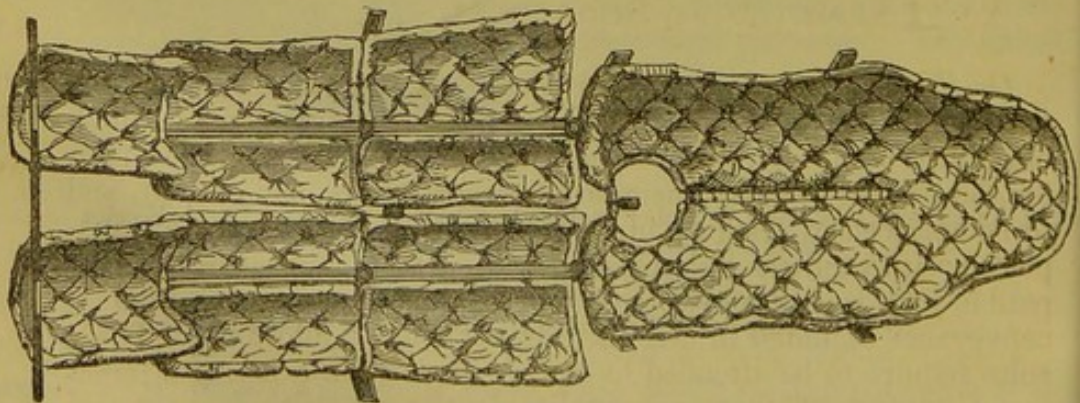


Fig. L.—Palasciano's Stretcher open for the reception of a patient.

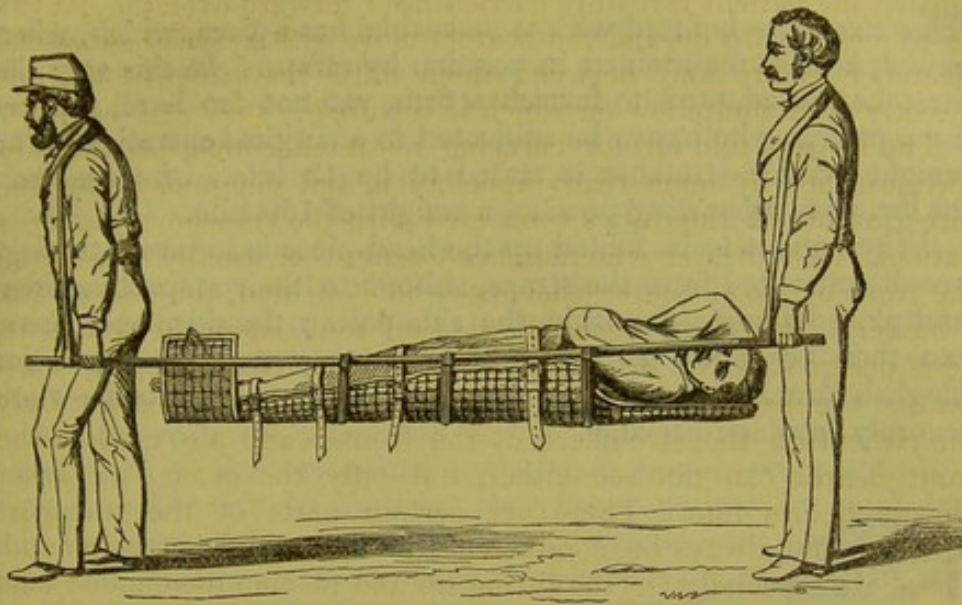


Fig. LI.—The same Stretcher with a patient being carried upon it.

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.

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.

Arrault's
stretcher and
operating table
combined.

* Brancard pliant, pouvant servir de table à opérations.

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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 kilo.

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.

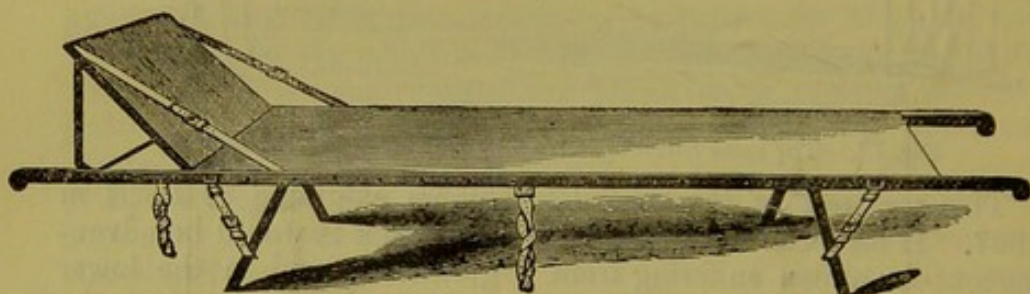


Fig. LII.—Arrault's Folding Stretcher, adapted to serve as an Operation Table.

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 regi-
mental ambu-
lance 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

inches at the head from the under stretcher, and closely connected with it at the foot. This inclination is given by the india-rubber springs, two sets of which, of different heights, are placed between the two stretchers. The framework of the under stretcher is strengthened by a strong girthing network, and is furnished with handles. Two small rollers, one before and the other behind, are connected with each of the side poles of this stretcher, to facilitate its insertion into and removal from the wagon, on the floor of which it is designed to be carried when in use. The length of the upper stretcher is a little over six feet; the lower is of the same length, but with the addition of the handles; the width of the bottom between the side-poles is one foot and a half. (For a description of the regimental ambulance wagon see page 419.) This stretcher can be used for carrying a patient by hand, but only for short distances, and then with special care, owing to the 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.

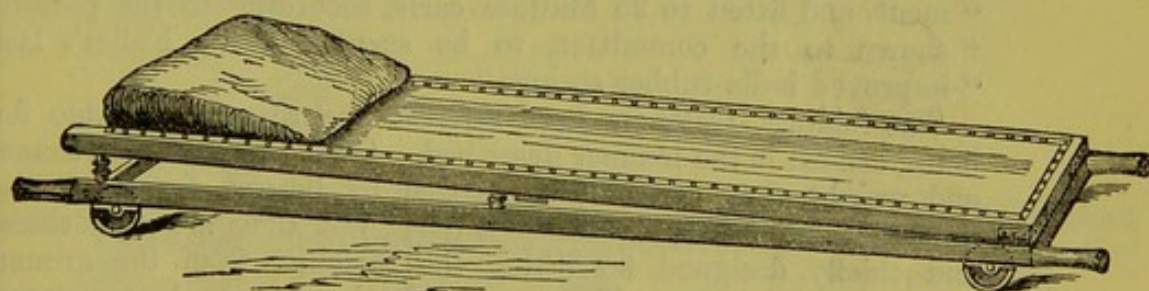


Fig. LIII.—Perspective view of the British Ambulance Wagon Stretcher.

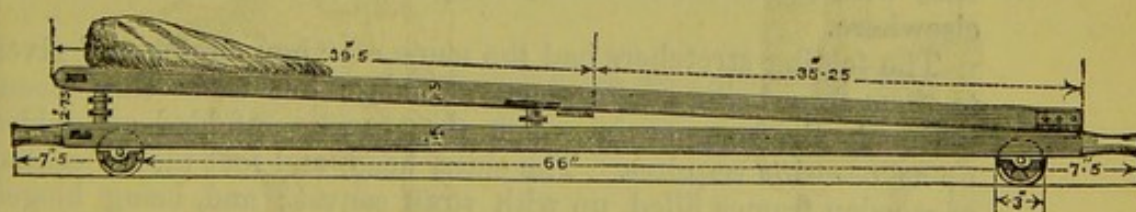


Fig. LIV.—Side elevation of the same, with measurements.

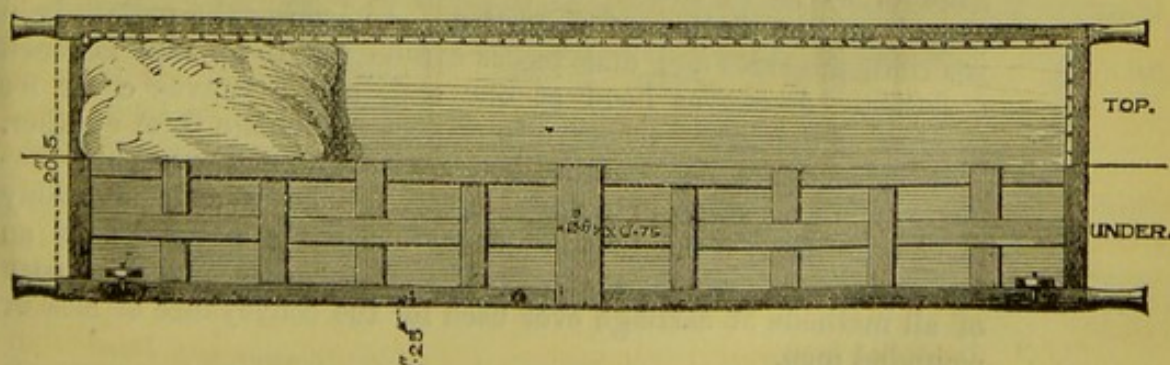


Fig. LV.—Upper and under plan of the same, with measurements.

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 ———
 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 department, 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.

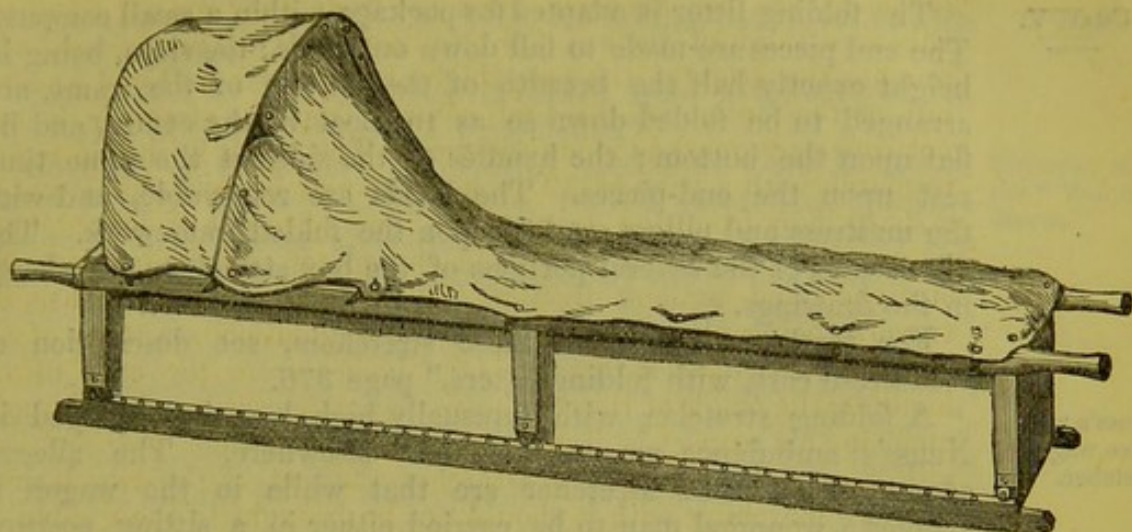


Fig. LVI.—Perspective view of Holmes's Box Stretcher used with the Maltese Ambulance Cart.

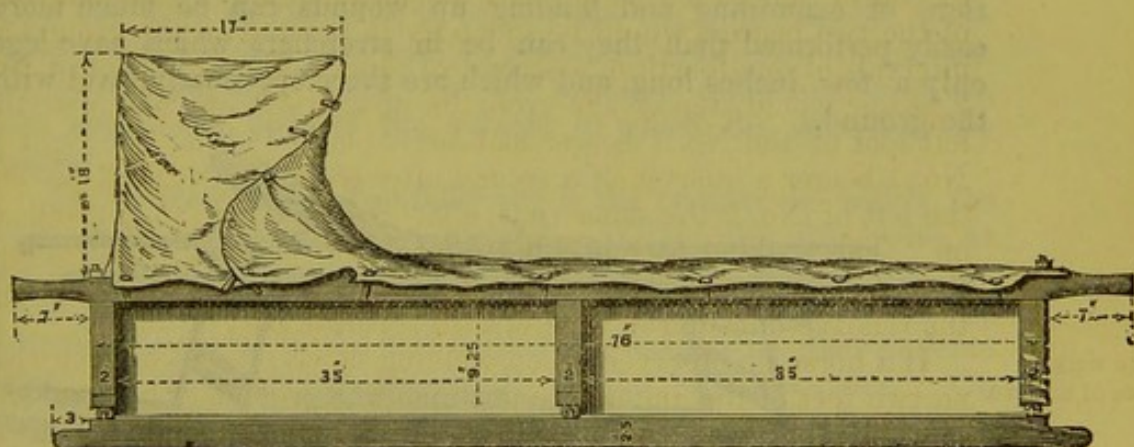


Fig. LVII.—Side elevation of the same, with measurements.

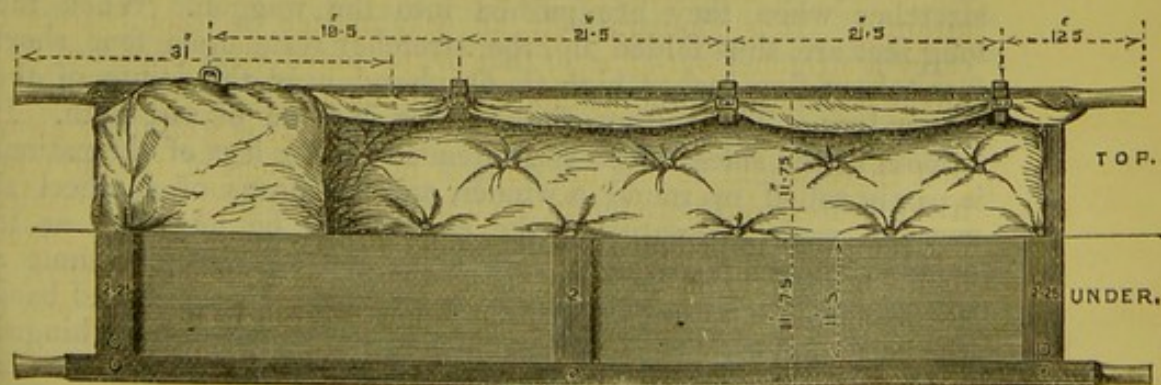


Fig. LVIII.—Upper and under plan of the same, with measurements.

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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 376.

Neuss's ambulance wagon 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.

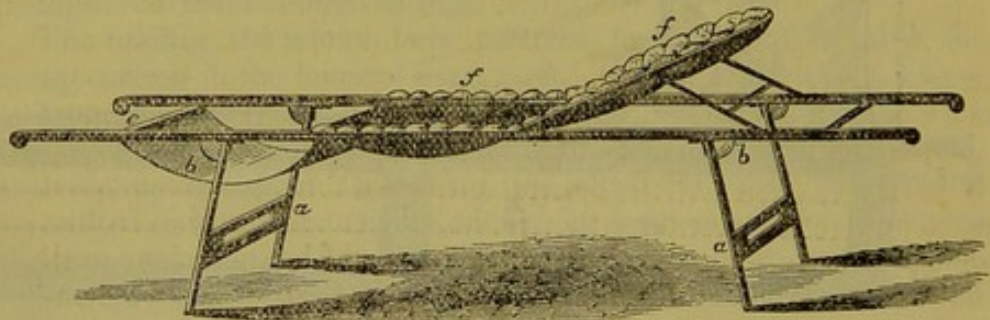


Fig. LIX.—Neuss's Ambulance Wagon Stretcher.

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

middle 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 French two-wheeled Ambulance Cart, known as the "Voiture Macou."—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.

Stretcher of
the "Voiture
Macou."

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 Schwerverwundete, p. 10. Berlin, 1864.

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are pushed home, and they exactly fit into the interior of the cart to which they belong. The width of each stretcher is $20\frac{1}{2}$ inches; the height of the back part of the stretcher is $12\frac{1}{2}$ inches. Two of these stretchers are carried in each cart, being separated by a narrow strip of wood which runs along the floor between them.

Russell's spring
stretcher or
hospital camp
bedstead.

This modification of the ordinary stretcher consists of two square wooden poles with handles, stretched apart by moveable angular iron traverses, with a firm sacking bottom. The latter is in one piece, and can be removed for being washed. The traverses are arranged at their ends so as to fit into iron sockets placed to receive them on the side-poles. Shoulder-straps are provided for the bearers. The chief peculiarity of the stretcher consists in the nature of the folding legs which are attached to the under surfaces of the side-poles. They are made of elastic wrought iron or steel, curved in such a way as to act both as supports to the stretcher and as springs. When folding up, the legs are bolted to the under surface of the corresponding side-poles; when unfolded, they are locked in position by iron side-stays. The fastening is very simple and secure in each case. The frame of the stretcher is made very substantial, and hoops supporting a canvas cover are applied to it by being let into sockets outside the side poles. The hoops are hinged in the middle so as to double up for packing. There is a moveable leather head-piece which acts as a pillow. The weight of the stretcher, with canvas cover, hoops, pillow, and straps complete is 54 lbs. 14 oz.

According to Captain Russell, the inventor, "this stretcher was made expressly for camp hospital and camp use, to remove badly wounded men. The springs prevent shock in changing bearers, and keep the patient from the damp ground; only requiring a blanket to form a comfortable bed. It rolls in a small compass, and is quickly put in or out of use. The simply arranged cover is not to keep out sun and weather, but to prevent the depressing effect of witnessing mutilations, any amount of air can be admitted in a moment. It is believed to be also peculiarly serviceable for railways, hospitals, and general use, to convey bad accidents along the streets to medical aid."

There is no doubt that this stretcher is well calculated to meet the requirements of a hand-litter under the circumstances last mentioned. It is an easy kind of conveyance for very weak patients, or for persons badly injured. But it is questionable whether the length of the spring legs would not render them liable to be easily broken; the heavy weight of this stretcher would also counteract many of its advantages as an article for camp hospital use. On the other hand, it is to be remembered, as regards general use with fixed hospitals, that the separation of the stretcher into detached pieces for economizing space in package is a matter of less utility than would be the additional strength and security which a solid framework would afford.

Stretchers combining the qualities of the Primary with those of the 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.

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.

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 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.*

Dr. Gauvin's
spring-stretch-
er.

* Page 251, where also will be found a sketch of the stretcher off as well as on the wheels.

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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 ($12\frac{1}{2}$ 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 wagon, from a wagon 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

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 wagons 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.

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.

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.

Qualities
necessary to
constitute a
good primary
or field stretch-
er.

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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 all the eight qualities before named seems therefore to be a matter still to be desired.

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.

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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.

Contrivances
designed to act
as temporary
substitutes for
stretchers.

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.

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.

"*Brancard à
l'improviste.*"

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

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Beaufort's
impromptu
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

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.

Beaufort's
impromptu
stretcher.

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

Certain rules
require to be
enforced in the
use of stretch-
ers.

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

Ill consequences of a rough mode of carriage.

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.

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.

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.

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.

Carriage of patients with chronic wounds.

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.

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-

Arrangements necessary before lifting a wounded man on a stretcher.

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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.

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.

(b.) Arrange-
ment on
starting.

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.

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

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.

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 versa*, and this broken step must be maintained throughout the whole distance of the transport.

The bearers to
break step in
marching.

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.

Special train-
ing needed to
enforce this
rule among
drilled soldiers.

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Reasons of the
rule for break-
ing 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 their 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 prin-
ciples 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.

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 $3\frac{1}{2}$ inches; with a man upon it, the arms being then stretched to the full by the weight, the dip is $4\frac{1}{4}$ inches. When the pace is 20 inches, the dip, without a man upon the stretcher, is only $1\frac{1}{2}$ inches; with a man, $2\frac{1}{4}$, 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

Effect of
length of pace
in marching
with stretchers.

* "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.

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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 would 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.

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.

Bearers to be as nearly equal in height as possible.

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*.

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

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.

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

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 ascending sloping ground with bearers of different heights.

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

When descending sloping ground with

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bearers of different heights.

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

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

Position if he is being carried down hill.

Stretchers not to be carried over walls or fences.

Mode of carrying stretchers across dykes or hollows.

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

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.

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.

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.

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.

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.

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.

Stretchers not to be carried on the shoulders of bearers.

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.

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

INTRODUCTORY REMARKS ON DHOLIES.

Characteristic
features of
dhoolies.

In what re-
spects they
differ from
stretchers.

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.*

SECTION I.—DESCRIPTION OF PARTICULAR FORMS OF DHOLIES.

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

* The derivations of these several terms have been given to me by my friend Dr. De Chaumont, 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.

DHOLEY, 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.

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

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. 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.

Indian hospital dhooley.

Dhooley-bearers.

Purposes to which hospital dhoolies are applied.

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 stragglers who have been unable to come on with the column."

Proportion of dhoolies issued to European regiments in India.

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

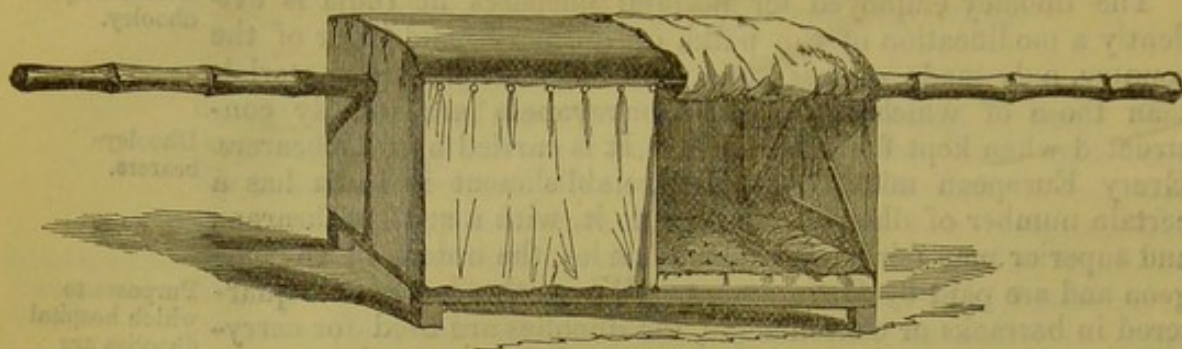


Fig. LX.—Bengal dhooley and bamboo pole complete, half of the side-curtain being thrown over the top in order to show the interior, with the mattress and pillow.

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 $2\frac{1}{2}$ 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. 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.

The end-pieces.

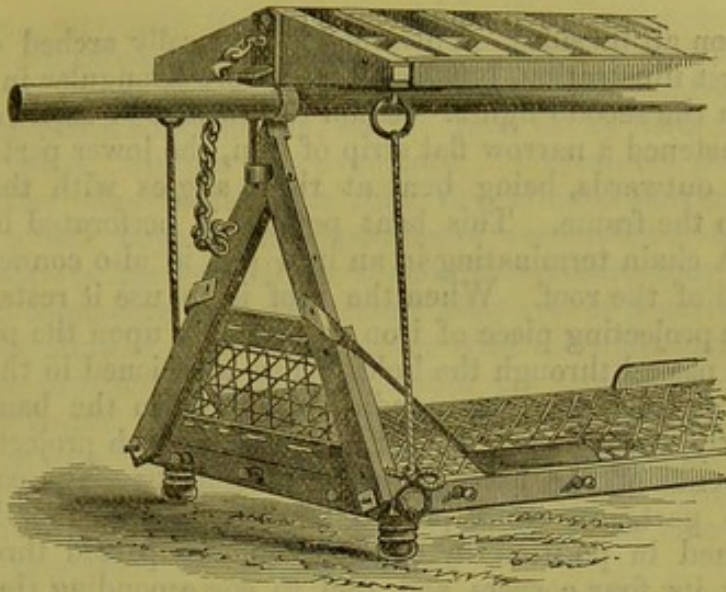


Fig. LXI.—Sketch of part of the framework, showing the manner in which the ends are secured to the horizontal part of the litter, and also the plan by which the cover is maintained in position.

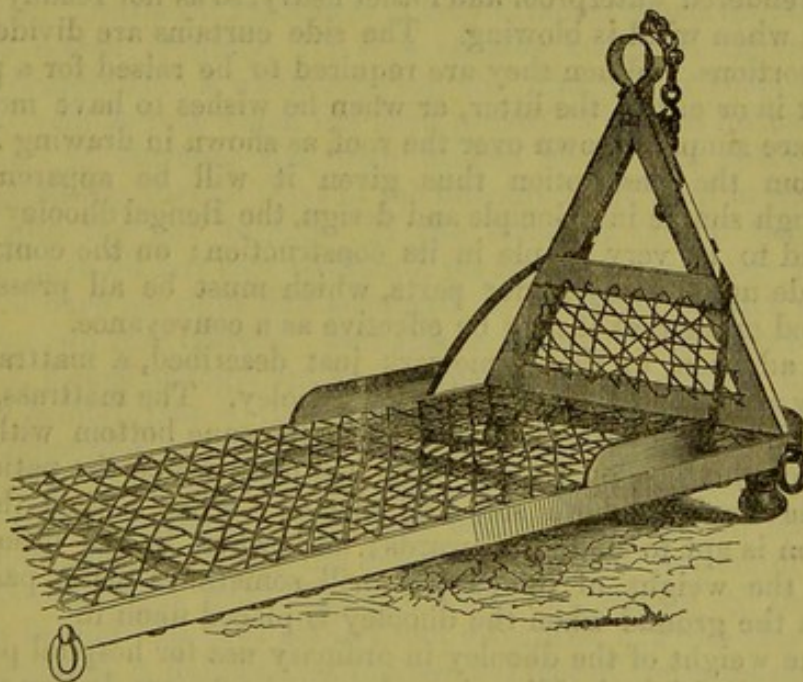


Fig. LXII.—The cover, curtains, and pole removed, showing its condition when used as a camp bedstead.

The Pole.—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.—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

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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.

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 mattress and pillow are issued for use with each dhooley. The mattress, 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 dhoo-
ley.

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 (mattress and pillow) - -	0	18	36
Cover (frame and painted canvas) - -	0	10	20
Pole (bamboo) - -	0	11	22
Total - -	1	28	136

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 $2\frac{1}{2}$ 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.

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Training of
dhooley-bear-
ers 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.

System on
which dhoolies
are carried in
India.

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.

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among them, and also the mutual support which the bearers are 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 con-
struction of
dhoolies.

Inspector-Ge-
neral Taylor's
dhooley.

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 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.

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." *

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

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

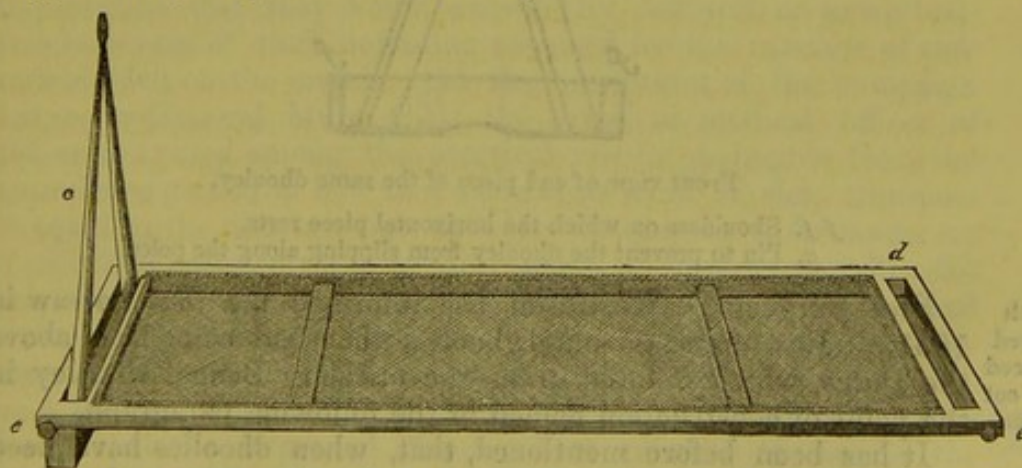


Fig. LXIII.—The cot, and one of the upright pieces in situ, of Inspector-General Taylor's dhooley.

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.

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

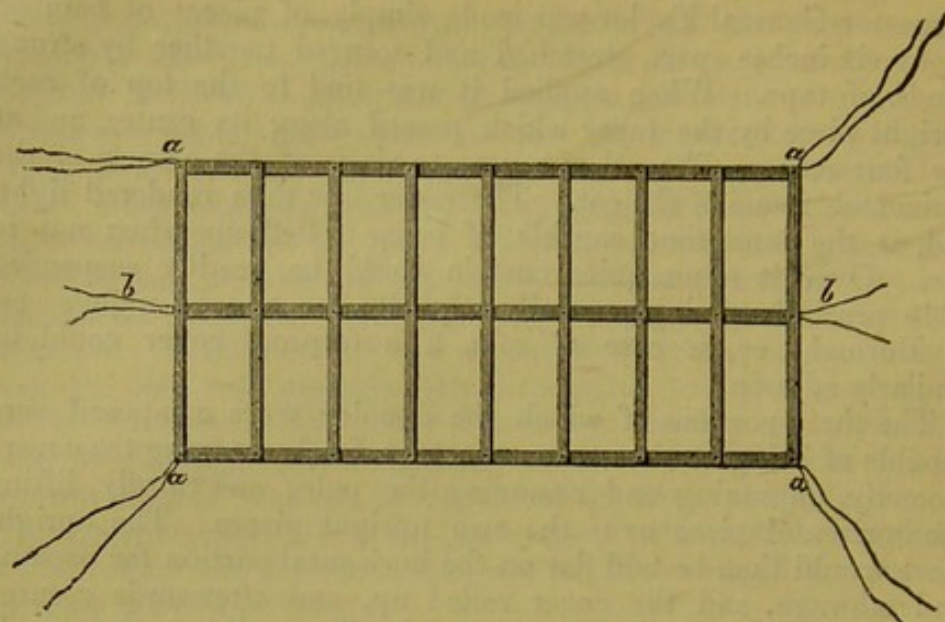
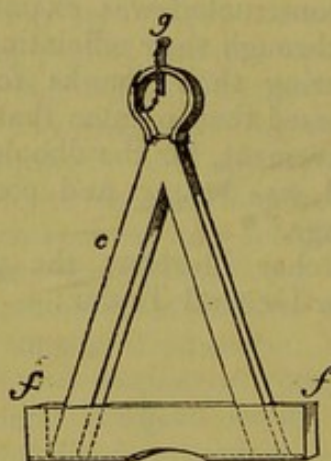


Fig. LXIV.—Frame of Cover of Inspector-General Taylor's dhooley.

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



Front view of end piece of the same dhooley.

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 protection 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.

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 Peking 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.

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

Dhoolies constructed for use in the China war of 1860.

Improved China dhooley.

* "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. 1227a and 1228a.

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Improvement
in regard to
weight.

patterns and models have been three, viz.: 1. Diminution of weight; 2. An improved plan of package of the several parts of 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.

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. Improve-
ment 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. *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.

3. Improved protection against breakage of the feet.

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.

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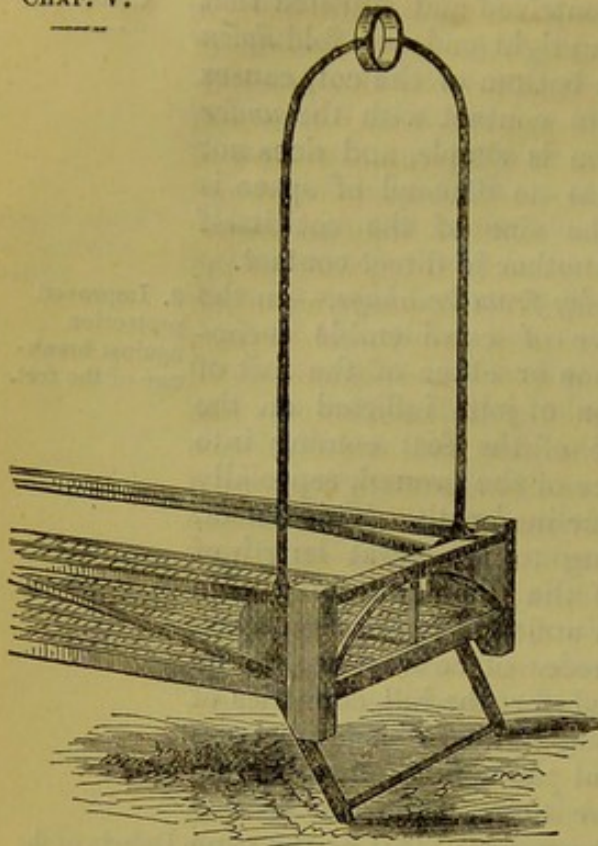


Fig. LXV.—End of improved dhooley. Pole-ends fixed inside the frame of the dhooley and connected with folding iron feet. Mil. Surg. Museum, Spec. No. 1,227 a.

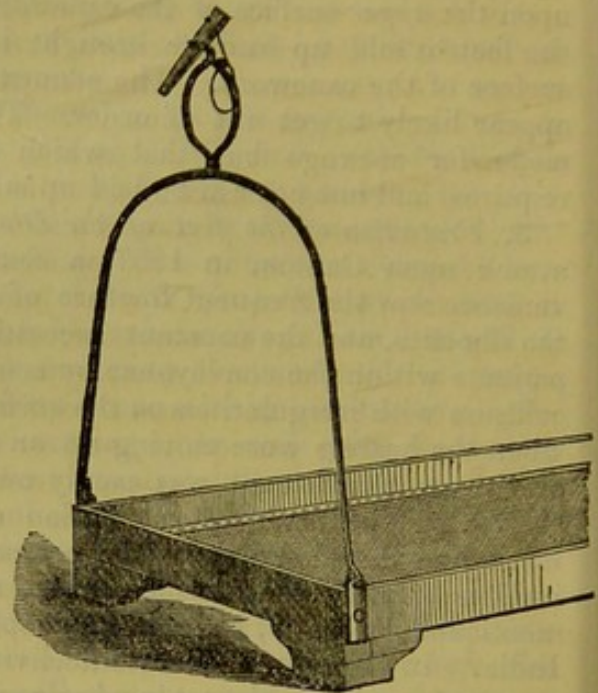


Fig. LXVI.—End of dhooley constructed for use in China during the war of 1860. Pole-ends fixed outside the frame of the dhooley. Mil. Surg. Museum, Spec. No. 1,228 a.

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

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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.

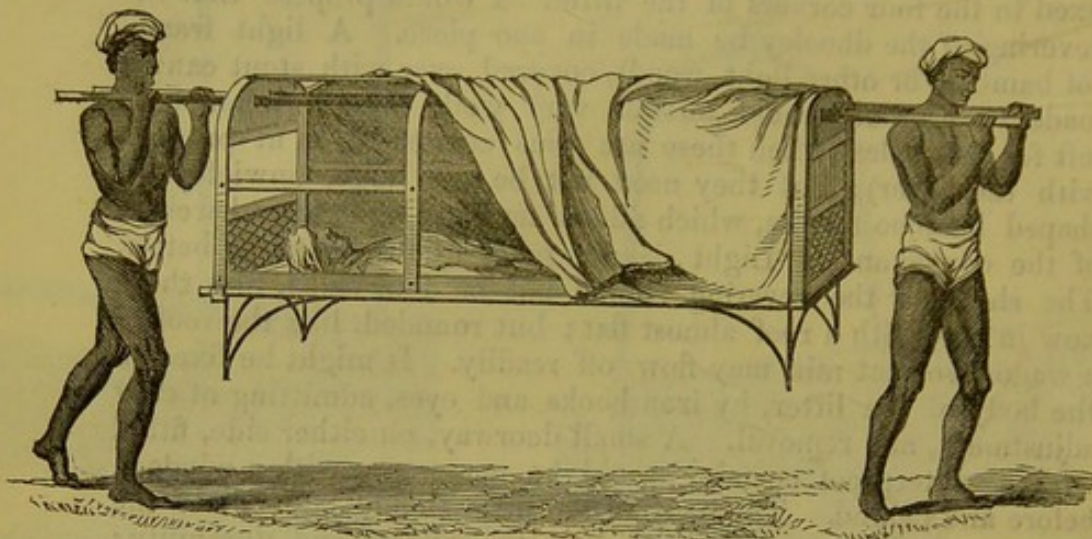


Fig. LXVII.—Dr. Francis' Improved Dhooley.

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.

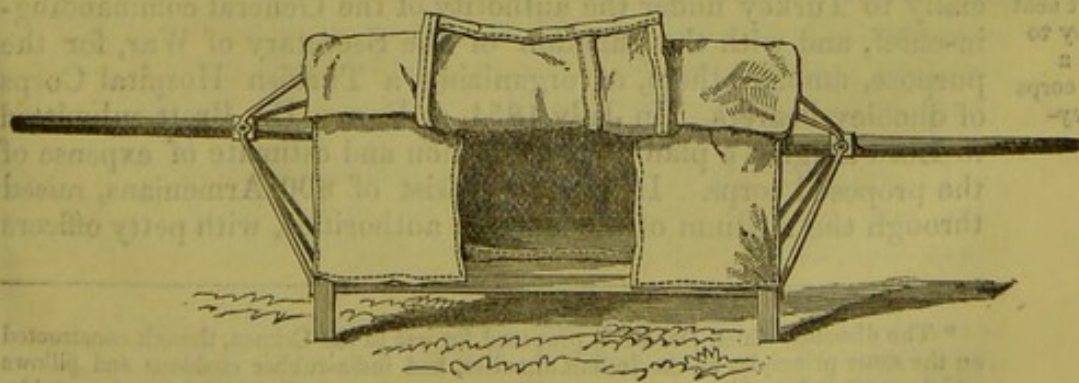


Fig. LXVIII. Madras Dhooley. The entrance curtain, or door, of the dhooley is turned over the roof and shows the interior of the conveyance.

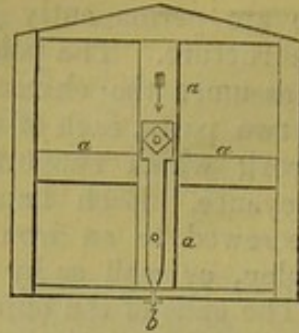


Fig. LXIX.—Interior View of end of Madras Dhooley.

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

y. 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*.

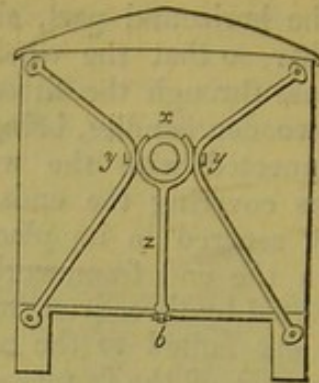


Fig. LXX.—External View of end of Madras Dhooley.

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 CONTINUED 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.

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."

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.

The Indian dhooly 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-

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

Objections to the employment of Turkish dhooly bearers.

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

Objections to employing East Indians in Europe.

Universal praise of the dhooly as a conveyance.

* 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.

† "*Notes on the Wounded from the Mutiny in India*," by G. Williamson, M.D., Staff-Surgeon, Lond. 1859, page 123.

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Explanation of
the great esti-
mation in
which dhoolies
are held as
sick convey-
ances.

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.*

* 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

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.

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

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

Present difficulties of obtaining dhooley-bearers.

"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 Bengali 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.

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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.

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

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.

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.

* 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.

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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.

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 Kimerdy 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."

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

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.

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

* 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.

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 dhoolies in
 India imprac-
 ticable.

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.

“ 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.”

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India imprac-
ticable.

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.”

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.

Supplies of
dhoolies
advised by
Bengal
Sanitary
Commission.

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.

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.

The Palki.—The description previously given of the Madras Palkis. 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.—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

Muncheels.

Their construction.

Their defects.

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- 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 distinction 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.
- Jhampons.** *Jhampons.*—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 a dhooley were 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, it were 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 jhampons 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.**

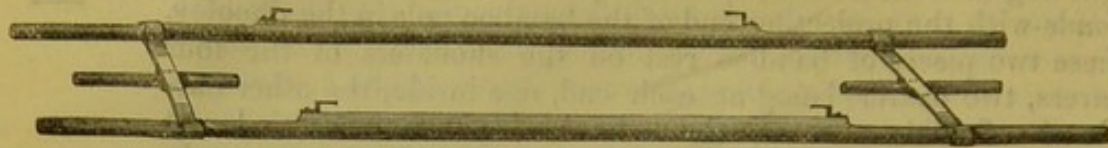
right angles to it, is secured a short piece of bamboo, which corresponds with the projecting end of the bamboo pole in the dhooley. These two pieces of bamboo rest on the shoulders of the four bearers, two bearers being at each end, one inside, the other outside the flexible traverse, when the conveyance 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.

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.

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

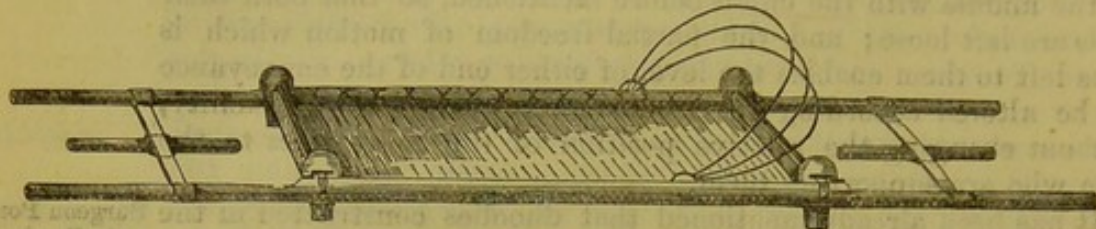
* A model of this conveyance is in the Mil. Surg. Museum at Netley, Spec. No. 1,245.

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.

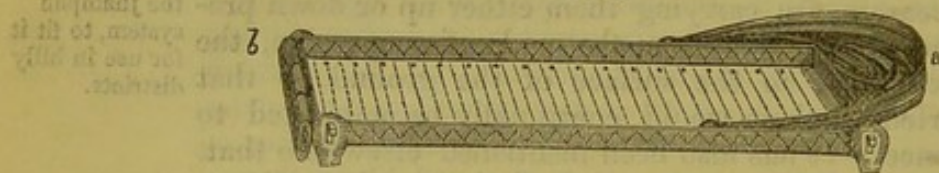
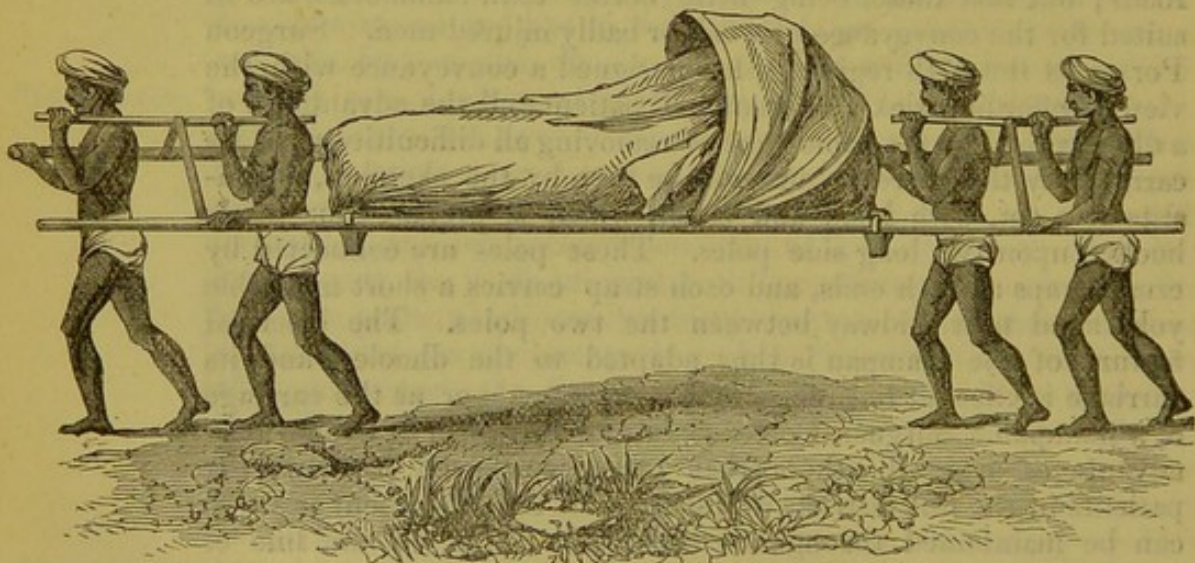
Surgeon Porter's Hill-dhooley as a Hospital Cot, the Jhampan Frame being removed, the Hood *a* lowered, and the Cover *b* rolled at the Foot of the Cot.

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 palanquien 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 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.

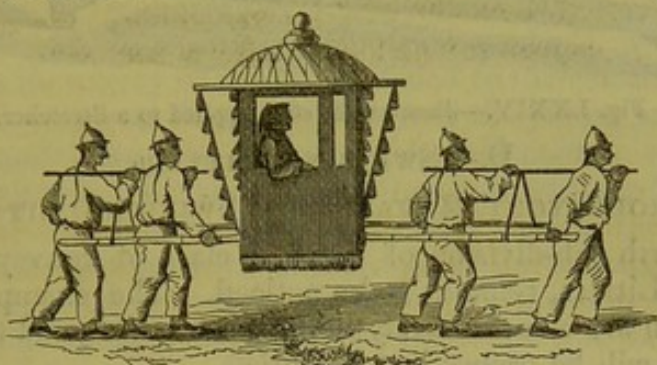


Fig. LXXIII.—Chinese Palanqueen, carried Jhampan fashion.

Staff-Surgeon Guthrie, in 1863, when in medical charge of Lohoo-Ghât 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-ghât 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 dhoories used in the plains.

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

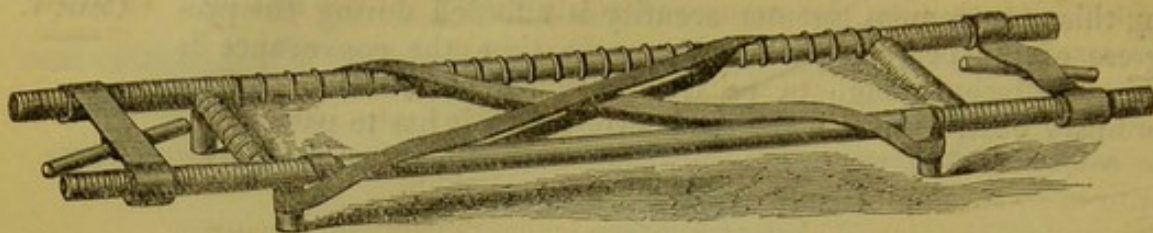


Fig. LXXIV.—Jhampan System applied to a Stretcher.

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.

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

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

* 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.

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.

Their special design.

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.

Swinging litters applied to railway carriages.

DESCRIPTION OF PARTICULAR FORMS OF SWINGING LITTERS.

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

Construction of Col. Crichton's swinging-car.

* 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.

Instructions for
using this litter.

Directions for
the mode of
using this litter.

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 sack- ing 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.

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.

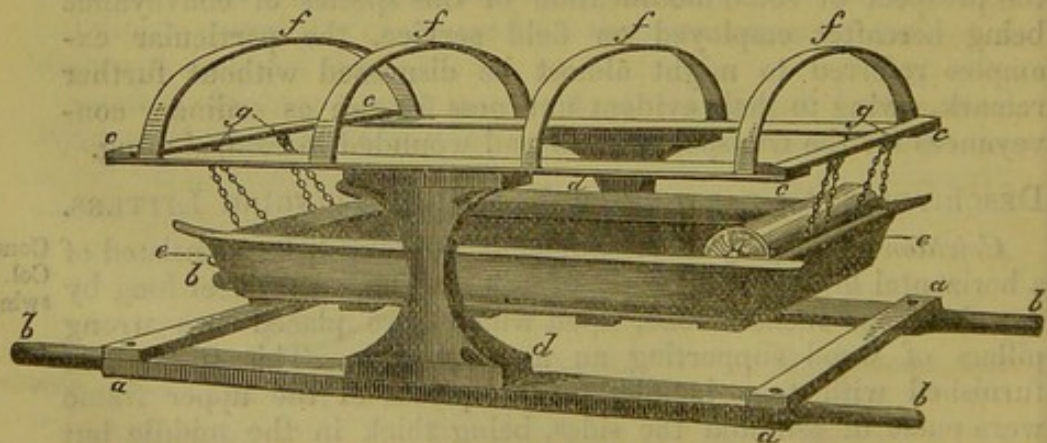


Fig. LXXV.—Col. Crichton's Swinging Car. *a a a*. Lower frame. *b b b b*. Handles. *c c c c*. Upper elastic frame. *d d*. Pillars supporting the upper frame. *e e*. The cot. *g g*. Four iron hooks from which the cot is suspended. *f f f f*. Four hoops for supporting a cover.

Sommier-bran-
card.

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.

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.

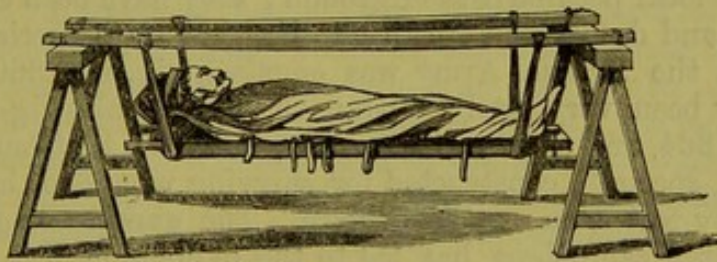


Fig. LXXVI.—The *Sommier-brancard* or swinging stretcher. The stretcher is suspended by elastic bands from two poles.

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.

Stretchersslung
within carts
and wagons.

CLASS II.—CONVEYANCES WHEELED BY MEN.*

GENERAL OBSERVATIONS.

CHAP. V.

Wheeled stretchers only recently introduced.

Objects aimed at by their use.

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 suitability 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.

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.

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.

CHAP. V.

To act as substitutes for mule transport.

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.

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 forepart 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.—During the period of the Crimean war, in February 1855, a surgeon in practice in London, Mr. G. Evans, published an account of a hand-wheel litter which he had caused to be constructed as a subsidiary appliance, or addition, to the ordinary means for the conveyance of wounded from a field of battle. It was designed so as to be capable of carrying either one or two wounded men, one being in a recumbent, the other in a sitting position, and could be wheeled by one or carried by two bearers, according to circumstances. The drawing will sufficiently explain the nature of its construction without further description.*

This conveyance was planned, according to its designer, to combine the following advantages:—

(a.) Where the ground is favourable two wounded men, with their arms, can be removed on it by one man.

(b.) Where the ground is too rough for the wheels to be used it can be carried so loaded by two men as an ordinary litter.

(c.) The back can be raised or lowered, to give the recumbent patient whatever degree of inclination the nature of his wound makes desirable.

(d.) The back at the same time forms a commodious canteen, under lock and key, for the following important medical and surgical necessities: canteen of water, canteen of brandy, a drinking cup, field tourniquets, lint and tow, plaister and ban-

* The original litter made after the designs of Mr. Evans is now in the Museum of Mil. Surg. at Netley. Spec. No. 1,261.

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 immediately it is landed.

In April 1855 the litter thus described was examined by a Board of Army Medical Officers in London. Their report was unfavourable to its introduction into the military service. The weight was considered to be too great for the conveyance to be conveniently drawn by manual labour notwithstanding the aid of its wheels, or to be carried, when divested of them, in the way that the ordinary stretcher is carried.

Evans' litter not approved on examination.

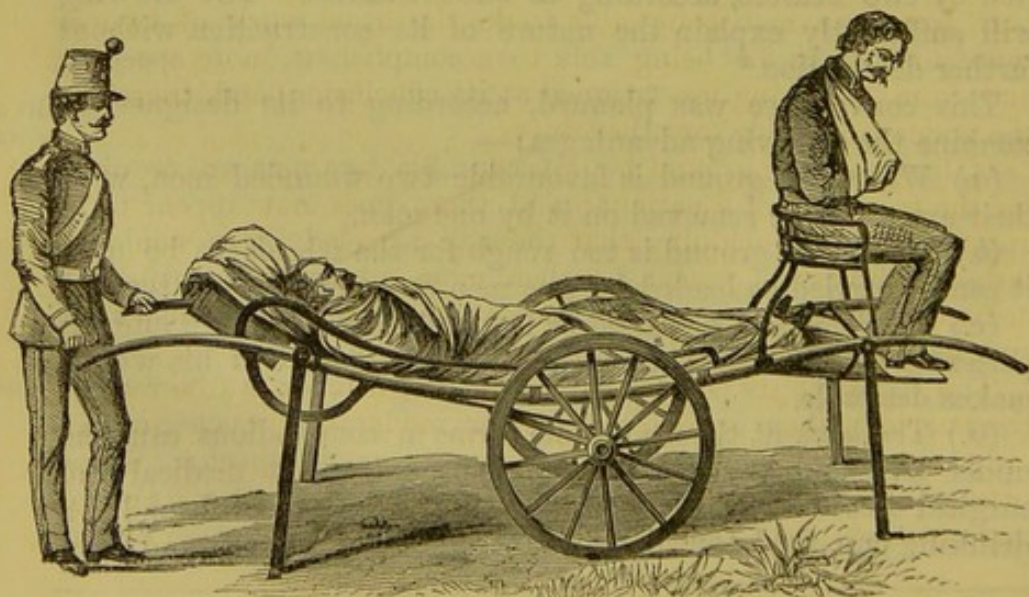


Fig. LXXVII.—Evans' Hand-wheel Litter.

Ordinance 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.”

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Ordinance
ambulance
barrows.

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 Peking, 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 lower provinces. The extensive and easy means of river carriage which were found, however, to exist almost up to the walls of Peking obviated the need of using these conveyances, and, among other circumstances, prevented the opportunity from being afforded of testing practically the utility of the hand-barrows for ambulance transport.

Ambulance
wheelbarrows
sent to China
in 1860.Origin of these
conveyances.

The China ambulance barrow (Fig. No. LXXVIII.) has the general appearance of a small cart open in front but closed at the sides and behind. In this state it forms a suitable cart for the conveyance of stores or provisions from the rear to the front, being capable of being drawn by a single man or small horse placed between the shafts.

When about to be arranged for sick-transport purposes a change in the arrangement of the cart has to be made. The hind board

CHAP. V.

Adaptation of
the China bar-
row for car-
riage 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. LXXIX.). 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.

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.

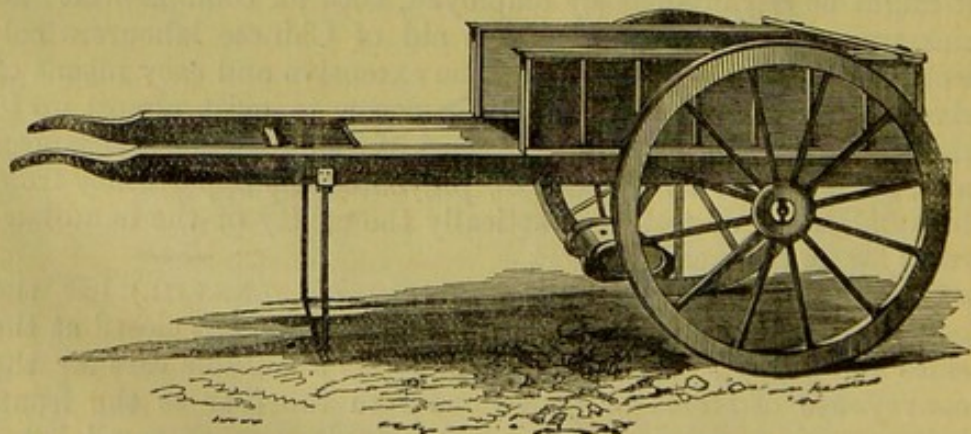


Fig. LXXVIII.—Ambulance Barrow (China pattern), arranged as a Commissariat Store Cart.

* Spec. No. 1,345a in the Mil. Surg. Museum.

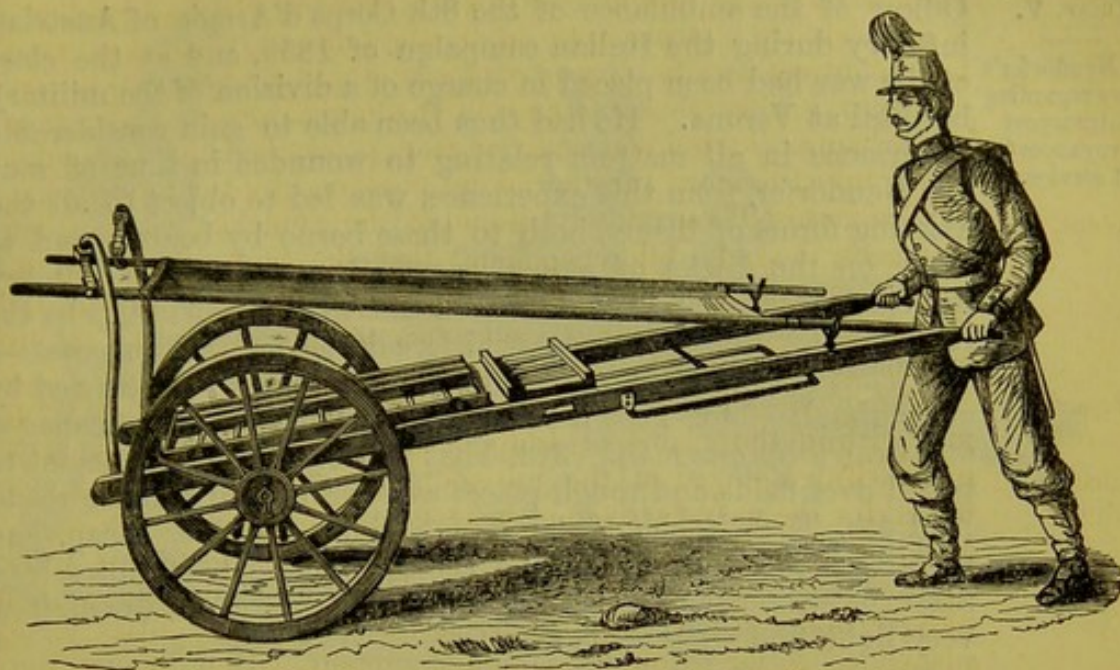


Fig. LXXIX. Ambulance Barrow (China pattern), with the Stretcher ready for carrying a Patient, but without the Hood.

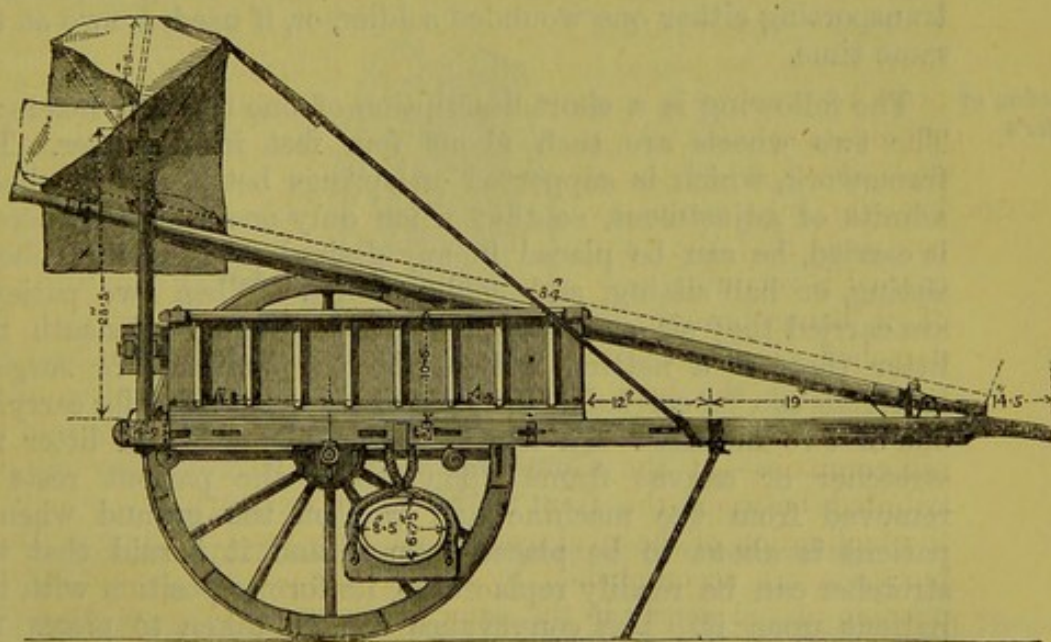


Fig. LXXX. Side Elevation of Ambulance Barrow (China pattern), with Measurements.

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

Neudörfer's
hand-wheel
litter.

* "Handbuch der Kriegs-Chirurgie, ein Vade-Mecum für Feldärzte, nach eigenen Erfahrungen bearbeitet," von Dr. J. Neudörfer, etc., etc., Erste Hälfte. Leipzig, 1864.

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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.

The illustrations numbered LXXXI. and LXXXII. 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.

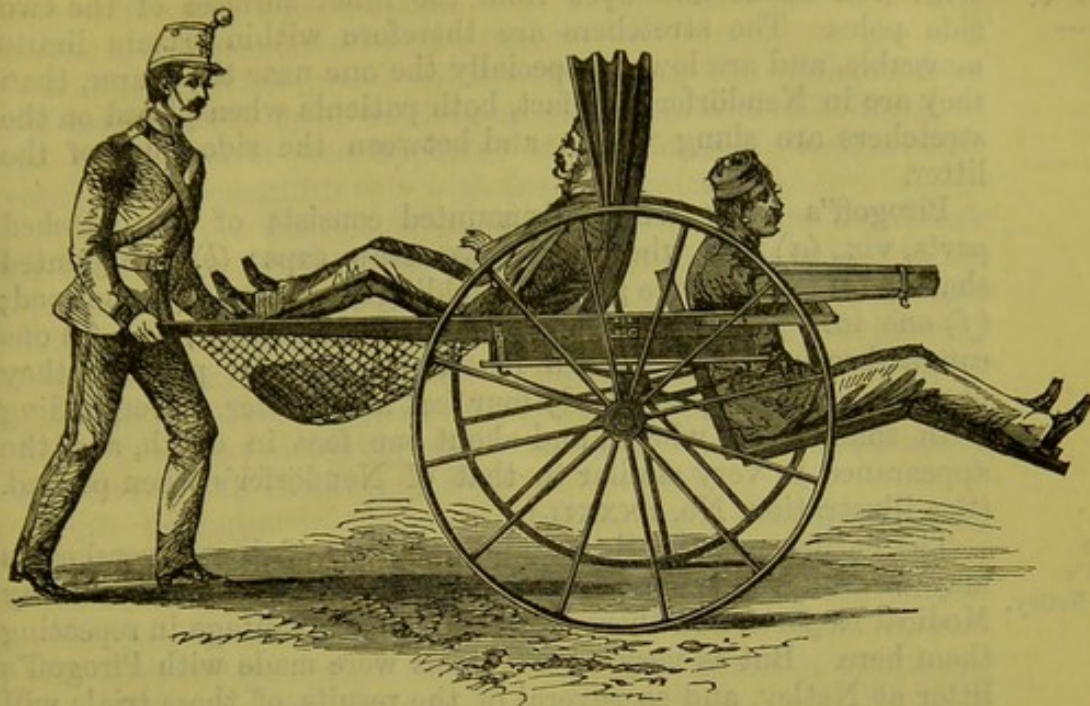


Fig. LXXXI.—Neudörfer's Two-wheeled Litter, for the transport of one, or two, wounded soldiers.

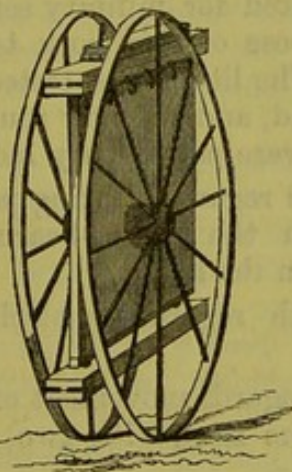


Fig. LXXXII.—Neudörfer's Litter folded up and packed for carriage.

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 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

Pirogoff's
wheeled litter.

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. LXXXII.)

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.

* 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.

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Results of
trials made at
Netley of Piro-
goff'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 counter-weight 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.

The results of the experiments under these several heads having thus been noticed, the following remarks suggest themselves:—

Conclusions arrived at regarding Pirogoff's wheeled litter.

(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 $4\frac{1}{2}$ 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

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 ———
 Conclusions
 arrived at re-
 garding Piro-
 goff'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.

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.

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.

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-

Position of
patient on
Neuss's litter.

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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.*

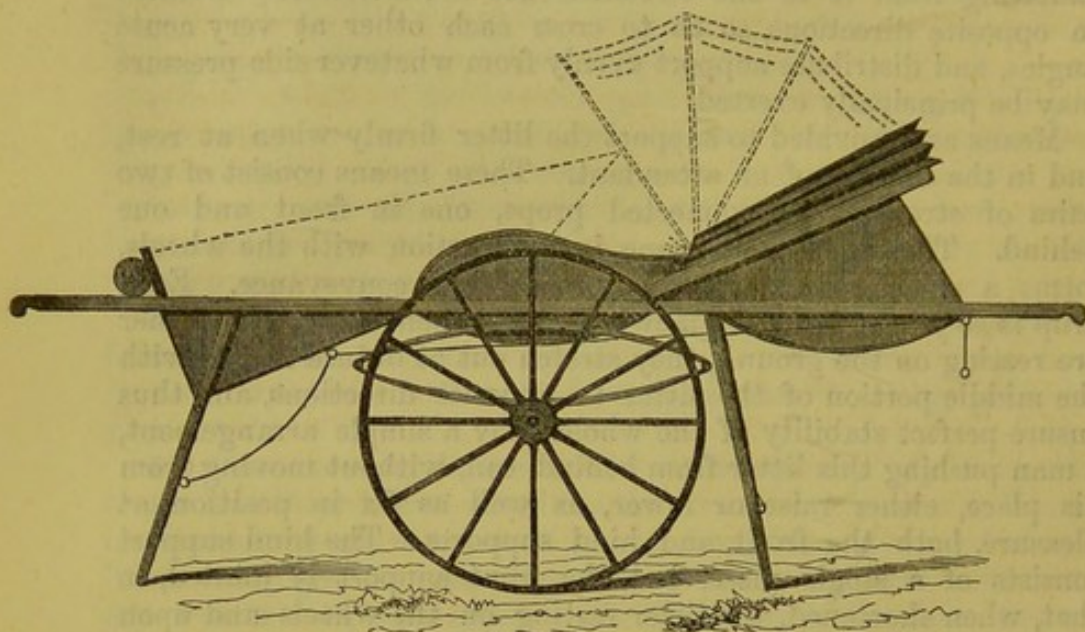


Fig. LXXXIII.—Side view of Neuss's Two-wheeled Litter. (Scale of $\frac{1}{2}$ inch to 1 foot.) Copied from Dr. Gurlt's pamphlet before quoted. The dotted lines indicate the manner in which the sailcloth hood and cover are used when required to protect a patient from rain or sun.

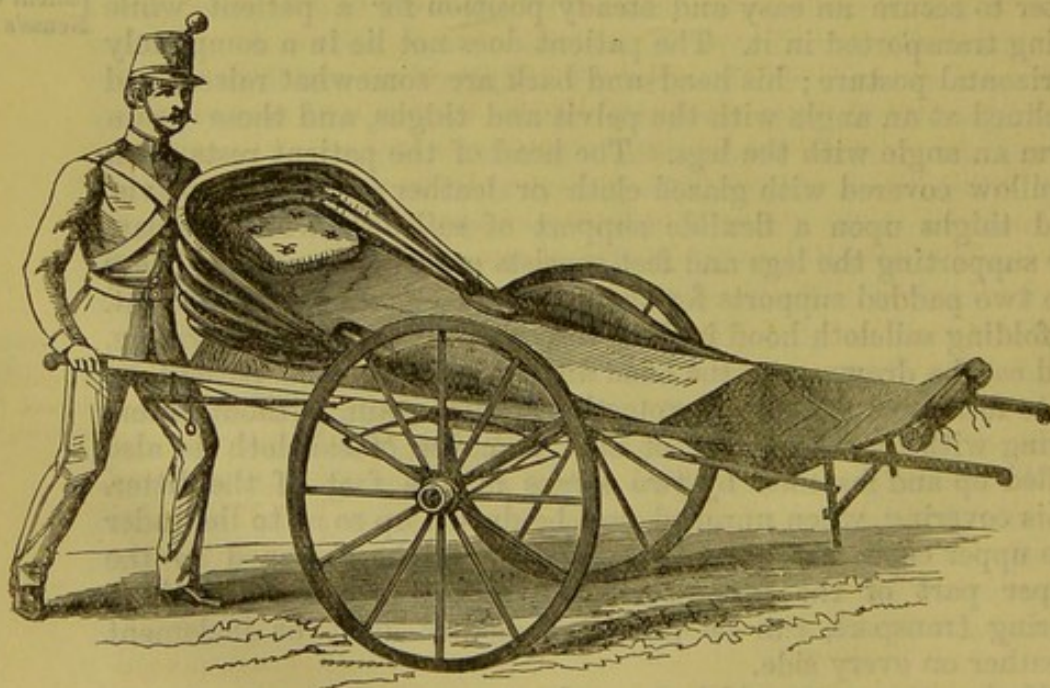


Fig. LXXXIV.—Neuss's Two-wheeled Litter, as seen in perspective.

* Spec. No. 1,263 in the Museum of Mil. Surg. at Netley.

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, 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 provide completely for the requirements of the wounded, yet it would be impossible to shut our eyes to the immense improvement 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

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Dr. Gurlt's
experience of
Neuss's litters.

Dr. Neudörfer's
experience of
Neuss's litters.

* "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.

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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.

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Unfitness of
Neuss's litters
for general use
in the British
service.

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.

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.

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.

Fitness for use
of Neuss's lit-
ters if required
in England.

* 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.

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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, they 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.*

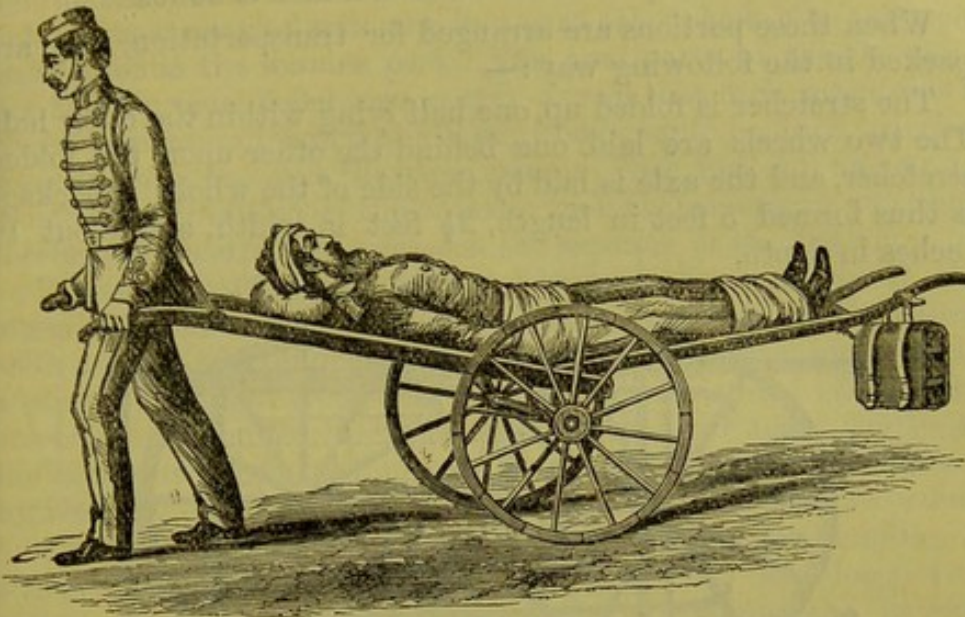


Fig. LXXXV.—Gablenz's wheeled Litter.

Messrs. Fischer and Co., of Heidelberg, were the manufacturers of this conveyance, and they thus describe its merits:—

"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." Advantages attributed to Gablenz's wheeled litter.

"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.

* "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.

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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, $2\frac{1}{2}$ feet in width, and about 10 inches in depth.

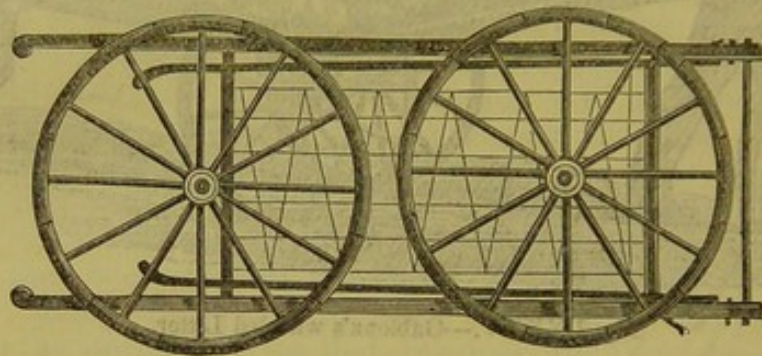


Fig. LXXXVI.—Gablenz's Litter, separated and arranged for packing.

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

to be closely folded together, one part within the other. The length of the open stretcher, including the handles, is seven feet ten inches. It is secured in its extended position by means of two hooks connected with the iron part, which lock into two eye-bolts fixed in the wooden part. The two parts of the stretcher are held by these fastenings in such a way that each maintains a slight inclination towards the other; they cannot be fixed together so as to be in one and the same plane. (See Fig. No. LXXXVII.) Further, the position of the hooks is such that a weight put upon the bed of the stretcher increases the security of the fastening.

The inner surfaces of the sides and of the traverses of the stretcher, both of the wooden and iron portions, are furnished with a series of fixed iron eyes. Through these eyes successively a rope is passed, so as to form a network, or corded bed, to the stretcher. Upon this corded bottom again there rest: firstly, at the head, an empty pillow-case, made of canvas, and connected by rings, so as to render it capable of being shifted according to the height of the patient; secondly, near the middle, a slightly padded bandage or girth, about two feet long, furnished with three leather straps for strapping the patient safely to the stretcher; and thirdly, near the foot, a similar bandage, but only a few inches in width, for securing the feet of the patient.

As before mentioned, the stretcher can be used for carrying a patient either off or on the wheels. Again, it can be either placed upon the wheels or taken off them with the utmost readiness. This facility of converting the wheeled carriage into 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. LXXXVII.) 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 $2\frac{1}{2}$ feet.

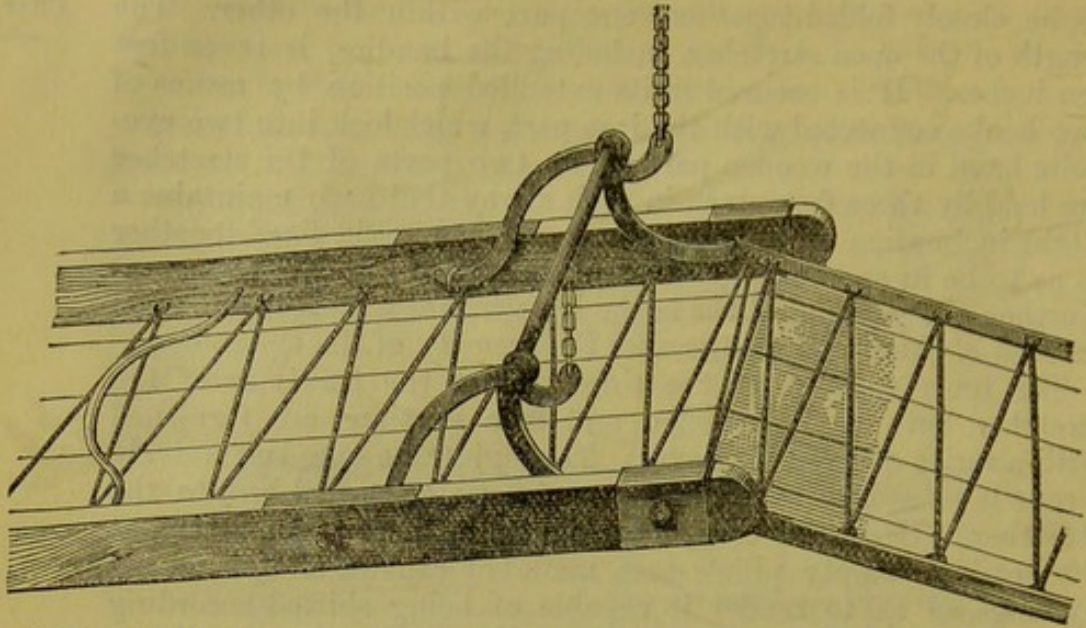


Fig. LXXXVII.—Under view of Gablenz's Litter, to show the method by which the two arms of the folding stretcher are fastened together, and also the manner of fitting the stretcher itself to the axle and wheels.

Results of
trials of Gab-
lenz's litter.

On this litter being tried at Netley the following results were observed:—

1. When a man was lying on the ground his removal to the stretcher, whether on or off the wheels, was very easily effected. The angle at which the two parts of the stretcher are joined facilitates the transfer of the patient, as the narrower and heavier end of the stretcher can be made to glide under the patient's back, and it is, therefore, not necessary to lift him so completely 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 midway, 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

manceuvre 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.

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.

Conclusions
regarding
Gablenz's
wheeled litter.

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

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Construction
of Arrault's
brancard
roulant.

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.

(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:—

Firstly, it was very difficult to place the stretcher, with a patient lying on it, 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 the stretcher, with a patient lying on it, from off the wheels.

Practical objections to Arrault's brancard roulant.

Secondly, it was found to be anything but an easy mode of conveyance for the person 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.

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.

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Practical objections to Arrault's *brancard roulant*.

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.

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.

Unfitness of the *brancard roulant* for army use.

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 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.

Shortell's
wheeled
stretcher-sup-
port.

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.

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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.

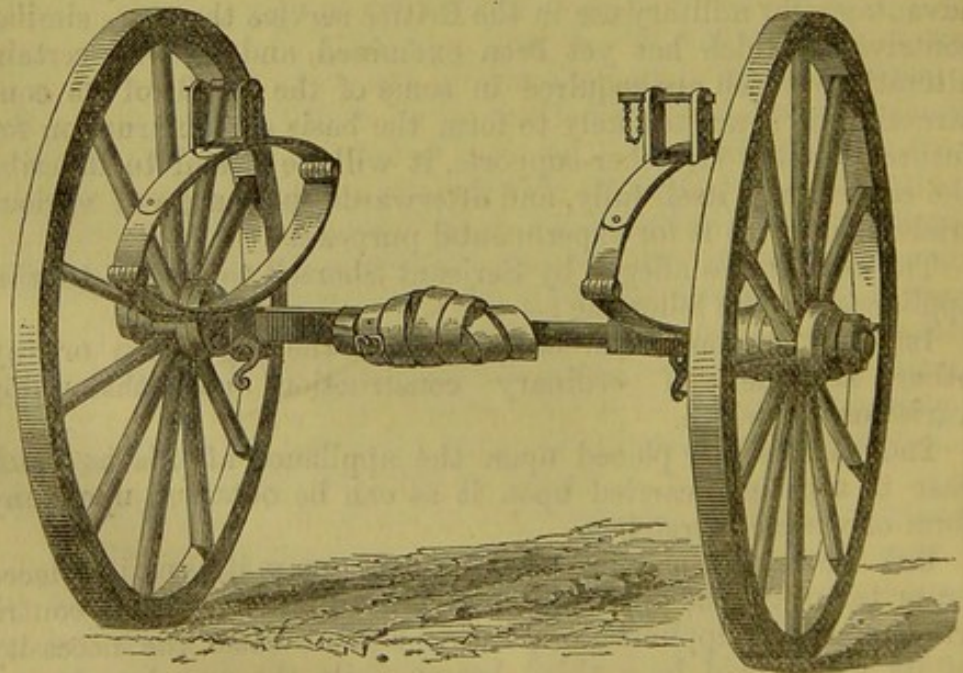


Fig. LXXXVIII.—Shortell's Wheeled Stretcher-Support.—The springs are fixed upright by the action of the clamping screw in the nave of the wheel, which appears on the left of the drawing. The crutch pins are in the crutches.

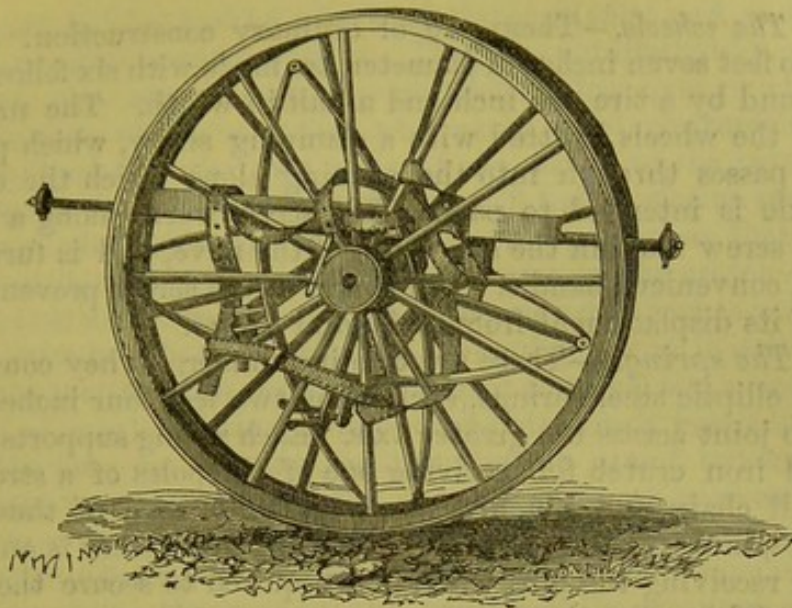


Fig. LXXXIX.—Shortell's Wheeled Stretcher-Support packed for stowage.

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.

Construction
of Shortell's
stretcher-sup-
port.

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.

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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.

Mode of using
the stretcher-
support.

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

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 wheel. 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.

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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 storage.*—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 instead 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 :—

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.)

Results of trials of Shortell's stretcher-support.

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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.

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.

Suggested
improvements.

(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.

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(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.

* 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."

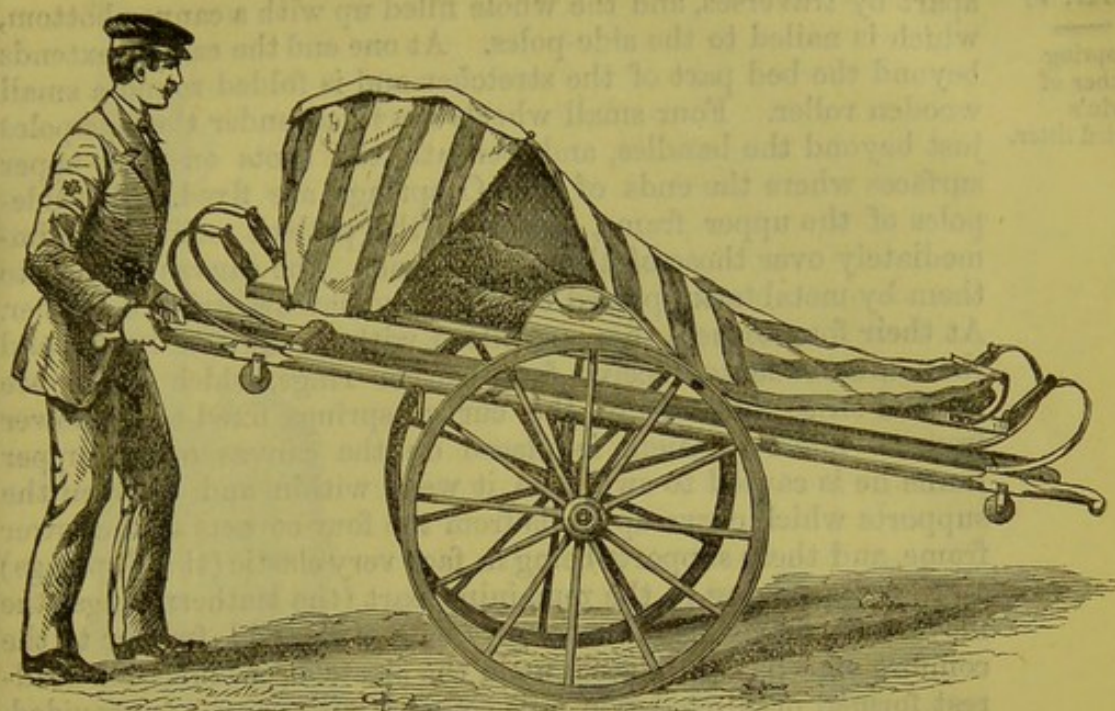


Fig. XC.—Dr. Gauvin's Spring-stretcher on Wheels.

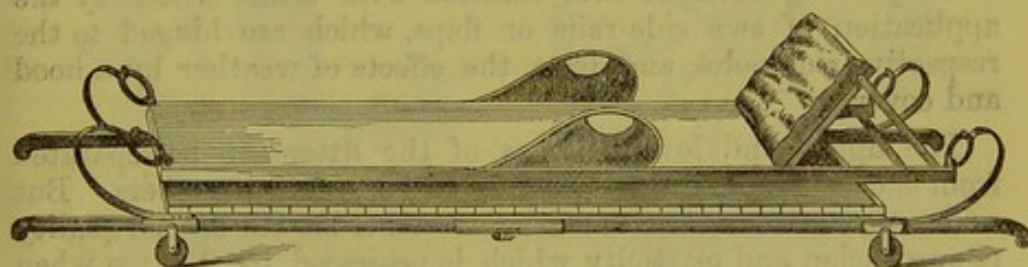


Fig. XCI.—Dr. Gauvin's Spring-stretcher removed from its Wheels. The small wheeled feet shown in the drawing are to facilitate its passage over the floor of a wagon.

An examination of Figures Nos. XC. and XCI. 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. XCIII., 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

Essential features of Dr. Gauvin's contrivance.

CHAP. V.
 The spring
 stretcher of
 Gauvin's
 wheeled litter.

apart by traverses, and the whole filled up with a canvas bottom, which is nailed to the side-poles. At one end the canvas extends beyond the bed part of the stretcher and is folded round a small wooden roller. Four small wheels are fixed under the side-poles just beyond the handles, and beneath the spots on their upper surfaces where the ends of four C springs are fixed. The side-poles of the upper frame, on which the patient reclines, are immediately over those of the lower frame. The canvas is fixed to them by metal tacks passed through two narrow strips of leather. At their four corners they are fitted with small iron hooks, and these are made to receive four leather rings, which again are hooked on to the ends of the curved springs fixed to the lower frame. When a patient is placed on the canvas of the upper frame he is caused to swing, as it were, within and between the supports which curve upwards from the four corners of the lower frame, and these supports being in fact very elastic (the C springs) and freely moving in the remaining part (the leathern rings) the movement is rendered extremely easy. To add further to the comfort of a patient placed upon the stretcher a moveable head-rest formed of hinged iron rods covered with canvas is provided. The patient is in addition protected against the risk of his arms or body being brought into collision with either wheel by the application of two side-rails or flaps, which are hinged to the respective side-poles, and from the effects of weather by a hood and cover.

The upper and lower frames of the litter can be separated from each other and then used as two separate stretchers. But under these circumstances neither stretcher has the special quality of suspension and elasticity which is possessed by the two when in combination.

The upper frame when used as a stretcher is held by the four leathern rings, already mentioned, instead of the usual handles. The lower stretcher is held by its handles. The springs fixed to this stretcher no longer act as springs, but two of them are employed for receiving the wooden roller with the additional canvas attached to it, previously alluded to, and so far assist in forming a head-rest for a patient.

The spring stretcher without the wheels, both frames included, can be folded up into a comparatively small space to facilitate package. This is effected by both frames being alike connected by iron traverses jointed in their centres. Dr. Gauvin calculates that two hundred and twenty-five of the spring stretchers without the wheels can be carried in a goods' wagon on a railway, and that thus, as each spring stretcher can be divided into two for use on a field of battle, four hundred and fifty stretchers are provided. The wheels with the axle are adapted for being fastened together in a separate package by the aid of a strap, much in the same way as Shortell's stretcher-support. The spring stretcher and wheels packed are shown in the following illustrations:—

The wheels
 and axle.

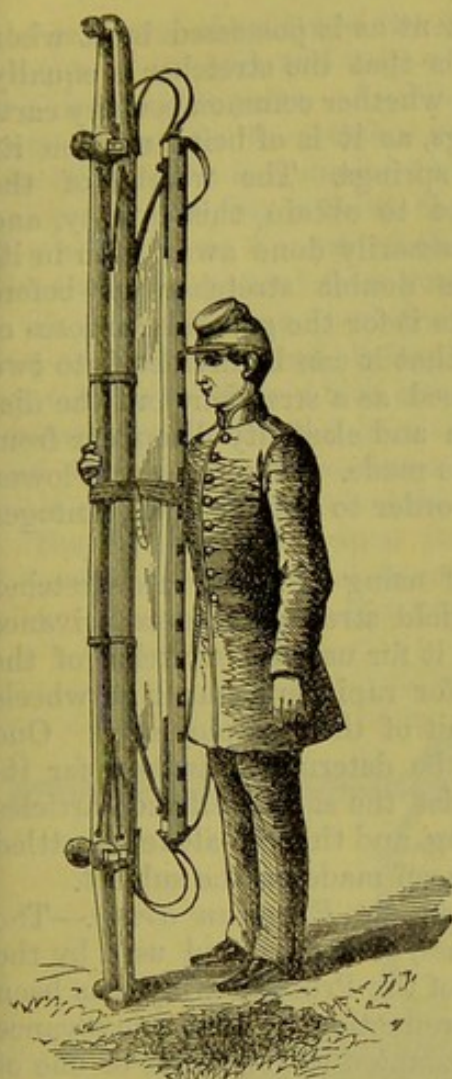


Fig. XCII.—Gauvin's Spring-stretcher folded up for package.

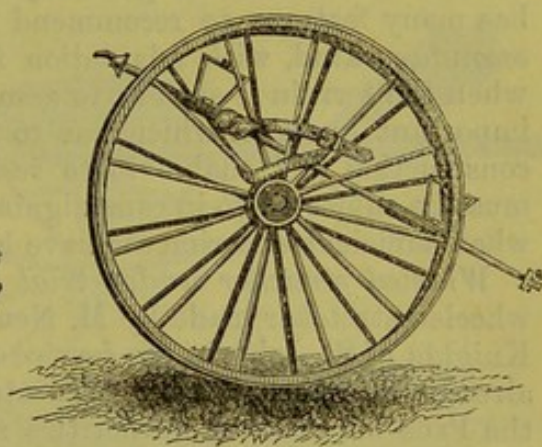


Fig. XCIII.—The wheels and axle of Gauvin's wheeled spring-stretcher arranged for package.

In placing the stretcher upon its wheels the connexion has to be formed by the aid of two iron pegs or tenons fixed to the middle of each side-pole of the lower frame. These iron pegs, which are a short distance apart, are made to pass through two corresponding openings with which the upper part of each of the oblong iron supports upon the axle is pierced. The pegs are afterwards prevented from starting out of these openings by small bolts suspended by chains being passed through their lower ends. As no means are provided for fixing the axle supports upright, they naturally fall downwards when left to themselves, and hence a third bearer is necessary to keep them in proper position when the two bearers carrying the spring stretcher are about to secure it to the wheels and axle.

The most important quality in the conveyance, and that in respect to which it chiefly differs from all other wheeled stretchers, is the elasticity and swinging movement possessed by it, independent of any springs connected with the wheels and axle. Being attributable to the manner in which the stretcher itself is constructed, these qualities remain with it after it is removed

Connexion of the stretcher with its wheels.

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. Dittmar. This contrivance differs in many particulars from Neuss's litter.

Construction of
the stretcher.

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

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.

The wheeled support made to receive this stretcher consists of two short wheels, each being about $2\frac{1}{4}$ 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.*

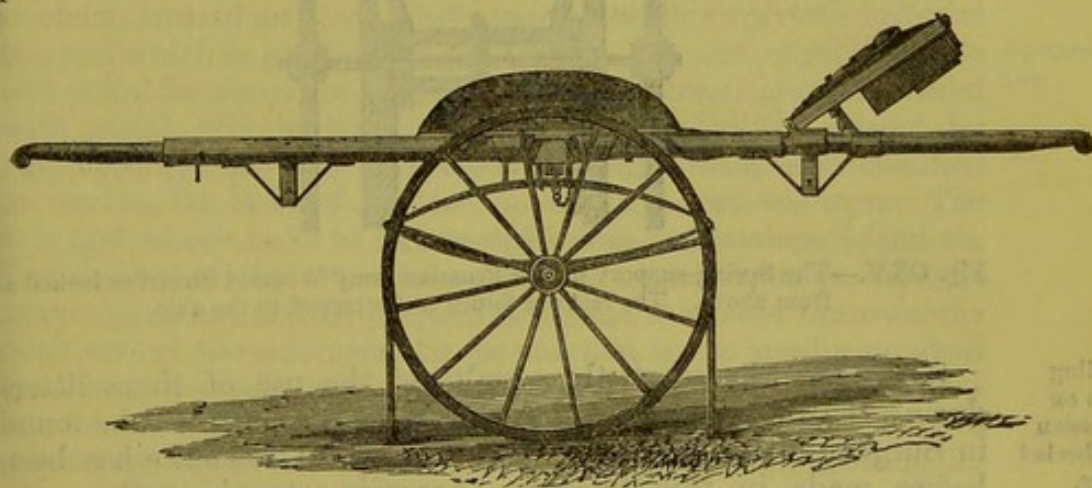


Fig. XCIV.—Side-view of the Wheeled Stretcher in use in the Prussian army.

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

Connexion of
the stretcher
and wheels.

* For a reference to this work see Appendix, note 4.

CHAP. V.

The feet of
the stretcher-
support.

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 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:—

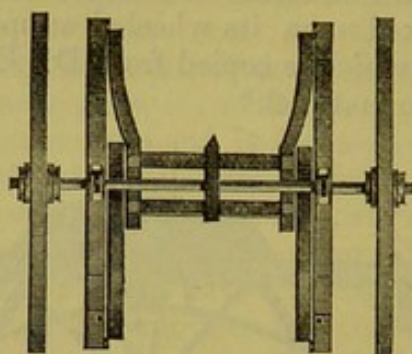


Fig. CXV.—The Spring-support of the Prussian army Wheeled Stretcher looked at from above. The feet are folded and strapped to the axle.

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 $3\frac{1}{2}$ 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.

itself, when horizontal, will be $2\frac{1}{2}$ 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.

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."

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.

Swiss wheeled stretcher.

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.

Mode of fixing
the stretcher to
its wheeled
support.

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. 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

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.

CHAP. V.

Construction of the wheels.

WHEELED STRETCHERS WITH VERY SMALL 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.

Stretchers with low wheels.

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.

Castiglioni's stretcher.

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

Its construction.

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.

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.

Observations
on Castiglioni's
wheelbarrow
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.

Bn. Mundy's
one-wheeled
stretcher.

Its construc-
tion.

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

Observations
upon this
contrivance.

CHAP. V.

M. Devillers' one-wheeled stretcher.

Bn. Mundy's two-wheeled stretcher.

Bn. Mundy's improved two-wheeled stretcher.

weight of the conveyance complete appeared to be about fifty pounds.

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.

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.

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.

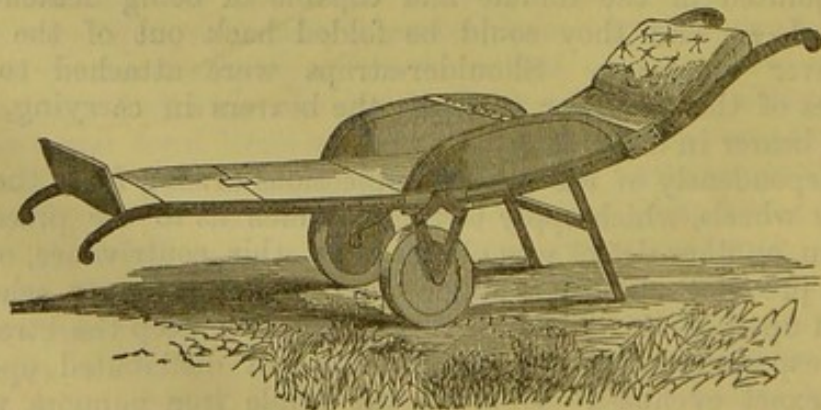


Fig. XCVI.—Baron Mundy's Stretcher on two low wheels.

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.

CHAP. V.

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 re-
quired 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.

CLASS III.—CONVEYANCES BORNE BY ANIMALS.

GENERAL OBSERVATIONS.

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.

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.

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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Quadrupeds chiefly employed in ambulance transport.

Leading forms of the conveyances borne by animals.

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The forms of the conveyances must be adapted to the animals that carry them.

Limits to the use of the 3rd class of conveyances.

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.

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. 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 strewn 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 enduring of prolonged fatigue.

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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.

* 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.

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Need of mule
transport in
certain posi-
tions.

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 viscosity 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.

* See remarks on p. 273.

† "Narrative of the surveying Voyages of H. M. Ships *Adventure* and *Beagle*. Passage of the Cordillera." Vol. 3.

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.

East Indian
mules.

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

Horses suitable
for carrying
sick men.

* 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.

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Sick men not
to be seated
on saddles.

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.

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 supplied 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 alternative,—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.

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.

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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.

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.

Views of
French officers
on the use of
mule-litters.

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 mules 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.

Mule-litters in
the British
service.

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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Their first employment in the Crimea.

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."

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 train-
ing.

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

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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.

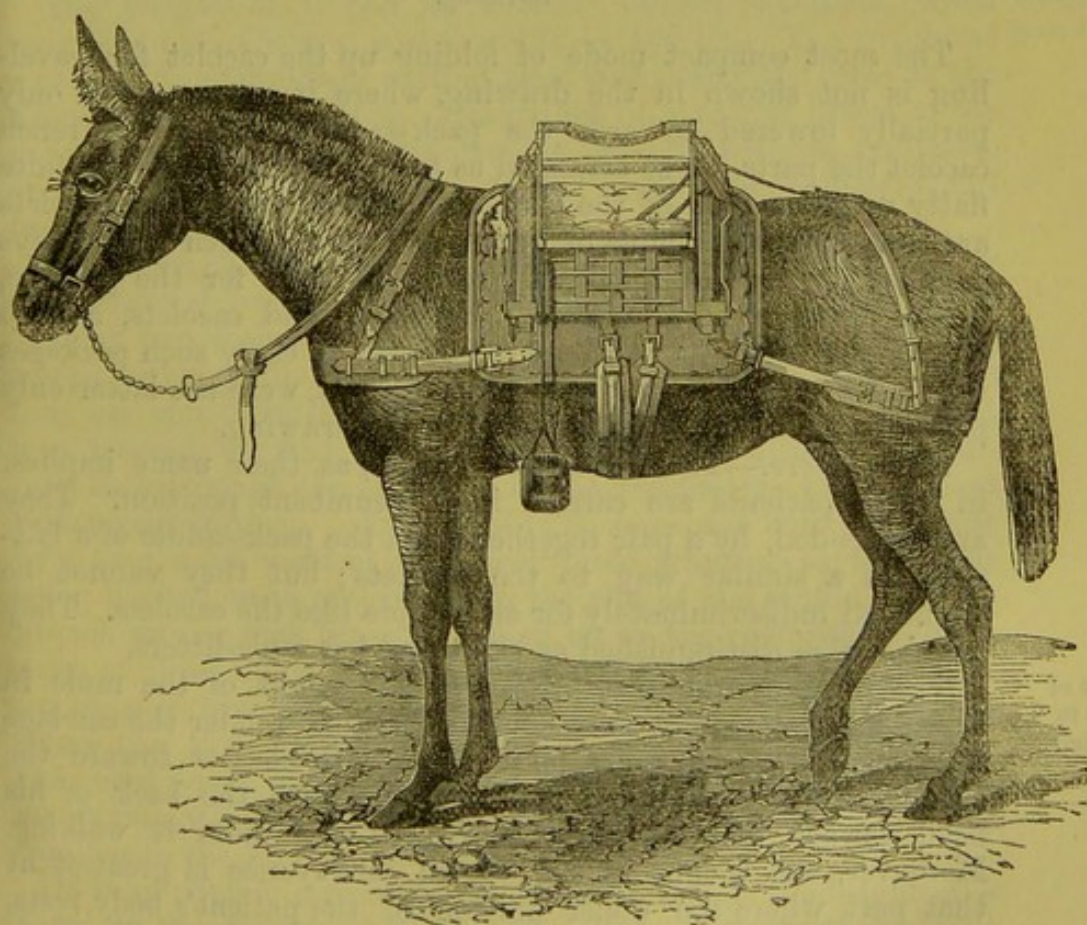


Fig. XCVIII.—Side view of mule chair or cacolet attached to its pack-saddle.

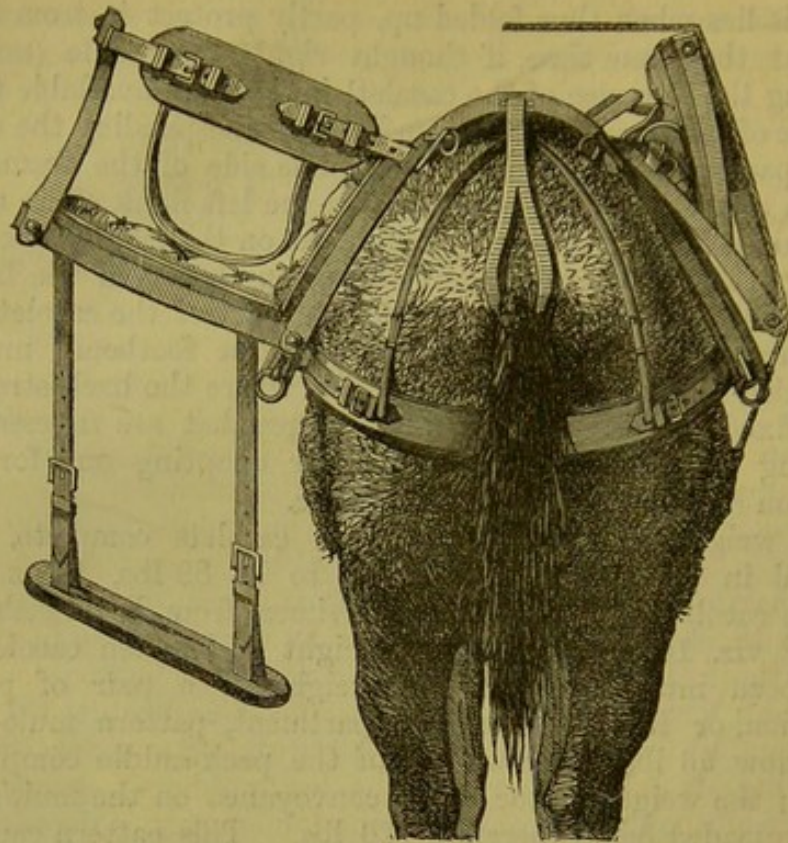


Fig. XCIX.—End view of mule chair or cacolet, open for use, and packed for travelling.

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.

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-

Carriage of
patients in
mule-litters.

litter is, therefore, carried in a direction contrary to that in which the sitting patient is moved on a mule-chair.

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.

Construction of
mule-litters.

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.

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.

Weight of
mule-litters.

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

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"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.

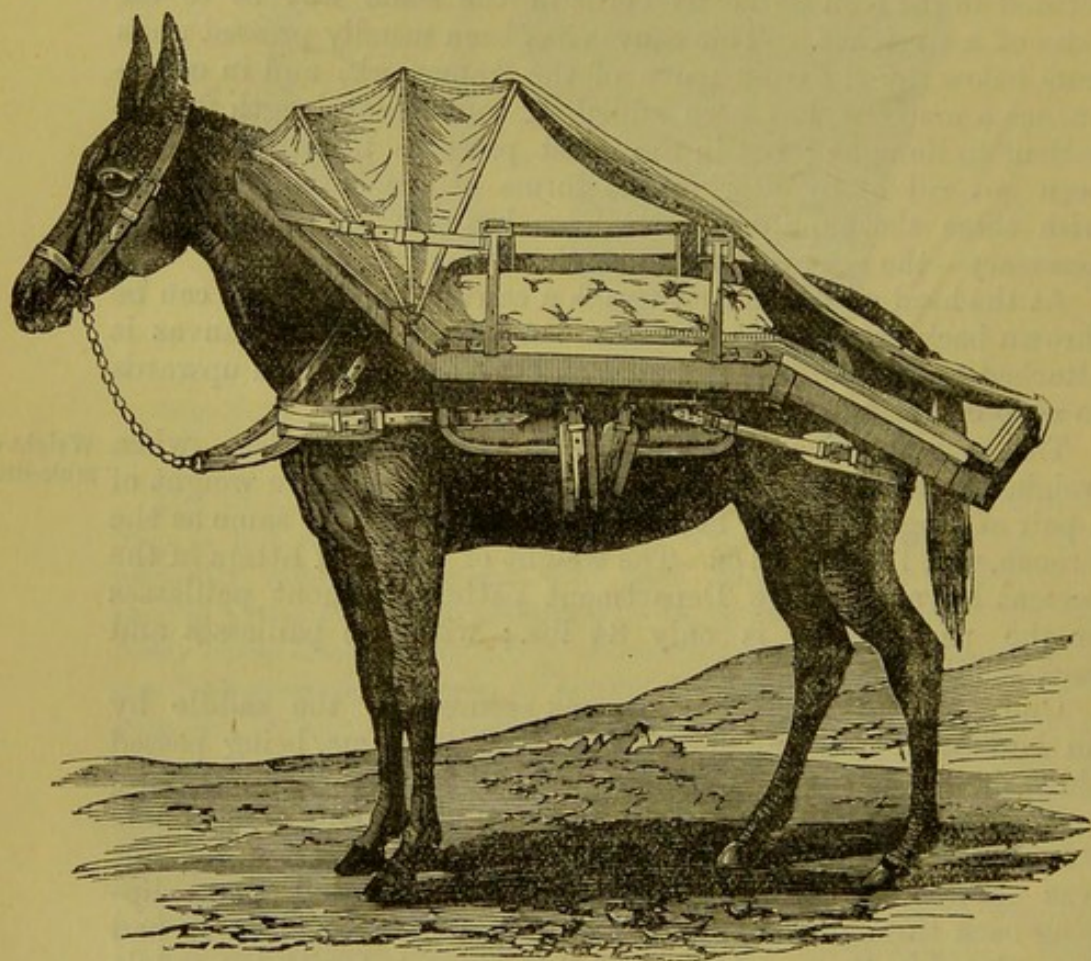


Fig. C.—Mule-litter attached to its pack-saddle.

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.

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.

Security of
patients in
mule-litters.

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.

Mode of pre-
venting litters
from swaying.

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

Peculiar
motion of
mule-litters.

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—

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.

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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.

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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. 1251b.

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.

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.

Design of
Locati's mule-
litter.

Its construc-
tion.

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.

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The mode of applying one of these side-litters to the pack-saddle is shown in the following sketch:—

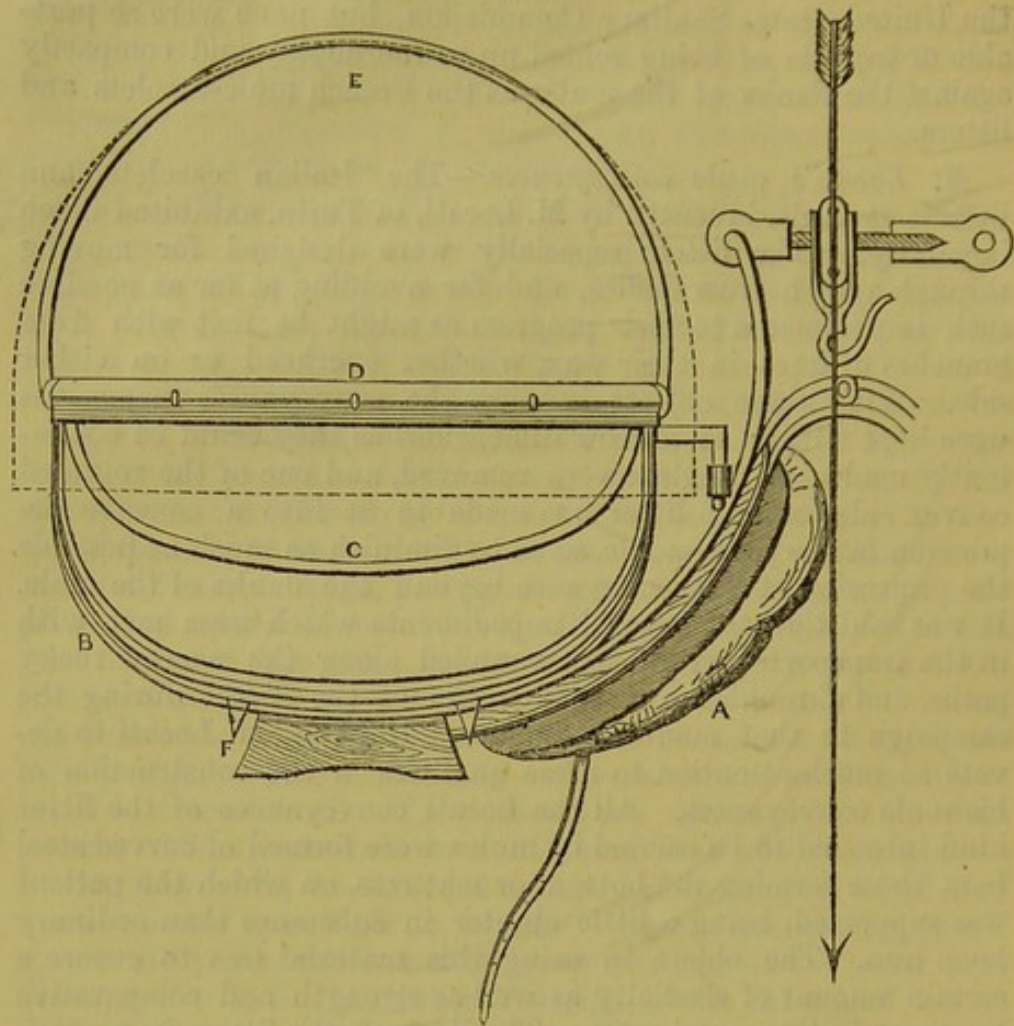


Fig. CL.—Sectional view of one of M. Locati's side litters fixed to its pack-saddle. A, pad of one side of pack-saddle. B, outer rib of litter. C, level of ribbed mattress for patient. D, back of lateral frame of litter. E, hoop for supporting cover. F, wooden foot of litter.

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

in each division. The animal's head is between these divisions when the litter is in a longitudinal direction in respect to the animal, as it is when a patient is being carried upon it. The pack-saddle, litter, and the hoops supporting the cover, have been all made as short from above downwards as practicable, so that when they are all in position the whole does not exceed the height of the animal's head. Here again, the object was to obviate the risk of collision with the branches of trees overhead. The litter was made to fold in three parts for package; each leg-piece folding upon the middle part, and the head-piece over both. To place a patient upon the mule the joints of the litter, which is laid upon the ground, are first fixed by the iron pins, and the patient is then laid upon it. When the patient has been settled in his place, the litter is raised up by two men, and laid on the revolving plate *across* the mule. As soon as the pins of the litter are in their sockets, the plate is turned round, so as to make the litter take a *longitudinal* direction corresponding with that of the mule itself. The litter is further secured to the pack-saddle by side-straps. As the width of the litter in this arrangement corresponds very nearly with the outer limits of the animal's flanks, and its height with that of the animal's head, as little impediment is offered to the progress of the conveyance as can be practicable with any form of mule-litter.

Mode of
placing it on
its pack-saddle.

The sketch shows the arrangement of the litter upon the pack-saddle, the head of the litter being presented to view.

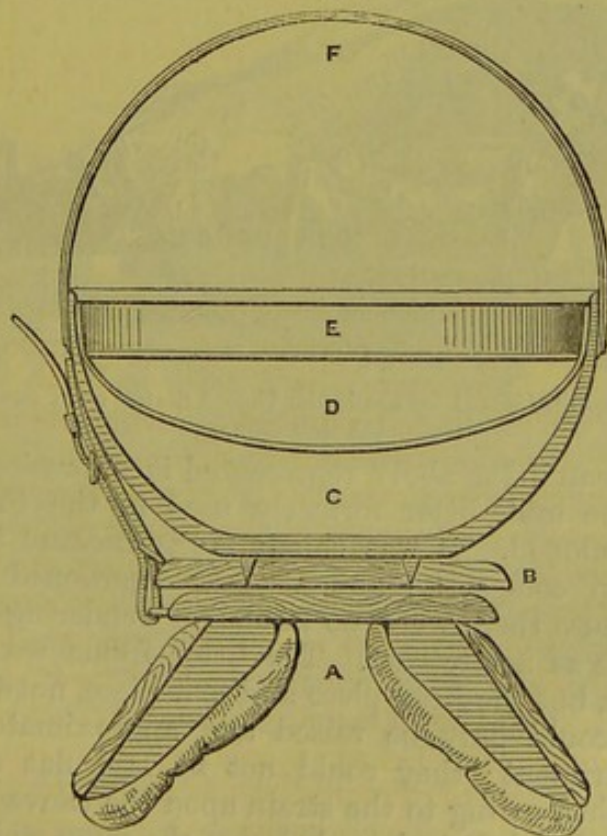


Fig. CII.—End view of M. Locati's single-litter mule conveyance,* fixed to its pack-saddle. A, space between saddle-pads. B, revolving plate. C, one of the strong supporting ribs of the litter. D, level of the ribbed mattress on which the patient lies. E, back of lateral frame. F, hoop for supporting the cover.

CHAP. V.

Mule-litters
slung from
outriggers.

The mule litters of other countries at the Paris Exhibition offered no special features worth description. The Portuguese, which were similar to the French in general design, were very bulky and heavy; so much so, that they could only be carried by mules of the largest and most powerful kind.

Woodcock's mule-litters.—Some mule-litters exhibited by the United States' Sanitary Commission were partly supported by being suspended from wooden outriggers, one on each side. These crane-like supports formed a portion of the pack-saddle, from the upper part of which they projected. Leathern straps were used to connect the litters with the outriggers. The design of this contrivance was to preserve a strictly horizontal position of the two litters while patients were lying upon them. It was evident from considering the material of which the projecting supports were composed, their shape, the length of leverage, and the force which would be exerted upon them, that such contrivances would speedily become broken or otherwise disabled on active service. They were the invention of a Mr. Woodcock of New York.

United States' mule-litter.—The mule-litter which was adopted for use in the United States' army is shown in the following illustration. It is copied from a drawing kindly sent to me by Surgeon-General J. K. Barnes.

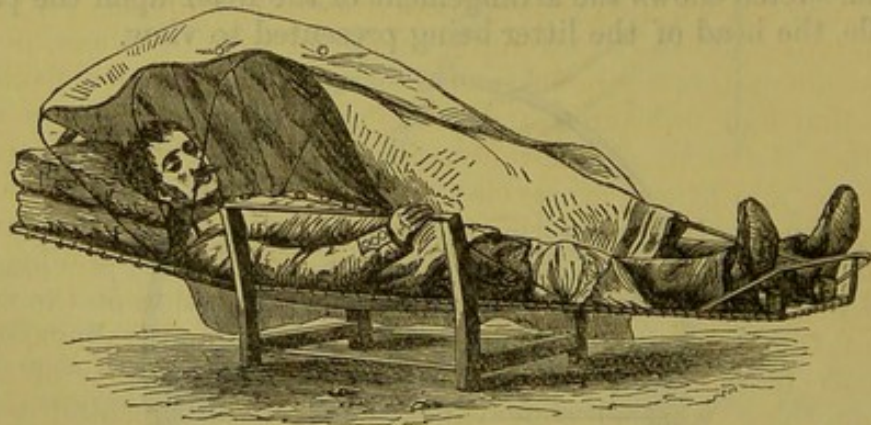


Fig. CIII.—Mule-litter issued for use in the United States' army during the war the Rebellion.

United States'
army mule-
litter.

The American litter above represented is of precisely the same pattern as the mule-litter formerly used in the French army, but now abandoned. It was chiefly faulty because it could not be folded up compactly, and also, as mentioned in former remarks, because there were no means of rendering it rigid for temporary use as a stretcher. The litter frame was jointed in three sections, but the head-piece and foot-piece, notwithstanding these joints, could only be raised and approximated over the centre compartment; they could not be laid flat one upon or within the other, owing to the strain upon the canvas, and to the fact of the head and foot pieces being of the same width.

The greater part of the field operations during the war of the Rebellion in the United States was conducted in comparatively level plains, where railway or wheeled conveyances could be

readily made use of for the transportation of sick and wounded. Mule conveyances, 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." *

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.

Construction of
mule-panniers.

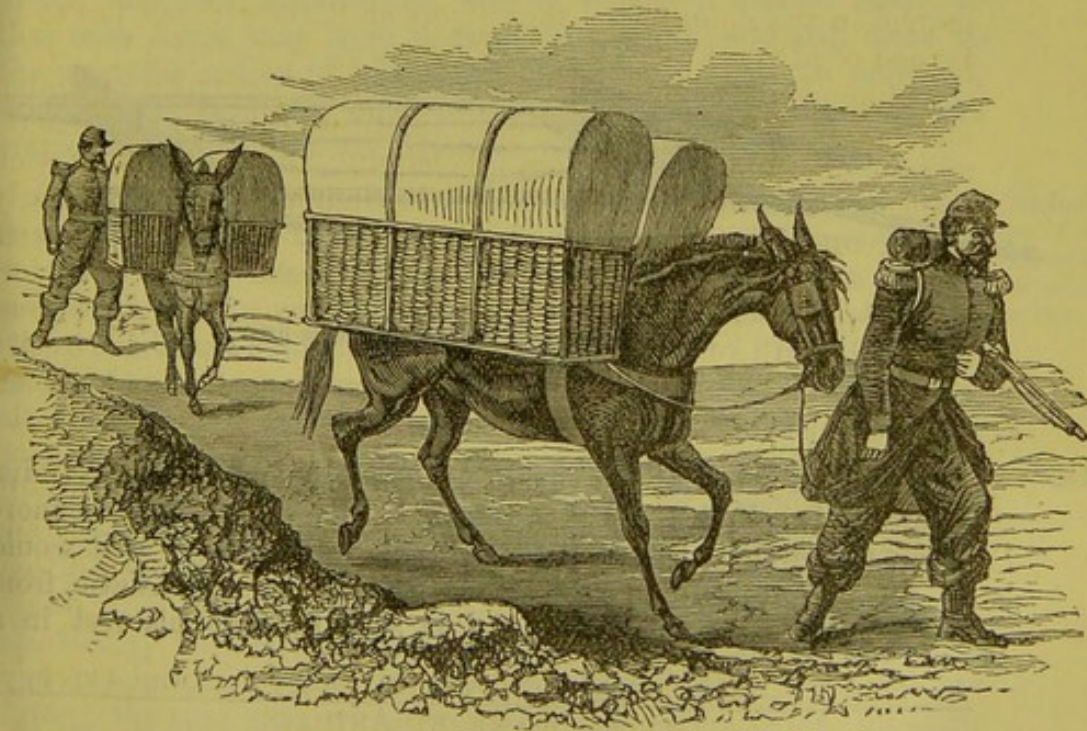


Fig. CIV.—Mule-panniers in use for the carriage of sick and wounded.

* Circular No. 6, Surgeon-General's Office, Washington, 1865, p. 82. On this page of the circular there is a drawing of the cacolet issued for 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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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 constructed 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.

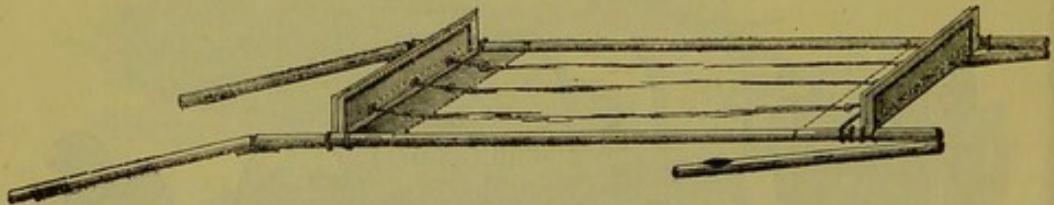


Fig. CV.—United States' two-horse litter.

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.

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 versa*, 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.

Remarks on
the use of two-
horse litters.

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.

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

Résumé on the
use of mule
conveyances
for military
service.

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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.

Useful qualities
of camels as
transport-
animals.

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

* 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 $2\frac{1}{2}$ 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 *sândnee*, 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.

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Comparative
economy of
camel trans-
port.

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.

Construction
of Larrey's
camel-litters.

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.

The following illustrations, which are selected from the sketches in Baron Larrey's memoirs,* will serve to show the forms of conveyance adopted by him on this occasion.

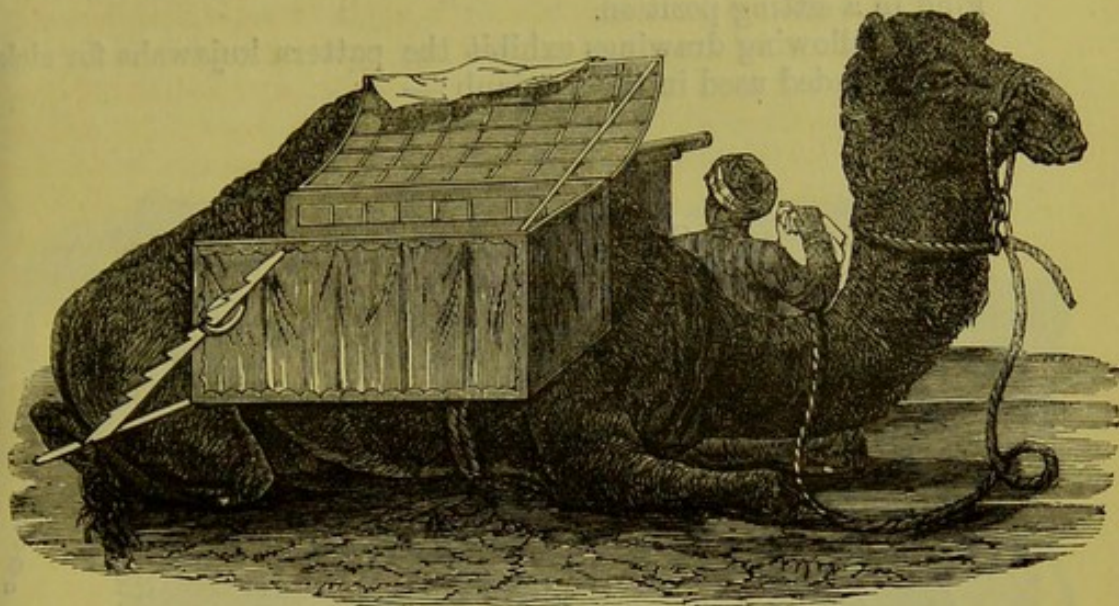


Fig. CVI.—Larrey's Egyptian Camel-litter. The animal is sitting down, and the litter shown on one side is open, ready for the reception of a patient.

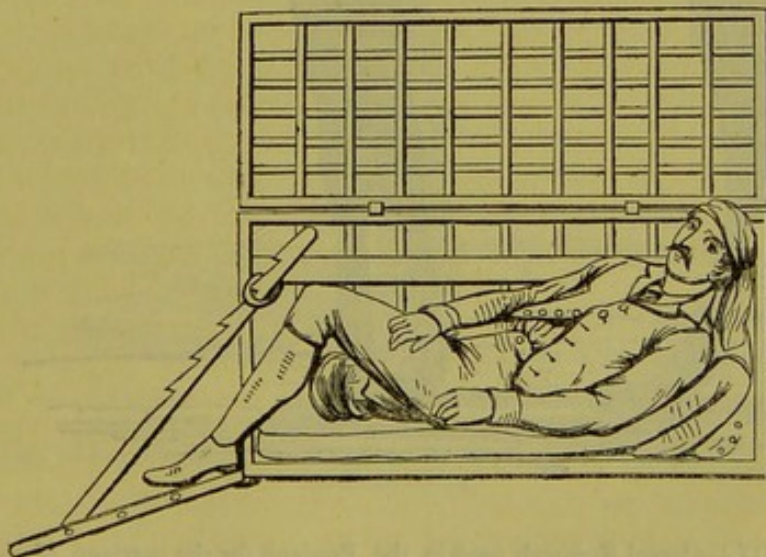


Fig. CVII.—Larrey's Camel-litter. One side is removed to show the position of a wounded man who has been placed in it after having undergone amputation above the knee.

* "Mémoires de Chir. Mil. et Campagnes de D. J. Larrey," Paris, tome i, 1812

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Indian camel conveyance.—Camel conveyances for the carriage of sick and wounded in India are known by the name of kujawahs.* They are of two kinds, corresponding with the litters and cacolets carried by mules, one kind being constructed so that the patient may be carried in a recumbent, the other kind in a sitting position.

The following drawings exhibit the pattern kujawahs for sick and wounded used in the Punjaub :—

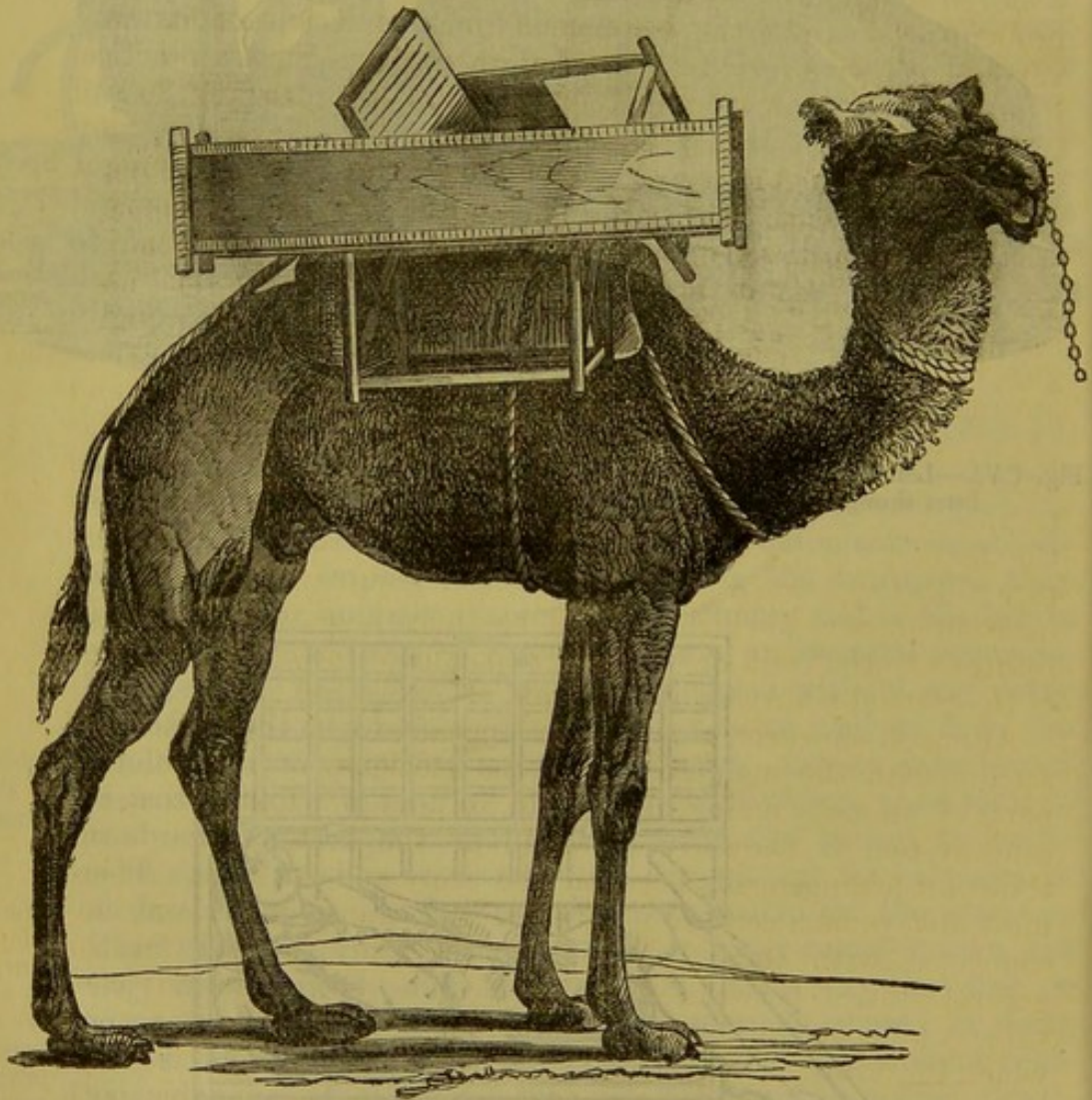
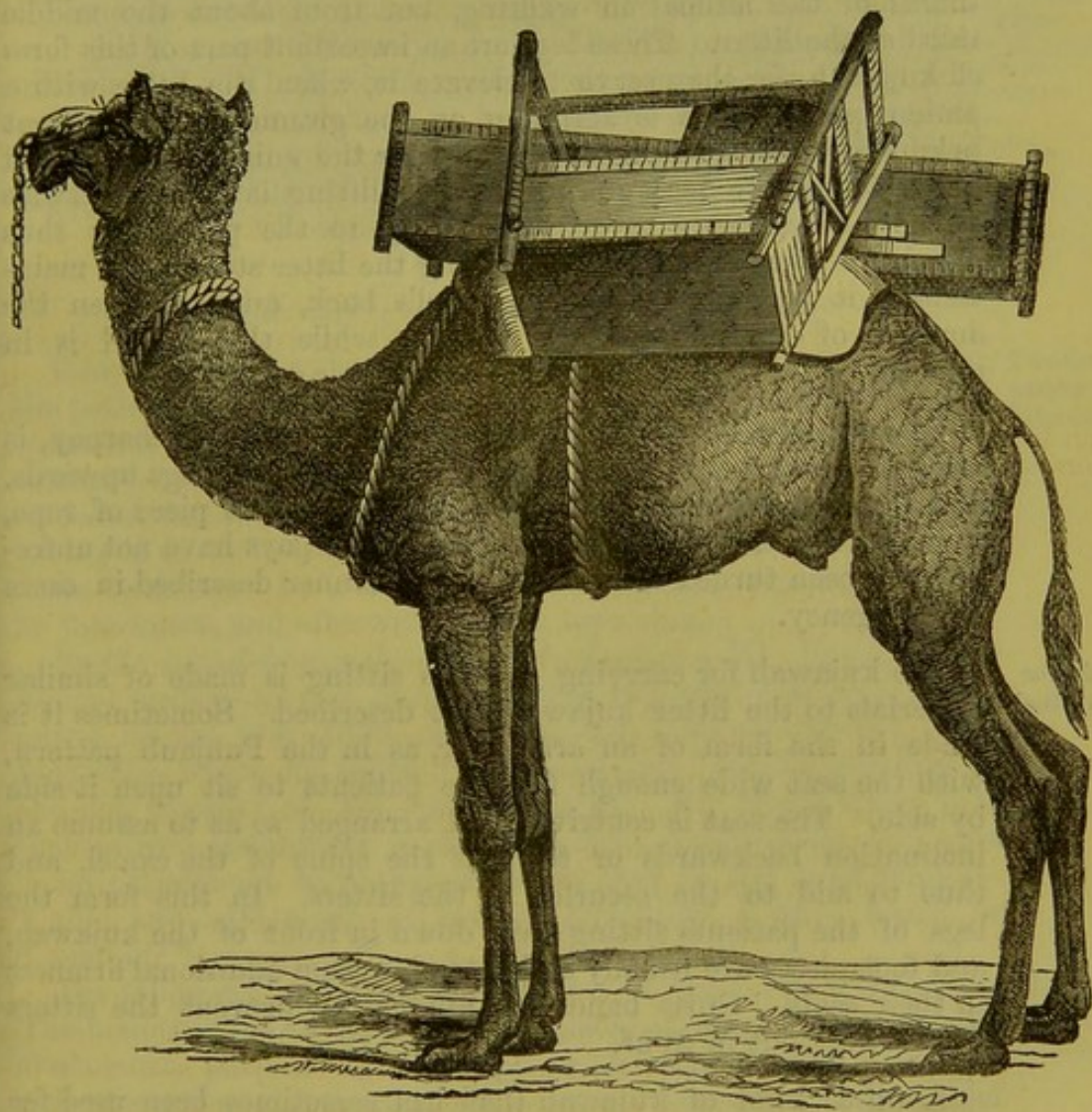


Fig. CVIII.—Camel Kujawah used in the Punjaub for the carriage of sick soldiers lying down.

* Mr. Brett mentions that the name of "kujawahs" has been given to these conveyances from a kind of hamper used in Afghanistan, in which fruit is sometimes conveyed to India.



* Fig. CIX.—Camel Kujawah used in the Punjaub for the carriage of two sick soldiers sitting.

* The original drawings, from which the two engravings of the pattern kujawahs for carriage of sick soldiers in the Punjaub have been copied, were kindly sent to me by Surgeon W. M. Webb, Secretary to the Inspector-General of Hospitals in India, in May 1865.

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Construction
of kujawahs.

Kujawahs are constructed of very simple materials. The kujawah used as a litter consists merely of a frame of wood, roughly but securely put together, with the sides and bottom filled up by stout cord interlaced or by strong canvas. Some iron rings are fixed into the framework for holding the ropes by which the conveyances are secured to the animal. Each recumbent kujawah is furnished with long legs, not prolonged from the ends, as they would then interfere with the shoulders and thighs of the animal in walking, but from about the middle third of the litter. These legs are an important part of this form of kujawah, for they serve to elevate it, when the litter with a patient placed in it is standing on the ground, to a sufficient height to be secured to the camel after the animal has kneeled down to receive it. The necessity of lifting it up or otherwise causing disturbance or risk of injury to the patient is thus avoided. They also assist in keeping the litter steady and maintaining it in position on the camel's back, and so lessen the amount of shaking to the patient while the animal is in motion.

The common bed used by the natives of India, or charpoy, is easily converted into a camel litter by turning the legs upwards, and then connecting these latter together with a piece of rope, so as to form sides to the conveyance. Charpoys have not unfrequently been turned to account in the manner described in cases of emergency.

Kujawahs for
patients sitting.

The kujawah for carrying patients sitting is made of similar materials to the litter kujawah just described. Sometimes it is made in the form of an arm-chair, as in the Punjaub pattern, with the seat wide enough for two patients to sit upon it side by side. The seat is contrived and arranged so as to assume an inclination backwards or towards the spine of the camel, and thus to add to the security of the sitters. In this form the legs of the patients sitting hang down in front of the kujawah, and foot-pieces are usually added to give them additional firmness in their seats. Cross bands are applied to prevent the sitters from falling out in front.

Another kind of kujawah that has sometimes been used for the transport of sick soldiers consists of a simple square frame with a wooden floor, its sides being either made of wood or filled in with interlaced cordage. A sort of box, open at the top, is thus formed, within which the person sits in a half doubled-up position. This conveyance is really only suited for the carriage of persons in health, and during the Indian Mutiny they not unfrequently were so employed in some parts of India for hurrying forward troops to places where their services were most urgently required. They are only fit to be turned to account for invalids in the absence of conveyances of a more suitable kind.



Fig. CX.—Camels carrying men sitting in kujawahs on the line of march.

When the litter kujawahs for recumbent patients are employed, the patient's head is placed on that part of the conveyance which is nearest to the hind quarters of the animal, a direction opposite to that in which it is placed in a mule litter. By this rule being attended to, the patient's head is never lowered unduly, and the jolting is much lessened, when the camel is in the act of sitting down or rising. In sitting down, the animal descends first on its fore-knees, and afterwards on its haunches.

Position of
patient in a
litter-kujawah.

Brett's camel-kujawahs or camel-dhoolies.—Mr. Brett, of the Bengal medical service, Surgeon to the Governor-General's body-guard, in the year 1839, contrived and had constructed some kujawahs, which he called "*camel-dhoolies*," for the carriage of the sick troopers on the line of march. Mr. Brett states that they proved themselves most satisfactory conveyances, and that "the experiment succeeded in every way as the most comfortable and safe mode of invalid travelling I have heard or read of."*

The following is a short description of their construction:—The main portion of each litter consisted of a very light wooden framework, adapted by its shape to the flanks of the animal, and strengthened by iron bands in the direction of the chief strains. The framework at the bottom, and also of a portion of the sides of the litter, was filled up with canework, the remainder with strong tent cloth varnished. The inside was lined with cushions; a light framework covered with doosootie cloth and painted white formed a shade or roof over the litter, from the sides of which depended curtains like the ordinary dhooly curtains. The litters were buckled on precisely in the same manner as camel trunks, by means of thick straps made of buffalo

Construction of
Brett's camel-
dhoolies.

* Notes to a Practical Essay on some of the Principal Surgical Diseases of India. Calcutta, 1840, page 505.

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hide. Four strong iron hooks, two on each litter, and a chain would, as Dr. Brett has suggested, have probably been preferable when fastened over the saddle or pullan, being equally secure as the straps, and leaving more room for the patient. The litter was sufficiently long to accommodate a person lying at full length in it.

The two sketches which follow sufficiently illustrate the plan and construction of Brett's camel dhoolies.*

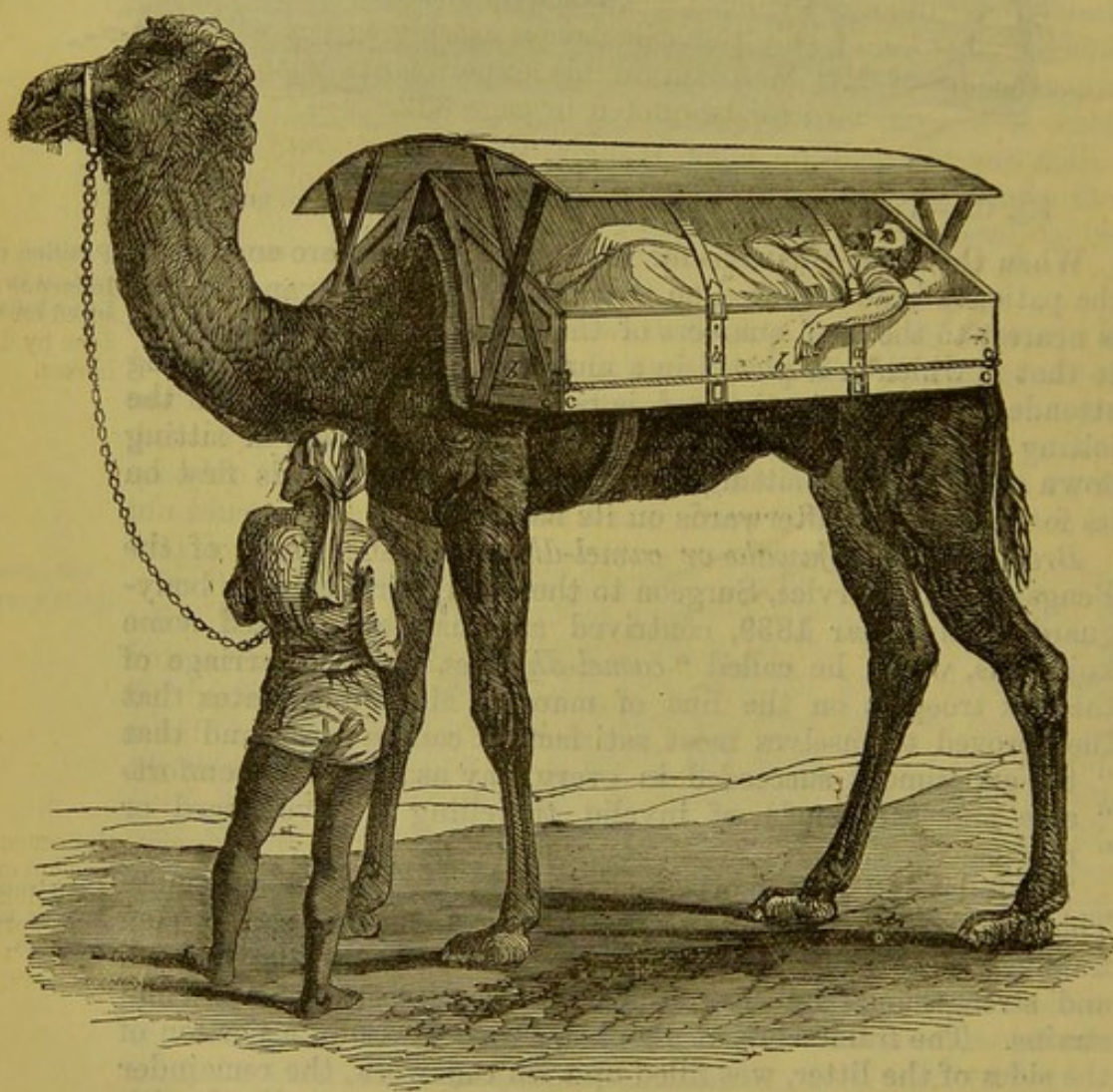


Fig. CXI.—Brett's Camel-dhooly attached to a camel by its straps, and still further secured by a strong rope passed through iron rings, and crossed over the saddle. The curtains which hang from the roof of the litter are not shown in the drawing. (*a, a*, straps; *b, b*, rope; *c, c*, iron rings.)

* These sketches are copied from the work before quoted. Two other illustrations are furnished in the same work for the purpose of still further elucidating the construction of these litters.

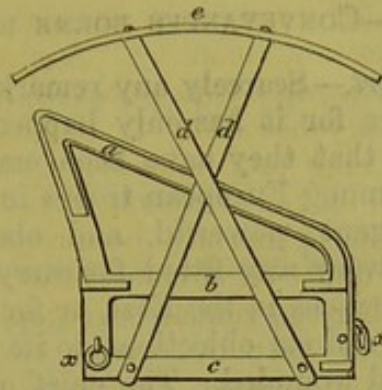


Fig. CXII.—End view of Brett's camel dhooly. *a, b, c*, part of the wooden framework. *d, d*, cross bars to support the roof *e*. *x, x*, iron rings through which the rope is passed.

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.

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. Their alleged advantages.

In respect to (*b*), four camels, with eight litters, could be maintained at something less than the monthly expense of one dhooly, 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 dhooly.

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 dhooly-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 dāk travelling by bearers. Brett's camel-dhoolies as substitutes for dhoolies carried by bearers.

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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.

CLASS IV.—CONVEYANCES DRAWN BY ANIMALS.

GENERAL OBSERVATIONS.

I COME now to a class of conveyances, the use of which has not only to be studied with reference to the intrinsic qualities of the vehicles themselves, their relations to the power by which they are set in motion, and to the other conditions which have been shown to influence the forms and construction of the several kinds of conveyances already considered, but also in respect to another circumstance, viz., the state of the surface of the country upon which they are to be employed. All the conveyances for sick and wounded which have been designed for carriage by men, as well as those borne by quadrupeds, are comparatively independent of this consideration, being adapted for use on any ground over which either men or mules can walk; and even the conveyances *wheeled* by men, owing to the facility with which they may be carried by bearers, are not liable to be baffled by meeting obstructions or excavations which would be fatal to the employment of wheeled conveyances drawn by animals.

The same qualities of strength combined with lightness, portability, adaptation to the necessities of sick and wounded, facility of loading and unloading, and economy in cost, as regards the vehicles: the same circumstances in regard to the maintenance, protection and fitness for service in the field, of the animals and of those who have care of them: have to be taken into account, just as happens with the several kinds of conveyances previously noticed; but, in addition, a tolerably level condition of the surface of the country, or, if broken into hills and valleys, the existence of made roads, is essential for the capability of employing these wheeled conveyances with advantage, and with due regard to the maintenance of their efficiency. At the same time, a field hospital conveyance should not be so constructed as only to be capable of being safely conducted over such well-made roads as are met with usually in this country; it ought to be put together strongly enough, and to be so mechanically arranged with regard to the maintenance of the line of gravity within the wheels, notwithstanding considerable deviations of the surface upon which it is moved, as to admit of its use in all places and under all circumstances in which other military wheeled conveyances can be used. Just as conveyances borne by men and animals should be competent to follow the combatants on every kind of ground that they can move over, so it is desirable that the wheeled ambulance carriages drawn by horses should be capable of being taken with ease and security over any ground, soft, rugged, or broken, and down any declivity, over which the

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Necessary qualities of conveyances drawn by animals.

Can only be employed upon ground which is tolerably level.

Should be capable of passing wherever the other transport vehicles of the army can go.

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Not to be expected that ambulance conveyances are to be capable of going wherever gun-carriages can go.

Circumstances of the two kinds of carriages compared.

rest of the transport of the army can be taken. It is sometimes said that the ambulance carriages should be capable of going wherever gun-carriages can go, but this ought not to be expected, and indeed, cannot be carried into execution. Gun-carriages have to be forced over the most difficult places, rocky ground, ground broken into deep furrows and high ridges, and at the same time to be manœuvred in a manner that no vehicles fitted with springs could be subjected to with impunity. Such springs as are capable of affording any ease to the patients carried in an ambulance wagon would be inevitably broken, or otherwise disabled, by the violent shocks which gun-carriages must be able to withstand with impunity. If the principle be accepted that an ambulance wagon is to be capable of going wherever a gun-carriage can go, then it will have to be built of such great solidity that one of the most important qualities of such a conveyance, ready mobility, must be at the same time destroyed. It is better, therefore, to lay down the rule that an ambulance wagon should be capable of going wherever the other wheeled transport vehicles of the army can go, leaving to hand conveyances or mule litters the duty of removing any wounded who may require removal from the difficult ground to which guns have occasionally to be taken on field service.

SECTION I.—HISTORY OF THE FOURTH CLASS OF AMBULANCE VEHICLES.

History prior to the Peninsular war.

There is no distinct account, as far as I am aware, of wheeled conveyances having been constructed with special adaptations for the conveyance of sick and wounded of British armies until the period of the Peninsular campaigns. In the wars in which the troops of this country were engaged on the continent of Europe prior to that period, it seems that, so far as attention was given to the subject at all, the authorities chiefly depended on obtaining some of the ordinary vehicles of the country which formed the theatre of war for the carriage of the sick and wounded of their armies back to the base of operations or port of embarkation. Special ambulance carriages of the fourth class are then of comparatively recent origin in this country. In France they do not appear to have been employed until the year 1792, when Larrey had light wheeled conveyances specially constructed for removing wounded soldiers from the field as part of the organization of his ambulance volante. It is a curious circumstance, as will be noticed hereafter,* that although France introduced these conveyances at this comparatively early date, she long since abandoned the use of them; while other countries, that introduced them among their military equipment much later, have not only continued to use them to the present time, but have unceasingly devoted great efforts and expense for their improvement.

First employed in France in 1792.

* See remarks on the caissons d'ambulance of the French army, p. 440.

It has been already mentioned that when the wagon train was organized at the commencement of the Peninsular war, among the carriages under its charge there were some especially constructed for the transportation of sick and wounded. These were spring wagons, designed for carrying eight men capable of maintaining a sitting posture, or two men lying down. After the termination of the Peninsular war and the campaign of 1815, little appears to have been done in this country with a view to the improvement of wheeled ambulance transport suitable for European service,—if we except the experimental trials made with Veterinary-Surgeon Cherry's carts, and the practical observations made of their qualities in the expeditionary force under Sir De Lacy Evans in 1835,—until the outbreak of the war with Russia in 1854. While that war was in progress, however, much attention was given to the subject, and since its conclusion numerous contrivances have been brought forward with a view to the improvement of the ambulance carts and wagons in use at the successive periods at which these alterations have been suggested. Indeed, the varieties of ambulance conveyances which have been brought to notice in England and on the continent of Europe, as well as in the United States, have been so numerous of recent years that it will be only possible to describe some of the most important among them in this work.

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During the
Peninsular war.

During the
Crimean war.

Very recently (1867) a large number of wheeled conveyances was collected, and for the most part placed side by side in the park of the Universal Exhibition at Paris. The Governments of England, France, and the United States exhibited the authorized wagons of their respective countries for carrying sick and wounded. Patterns of nearly all the conveyances of the same class that had been used during the war of the rebellion by the United States Sanitary Commission were exhibited in a collection formed by Dr. Evans, the eminent American dentist at Paris. Other examples were exhibited by the National Societies for Aid to Wounded in time of War of Italy, Prussia, Switzerland, and Austria. Altogether seventeen illustrations of this class of sick conveyances were exhibited, and of this number thirteen were full-sized patterns complete in all respects, the remaining four being models. An opportunity was thus afforded of comparing one kind of carriage with another, and thus of studying their relative advantages and defects, both as to general principles of construction and to the fittings and appliances with which they were respectively furnished.

Exhibition of
ambulance
carts and wa-
gons at Paris
in 1867.

A further stimulus was given on this occasion towards the improvement of this class of conveyances by the offer of prizes for any ambulance wagons more in consonance with the principles on which it was believed all such vehicles should be constructed than any of those under observation at the exhibition. The competitors for these prizes were permitted to study all the patterns in the collection, and to apply to their own inventions

Prizes offered
at Paris for the
best patterns of
these vehicles.

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Effects of the stimulus given at Paris to the improvement of these vehicles.

any of the meritorious features they might observe among them. The principles on which the new wagons were to be constructed were defined in the terms on which the offer of the prizes was announced. The time for the competition was short, and only two fresh patterns were sent in; to these a first and second prize were awarded. These wagons will be found described among others in the succeeding pages of this chapter.*

The good that was effected by bringing together so many examples of ambulance vehicles as were collected on this occasion, by the trials which were made of them, and the discussions which took place on their particular qualities, cannot be at present thoroughly estimated. The observers were so numerous that it is only reasonable to suppose that the information gathered must have laid the seeds for the production of many further improvements in the future. Experiments based on the observations made at Paris are already in progress in different countries. Before the year of the Exhibition was concluded an experienced medical officer of Her Majesty's Indian Army, Surgeon-Major Dr. Francis, had been led by his studies of the collection at Paris to invent a new form of ambulance wagon for use in India, which will very probably be subjected to the test of trial in the country for which it was designed. And as the authorized ambulance wagon of Her Majesty's British service is generally held not to be free from important defects, it is to be presumed that in any alterations of construction that may hereafter be adopted, the information gained in the inquiries on the subject at Paris will not fail to be turned to account.

Before commencing a description of special examples of ambulance carts and wagons, it will be useful to consider the general advantages and disadvantages belonging to this kind of sick transport for military purposes, bearing in mind more particularly the circumstances under which they have to be employed with troops on active service. It will also be useful to try to determine the principles on which all such vehicles should be constructed, and to note any circumstances that lead to the necessity of special arrangements as regards our own country; and further, to consider the comparative merits and fitness for service of the two leading forms of these conveyances, viz., two-wheeled carts and four-wheeled wagons. Both forms have been used in military service, and very different opinions have been expressed and are still entertained by competent and experienced judges of their respective merits.

SECTION II.—MILITARY ADVANTAGES OF AMBULANCE CONVEYANCES DRAWN BY ANIMALS.

The acknowledged necessity of having a regular and efficient system for transporting the sick and wounded of armies on the line of march as well as after an action with the enemy, has

* See Appendix, Note, 5.

been already enlarged upon in the opening chapter of this treatise. But further, it is now generally agreed that wheeled conveyances of some form or other drawn by animals constitute an essential part of the means to be provided for carrying this purpose into effect under the ordinary circumstances of modern warfare. That they are occasionally to be dispensed with when more important interests are at stake than the safety of the wounded of a particular force, as in the rapid movements of incursionary attacks or of reconnoitring expeditions, does not militate against the general principle of their regular employment with troops on active service. The conveyances carried by men, and those borne on the backs of animals, in European warfare, are usually to be regarded as expedients for meeting temporary purposes or special circumstances. The former cannot be employed for long distances owing to the limited number of bearers usually available, and to these quickly becoming fatigued; the latter are ill adapted for the carriage of sick or wounded for prolonged periods, and should only be so continuously employed when the surface of the country or other circumstances do not admit of wheeled transport being used. This has been already sufficiently shown in the several pages descriptive of these kinds of conveyance. But wheeled transport drawn by animals can be adapted to almost all the necessities of sick and wounded men over ordinary roads, as far as any kind of land transport can be arranged to meet them, and its progress can be maintained quite as well as the progress of the stores and matériel of the army. These qualities of wheeled ambulance conveyances make them especially suited for use on the line of march, and it has been long since proved that in the sustained movements of armies, especially when a force is numerically only adequate to the necessities of the occasion, the means of carrying for a few marches the men who suffer from the temporary ailments which constantly arise among troops on active service, or from slight injuries which only incapacitate them for duty for a few days, is a real military benefit. It is so, firstly, by preventing the strength from being diminished as it would otherwise be by such men being left behind or sent to the rear, and, secondly, by preventing the evil results which invariably follow the detachment of men from their corps when active operations are in progress. But as the ready mobility of an army is a quality which gives to the commander of it the greatest facility in handling it, commanders look generally on such incumbrances with little favour. From knowing there is so much temptation to carry a variety of things on field service they dread that if one cart be admitted for a given purpose other carts for other purposes will follow, and the impediments of the army be constantly increasing. Sir James McGrigor states in his autobiography* that when he joined the army in the Peninsula as

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Wheeled ambulance vehicles an essential part of army equipment on field service.

Importance of this part of field hospital equipment.

Superiority of wheeled conveyances to other kinds of transport on the line of march.

* "Autobiography and Services of Sir James McGrigor, Bart.," 1861, p. 265.

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Sir J. McGri-
gor's account
of Lord Wel-
lington's objec-
tions to regi-
mental ambu-
lance vehicles.

Regimental
ambulance ve-
hicles can only

Principal Medical Officer under Lord Wellington in 1812 he found the hospitals in rear crowded with an immense number of sick, or reported sick, and wounded officers and men. One consequence was that a disproportionate part of the medical officers of the army was detained in the stations where this accumulation of sick had occurred. To remedy these evils Dr. McGregor submitted to Lord Wellington a proposal that each corps should have a temporary hospital of its own, where slight cases of wounds and disease might be treated by the regimental surgeons, and that only special cases of either wounds or sickness should be sent to the rear, and these only after examination and reports by medical boards. The same rule was to apply to officers. Lord Wellington fully approved of these arrangements, as well as of other regulations having the same end in view; but when Sir James McGregor proposed further that each regiment and brigade should have provided for it the means of conveying its hospital establishment, Lord Wellington would not hear of it. He said he would have no vehicles with the army but for the conveyance of guns. He admitted it was lamentable to see so many men slightly ill or wounded sent constantly to the rear, and diminishing the force of the army in a greater proportion than the reinforcements from England were adding to it; but he said:—"I cannot risk encumbering the army and "impeding its movements either in advancing or retiring." Notwithstanding, however, the objections which then existed in Lord Wellington's mind on this subject, and which were not improbably due in a great degree to the peculiar circumstances of the occasion, the secrecy and rapidity with which the army was moving upon Badajoz with the intention of investing the place before the French commander could get down to relieve it, the practice of having a cart to carry slight cases gradually crept in, even during this march; for the regimental commanding officers, being unwilling to part with men at a time when every bayonet was of importance, did everything they could to keep with them all sick and hurt who were likely to be able in a few days to resume their places in the ranks, and the regimental medical officers readily entered into their views. And so it came to pass, Sir James McGregor remarks, that "few corps "were to be seen without a cart to carry their slight cases "with them when they marched."* The carts here referred to were the ordinary country carts of the country. It is quite obvious that if carts are to be used at all, properly constructed

* "When I passed the different divisions of the army, and saw the description of sick they were depositing at the appointed stations on the route, I entered into conversation with the regimental surgeons, all of whom agreed with me, that if they had only some kind of conveyance, such as the common carts of the country, it would be necessary to send but few men to the rear. Their commanding officers were of the same opinion, being very unwilling to part with a man in moments of emergency; but having no authority, they feared to incur censure by carrying slight cases with them. This practice, however, gradually crept in; few corps were to be seen without a cart," &c. Op. cit. pp. 267, 268.

carts, authorized and maintained under definite regulations, will answer the purposes for which they are employed much better as regards the sick, and be less likely to become incumbrances to the army, either by accidents happening to the vehicles themselves or by the loss of the animals attached to them, than when they are casually obtained from the inhabitants of the places through which an army may be marching, without any fixed plan for their maintenance and protection, as happened on this occasion. Indeed, without such authority and provision for their maintenance, conveyances taken up by regiments must prove frequent sources of vexation and disappointment under any circumstances, and will constantly be liable to have to be abandoned, whatever care and attention may be given to them by the regimental authorities interested in their preservation. The advantages of the system of carrying on slightly sick men was generally acknowledged during the campaigns of the Peninsular war, and spring wagons were not unfrequently ordered to be attached to regiments for the purpose from the wagon train. Subsequently hospital wagons were regularly issued to regiments as part of their field equipment. Two ambulance wagons, one for carrying sick or wounded men, the other a wagon for stores, were attached to every regiment forming a part of the army of occupation in the year 1815. The system of regimental issue was not followed in the Crimea, owing probably to the stationary nature of the operations in which the troops were engaged; but the ambulance transport was attached in fixed proportions to divisions of the army. According to present arrangements, a certain amount of carriage for sick and wounded is to be issued to every regiment on taking the field. By the code of Medical Regulations of 1859 one ambulance car is to be assigned as part of the regulated field equipment of every battalion 850 strong; and this car is to be capable of conveying six or eight men, besides fourteen stretchers and other articles of equipment.*

Should vehicles specially constructed for the carriage of sick and wounded be sent with armies, or vehicles competent to carry either stores or sick at discretion alone be admitted among its transport matériel?—Although wheeled conveyances specially constructed to fit them for transporting sick and wounded, and solely devoted to hospital purposes, have been constantly used since the time the spring wagons were authorized during the Peninsular war, yet the question has often been raised, whether it would not be better to have only one kind of transport vehicles in an army—vehicles rendered available by special construction and adaptations, not only for the carriage of the sick, but also for carrying every kind of store and supply required during a campaign. The question has been argued very ably and much consideration given to the right solution of it by persons holding very different, indeed opposite, views on the subject. Those who

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be maintained on active service when properly authorized.

Question of special and composite sick-transport vehicles considered.

* "Army Medical Regulations," para. 3, p. 69.

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Supposed advantages of having only one form of vehicle both for carriage of sick and stores.

Practical objections to this system.

Advantages of special vehicles being appropriated to particular departments.

have urged the advantages of having only one kind of transport vehicle for all purposes have based their views principally on the general fact that, whereas stores and supplies are required to be brought from the rear to the front, while sick and wounded have to be carried from the front to the rear, as a consequence, if two sets of conveyances are used, each will be unemployed while moving in one of these directions; and that, on the other hand, if a kind of transport common to both purposes be used, it can be employed equally in both directions. That there is a certain amount of truth and force in this argument cannot be denied; but the argument would be really much stronger than it is if the general principle on which it is based were found in practice to be constant and uniform in its action. But this is not the case. No dependence can be placed upon there being sick or wounded to be removed exactly at the time when the vehicles which have brought up stores are compelled to return; nor again, upon those vehicles being available at the very time when it is essential that the army in front should be disencumbered of its sick. It is practically not possible to make the two services dovetail into each other, for each, especially the hospital service, is subject to casualties which cannot be subjected to rules of time or place. Moreover, this divided duty not only interferes with the ability which is so desirable for efficient administration in each branch of the public service, to rely upon the means being at hand for meeting urgent wants which may casually arise at any time, and so of preparing beforehand the course of action to be adopted according to particular events, but also in a great degree destroys departmental responsibility. If a certain number of special vehicles be handed over to the Medical Department, the General in command has a direct control over that proportion of hospital transport being kept always ready for use; for, not being available for any other purpose, there can be no excuse for its not being always in an efficient condition. And lastly, by each kind of carriage being specially constructed for the particular purposes it is designed to fulfil, there is every reason to hope that greater perfection of adaptation to those purposes will be attained. There is, of course, a saving in first cost, in labour of construction, and greater facility as regards the general administration, when only one kind of wheeled vehicle for transport is allowed for all the wants of an army:—for the conveyance of hospital, commissariat, and camp stores, as well as for the conveyance of the sick and wounded, as happens in the French service. But to effect all these purposes the conveyance has to be reduced to such a simple form that it ceases to be fit for the service last named, and the sick and wounded carried by it suffer proportionably. The “caisson unique” of the French army has none of the qualities required for a good ambulance conveyance; the French army is in fact destitute of any proper wheeled carriage for sick among its regular army equipment, although on certain occasions comparatively lately, as in Algeria and Mexico, and in particular places, they have used carts and wagons with

special construction for carrying sick and wounded.* Their practice, therefore, has but little weight on either side of the question.

Regimental and brigade conveyances particularly designed for carrying the field hospital equipment are occasionally fitted with arrangements for adapting them, in addition, to the carriage of sick soldiers. This is for the most part a useless complication, for the circumstances of campaigning scarcely ever admit of the equipment carts being employed for the conveyance of sick to the distance at which hospitals in rear are usually placed from the field hospitals. The regular contents of the carts must be removed to admit of them being so used, and it can rarely be prudent to separate the equipment from the means of its conveyance on active service for any length of time. Such a practice, if adopted, is also very likely to lead to disorder and loss of stores. The right principle seems to be, then, so far as an army moving in the field is concerned, that such an average amount of wheeled transport both for conveyance of sick and of hospital stores, but each distinct from the other, as may be expected to be constantly required for use should be allowed to each separate part of the army, excess and deficiency being equally guarded against; and that these vehicles, with a proportionate amount of reserve transport, should be issued for the use of, and placed under the direction of, the Medical Department, just as ordnance, commissariat, and other transport vehicles are attached to the respective departments which are held responsible for the discharge of the duties connected with the particular services to which they belong. When no longer required for the special occasion or service which has led to their issue, they should be returned to the train or whatever department may be in charge of the general transport of the army.

Although, however, this system appears to be the most consonant with the maintenance of the efficiency of the different parts of an army acting in the field, it does not follow that the same system is necessary, or would be the best, as regards the transport arrangements between the army and its base. There must always be a certain number of sick-transport wagons unconnected with those belonging to the army in field, for the general duties between the intermediate hospitals and convalescent depôts established at different points of the line upon which the army is operating; and no objection offers itself to these conveyances being so constructed as to be available both for commissariat and hospital purposes, provided a plan can be devised by which their general efficiency will not be interfered with in either capacity. Or if supplies have to be brought from a port on the seacoast and carried to depôts, it seems only reasonable that transport vehicles of a mixed character may under such circumstances be employed with advantage. Inter-

Field-hospital store-wagons with adaptations for the carriage of patients.

This complication of little practical value.

Special vehicles for carriage of sick and wounded should be provided for an army in the field.

Conveyances adapted for carrying stores as well as sick are best between the intermediate hospitals and base of operations.

* The *voiture d'ambulance Macou*, used in Algeria and Mexico (see p. 342), and the *omnibus voiture d'ambulance* in use with the army in Paris (see p. 380).

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Circumstances
on which the
distinctions
above-named
are founded.

mediate hospitals will in all probability be established at the same places where the army depôts are. Such hospitals generally contain soldiers suffering from disorders which have become chronic; or from wounds of such a nature as to destroy their further efficiency for active service; and these men are usually only retained until an opportunity occurs of removing them to England. The circumstances of such patients differ greatly from those of patients in field hospitals; neither their own condition, nor their position relatively to the active part of the force, renders their removal a matter of urgent necessity, while, at the same time, they can usually be removed at any time when the opportunity of removal presents itself. In this case, a description of conveyance fitted on the one hand for bringing stores and supplies to the magazines and depôts, and on the other, for carrying back from the depôt hospitals those sick who have been disposed of as invalids for embarkation to England, is calculated to be most advantageous; for the system would not only not interfere with any special requirements of the service, but, on the contrary, would present many features that would tend no less to economy than to usefulness.

Effect of ges-
tation in the
open air on
convalescent
patients.

It is not to be expected that mixed vehicles, if thus employed, will present all the advantageous features of specially contrived ambulance wagons. The springs can not be so perfectly adapted to the weight of the sick, and yet they may have to be carried in these secondary wagons for many days together. But although the results may not be so beneficial as if the conveyances were of a kind more suited to the usual circumstances of patients, still there is no doubt that to sick men who have been for some time confined in the more or less vitiated atmosphere of an hospital, the mere effects of being carried in the open air, even in indifferent vehicles, are usually highly beneficial. The jolting of springless vehicles is particularly objectionable to men suffering from recent or inflamed wounds, but it would appear from experience that even to these patients the injury from transportation in such conveyances is less than the injury which attends their detention in places where they are much crowded together. In the Italian campaign of 1859 large numbers of the Austrian wounded were carried long distances under circumstances of very defective transportation, but the mortality among them was less than it was among those who were retained in the overloaded hospitals near the seat of war.* The French experience gained in the same campaign has also tended to establish this fact.† The philosophic Dr. Jackson, author of the well-known work on the constitution of armies, has written at considerable length on the useful effects of gestation in the open air to both sick and convalescents, and quotes many examples of

* "Das Krauken Zerstreunungs-System," Von Felix Kraus, Ober-Stabarzt. Wien, 1861.

† "Notice sur l'Hygiène des Hôpitaux Militaires," par Bon. Hte. Larrey, Paris, 1862.

its beneficial application.* Dr. Jackson was led to consider that the influence of the pure air was multiplied by the act of progressive motion in wheeled carriages, and that, in a certain proportion of cases, even the fact of the sick men being agitated and roused by exercise during the jolting of the vehicles placed them in a condition more favourable for recovery, than if they had been allowed to remain at rest in the wards of a hospital. The circumstance, therefore, of conveyances adapted both for carrying stores and sick, not possessing all the advantages of carriages constructed for carrying sick only, is not a sufficient reason to prevent them from being used in the situations, and under the circumstances, already above described.

To sum up the arrangements then, the system of employing specially constructed vehicles for the carriage of sick and wounded, not applicable to the carriage of stores, is the most efficient, and therefore in the end the most economical, for an army operating in the field; while, as regards transport communication between the several intermediate hospitals established along the line of operations of the army, and between them and the base, the use of carriages of a mixed kind, that is, vehicles capable of being adapted both to the carriage of stores and of sick, appears to be practically free from objections, and at the same time to be more economical as regards cost, taking into the estimate the amount of work done, than the use of special conveyances for each service.

SECTION III.—REMARKS ON HORSES IN RELATION TO THEIR EMPLOYMENT AS DRAFT-ANIMALS WITH SICK-TRANSPORT CONVEYANCES.

Observations are elsewhere made on this kind of horse most fitted for *carrying* sick and wounded. A few further remarks on the quality of horse suitable for *drawing* wheeled vehicles containing sick and wounded, and on certain circum-

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Dr. Jackson's views.

Summary of the question of two kinds of wheeled sick-transport vehicles being used.

* See Dr. Jackson's work on Fever, Edin. 1808, ch. 3, p. 398, "History and Effects of Gestation in the open Air in Wheel-carriages or other Conveyances, employed as a Remedy for the Cure of certain Conditions of Febrile Disease." As this work is rare, the following example, which occurred in the Buffs, one of the regiments comprising the army which retired from Holland in 1794-95, and with which Dr. Jackson was at the time serving, seems worth quotation. "In the subsequent part of the retreat, from the 20th of January to the beginning of April, the Buffs sent no sick to general hospitals; for it now, in common with other regiments, obtained permission to hire or press wagons for the transport of its incumbrances, and among others, for the transport of its sick. * * * The effect which the act of transport produced upon the sick and convalescent in this retreat was here well ascertained. The weather was sometimes intensely cold; strong frost in the early part of it, rains and fogs in the latter. Under these inconveniences the sick were moved in the rear of the corps; and though they were sometimes ten hours or upwards in the open air, I was not able to discover any material injury produced as the effect of such hardship; on the contrary, the benefit was for the most part great and visible," p. 416. The wagons used were common carts without springs and not covered, clean straw being laid down for the patients. In studying Dr. Jackson's remarks, on the effects of removing men from hospitals and carrying them in the open air, the then existing state of the hospitals as compared with their present condition must not be forgotten.

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—Kind of horse
fitted for the
draught of
ambulance
vehicles.Strength of
draft-horses.

stances connected with the application of horse-power for this purpose are now introduced. In Europe the use of horses for draft labour is universal; in the East and at the Cape of Good Hope, oxen or buffaloes are largely employed instead of horses.

On considering all the circumstances of ambulance vehicles, the nature of the work to be done, the usual rates of progression, the fact of the same horses having to work continuously the whole day, and often for many successive days together, it becomes obvious that the kind of horse which is most suitable for their draught, approaches more closely to that of the best breed of cart horses than to any other sort. Some of the qualities which distinguish the charger, the carriage horse, and the best descriptions of coach horses,—high speed and mettle, and especially what is called good action, lifting the feet high by free movements of the knee, showy pace, elevated crest and spirited carriage of the head,—are not only not required, but, indeed, are some of them very objectionable qualities in horses destined for the draught of ambulance wagons. Strength, a moderate amount of speed, prolonged power of endurance, a sound and vigorous frame, with the other qualities common to all horses liable to be employed in campaigning, are what are wanted in draft horses for these vehicles. There can be no doubt that the strength of horses is better applied in drawing than it is in carrying heavy weights. In the one case his muscular power is more or less interfered with according to the manner in which the weight to be carried is fastened on the animal: in the other, his muscular power is almost entirely free and unfettered. By the animal throwing his centre of gravity forward in the act of drawing, the weight of the animal itself is utilized and made subservient to the object to be attained, viz., the traction of the load; for his weight is thus made to act as an increment to his muscular power,—a help which is not experienced when the burden is placed upon his back. But it very much depends on the manner in which a draft-load is attached, on the construction of the vehicle and the way in which the horse is harnessed to it, whether the animal's strength is economically expended or otherwise. If the load be placed too high or too low, at too great a distance from the animal, if the line of draught from the load to the animal's shoulders be indirect, if the wheels be too small so that friction is unduly increased, the labour of the animal will be proportionably added to, and much of his strength will be expended in vain so far as the special objects of its employment are concerned. It is self evident, therefore, since all vehicles for the carriage of sick and wounded should accommodate as many persons as the strength of the animals attached to the carriage is competent to remove, and equally important that no interruption shall occur in the service, that those whose province it is to construct these conveyances, should fully understand the nature and functions in this particular direction of the animals on whom the duty of drawing the vehicles and their loads will be afterwards imposed.

On referring to the average work done by English cart-horses acting singly, under which condition it is understood a horse best exerts his power, it appears that as a general rule these animals labor from eight to ten hours a day six days in the week, at a pace varying from two to three miles and a half in the hour, and that the load drawn rarely exceeds twenty-four hundredweight. The weight of the cart must be added to the weight of the load, and this is generally about seven hundredweight more, making a total of thirty-one hundredweight drawn by the animal. This statement refers to the work done by cart-horses under the ordinary circumstances and over roads of mixed conditions in England; and the calculation closely agrees with the observations of Mr. McAdam in his experiments with single-horse carts over hard roads, quoted in page 332.

Work done
by English
cart-horses.

The load which a horse is able to draw is very greatly influenced by two circumstances, viz., (A), the rate of speed at which he is required to proceed; and, (B), the degree of friction between the vehicle and the surface over which it is drawn.

A.—As a general rule, the greater the speed the less is the load which a horse is able to draw in a day's work. It is sometimes stated as a maxim that the load which may be moved increases with the time, or, in other words, is inversely as the speed*, that is, if the speed be doubled the load should be halved, if twice doubled should be quartered; but this can only be practically true under particular circumstances, and should not be accepted as a rule of universal application. The rate of progression mentioned above as the average pace of English cart-horses with full loads, viz., from two to three and a half miles in the hour, is the rate which is usually regarded by farmers and others as the most advantageous for the labour referred to. Mr. Fairbairn's observations have led him to state that a horse performs the greatest amount of work when he travels at the rate of three miles an hour.†

Influence of
speed on work
done by draft-
horses.

B.—The influence of friction on the draught is known to everyone, but the following ratios which represent the proportionate amounts of effective loads, or the utmost labour a horse can perform in one day, in the different systems of transit mentioned, will serve to indicate this influence with more precision. They are taken from Mr. Fairbairn's work before quoted.

Influence of
friction on
work done by
draft-horses.

Forms of Transport.	Ratios of Labour performed.
Horse drawing a load in a wagon on the common road	7.5
Horse drawing a load on a railway - - -	131.1
Horse towing a load in a barge on a canal - -	134.5

* See useful information for Engineers, by W. Fairbairn, C. E. 1866, page 33.

† Op. cit., p. 34.

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The amount of friction with a cart or wagon depends greatly on the size of the wheels. The larger the size of wheels, other things being equal, the less is the friction and the easier is the draught for the horses, or, in other words, the greater is the power of overcoming the ordinary obstacles on a rugged road. But when the height of wheels applied to an ambulance wagon is considered, other circumstances have to be taken into account besides their influence on the draught, such as the height of the floor, and the necessity for sick and wounded men being got into and taken out of the vehicle with the utmost facility. These circumstances are, however, noticed elsewhere.

SECTION IV.—REQUISITE QUALITIES OF WHEELED AMBULANCE VEHICLES.

Certain qualities essential to carriages designed for the removal of sick and wounded of armies in the field.

Enumeration of these qualities.

Elasticity by means of springs or other contrivances.

Capacity adequate to the draft power employed.

Accommodation for recumbent as well as sitting patients.

Portability of the vehicle itself.

Means of repairing damage, and replacing losses, of parts of the conveyance.

Proper relation of strength, weight, and draught.

Provision for carriage of water and surgical requisites.

There are certain necessary qualities in conveyances moved by draft power intended for the carriage of sick and wounded men, and certain provisions necessary to ensure their efficiency, that are common to all such vehicles whatever may be their individual forms. These may be enumerated and considered with advantage before noting the special construction of particular carriages. They are the following :—

1. The conveyance must be fitted with proper springs or other contrivances in order to prevent the force of the concussions, which the vehicle will be subjected to in travelling, from being directly communicated to the patients within the conveyance.

2. The conveyance should be fitted to carry the greatest number of sick or wounded that can be got along by the amount of draft power employed, consistently with due provision for all the other requisites of an ambulance vehicle.

3. Provision must be made for the conveyance of men in a recumbent as well as in a sitting position.

4. The carriage must be capable of being packed up for transportation on board ship, and capable of being readily put together again for use on landing. This more particularly applies to carriages in the British service.

5. Provision must be made for repairing parts which are liable to be damaged, and replacing those which may be lost, especially such as are essential to the efficiency of the whole conveyance, as the wheels, for example.

6. The strength of the vehicle must be adequate to meet the shocks it will be liable to in campaigning, but this power of resistance must not be obtained by adding to its weight to such an extent as to unfit it when fully loaded for the draught, and continued exertion over all kinds of roads, of the number of animals it is intended to be drawn by. Durability and lightness of draught must be made mutually consistent.

7. Provision must be made for the carriage of water, a few stretchers, means of light, and such surgical articles and re-

storatives as the wants of wounded men in the field usually demand.

8. The vehicle should be provided with the means of protecting those who may be carried in it from rain, dust, and the glare of the sun.

Protection from rain, sun, and dust.

9. There must be a free circulation of air in the vehicle, especially in that part where the recumbent patients are placed.

Sufficient aeration of interior.

10. Arrangements must be adopted so that patients may be lifted into and removed from the carriage with ease to the bearers, and without risk of injury to the patients.

Facility of placing patients in and out of the carriage.

11. There should be ready means of communication between the sick, and the attendants, or others, who are in charge of them.

Ready means of communication between patients and conductors.

12. A place should be allotted for the knapsacks, arms, and accoutrements, of the wounded men who are carried in the conveyances.

Place for knapsacks, arms, and accoutrements.

Remarks on the foregoing list of requirements.—In the list of requisites just enumerated I have not included those for simplicity of design, general stability, limits of breadth and length, facility of turning in narrow roads, and other mechanical subjects of equal importance under the circumstances of campaigning, but which are common to all military wheeled vehicles, whatever may be the purpose of their construction. I have only mentioned qualities which are of particular importance to form a good *ambulance conveyance for the carriage of sick and wounded*, and these I propose now to consider a little further in detail.

1st. *As to the springs.*—Little need be said as to the need of springs. A cart or wagon without springs has its body intimately connected by bolts or other means with the axletree and wheels so that the whole is knitted together into one piece, and a sudden stroke or jolt communicated to either wheel is directly transmitted to the floor of the machine, and to anything placed upon it. The torture inflicted on wounded men, the injury added to the wounds themselves in many instances, especially to those in which bones are broken and splintered, the consequent increase of hazard to life, equally with the suffering and irritative fever caused to patients debilitated by severe illness, when they are subjected to the incessant unmitigated jarring, and occasional violent shocks and jolts, which are inseparable from the movements of springless carts and heavy wagons over ordinary country roads, and much more over roads that have been ploughed up into ruts by the constant passage of vehicles, are known to all who have thought on the subject, and sufficiently indicate the necessity for means by which such evils may be obviated. But it is not an easy matter to adapt springs so that the object sought for may be equally attained under all circumstances; for the strength of springs must be adjusted to the weight which is

Remarks on the need of springs.

Adjustment of springs to the weights carried.

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Adjustment of
springs.

placed upon them, and the weight in ambulance carriages cannot be calculated as a constant quantity. Again, if the road over which the vehicle is passing be very uneven, the pressure on the several springs will vary according to the inequalities of level, and their influence being proportionably disturbed, an unequal effect will be produced on the occupants of the carriage according to their position. Various plans have been resorted to for ensuring an evenness of result under all circumstances:—of breaking the concussion alike whether the vehicle be occupied by its full complement of patients or only by one or two. Some of these methods will be referred to when describing the particular carriages in which they have been employed. The material by which the elastic quality is given is not alike in all vehicles. In some ambulance conveyances the springs are made of steel and resemble ordinary carriage springs, in others they are made of vulcanized india-rubber. There is one serious objection to the use of india-rubber for springs in vehicles which are subjected to occasional severe strains and are designed for use in all climates. However elastic, and perfect in all respects, the india-rubber composition may be when first applied, it is liable to deteriorate gradually, more especially if it be employed in a hot climate. White lead, sulphur, and other matters, usually constitute some among the various ingredients of vulcanized india-rubber, and, in consequence, a chemical action slowly takes place within its substance, even though the material may be lying unemployed, and the result of this action is such that the homogeneous character of the rubber is lost, it acquires more or less of a granular condition, and is easily torn asunder. This deterioration occurs more rapidly when it is subjected to much straining, and when once this change has occurred throughout the spring, it is rendered useless for the purposes it was intended to fulfil.

Objections to
the use of india-rubber
springs.Different systems of springs
employed in
ambulance
vehicles.

The springs are of such a description in some vehicles that the concussion is only once broken or once removed from the persons carried in them; in others, the springs are so arranged as to place it at two removes from the persons carried. A third remove is gained in some vehicles by an interior set of springs, either acting upon or forming part of the stretchers on which the patients lie within the vehicles. As the regular supply of ambulance conveyances must on emergency be supplemented by country carts and wagons without springs, it has been proposed that all stretchers should carry springs, to obviate the ill effects of transportation in such vehicles. But these are matters which have been referred to elsewhere, when discussing the subject of stretchers. In all conveyances for carrying sick or wounded, elasticity properly regulated is, for reasons already given, an essential quality.

On the capacity
of ambulance
vehicles.

2nd. *Proportion of capacity to draft-power.* — Economy dictates the rule that the capacity of a vehicle as regards the number of sick to be carried by it should be fully equivalent to the draft-power attached to it, consistently with other

requisites. At the same time it must be admitted that it is very difficult to lay down distinct rules for the number of sick to be carried by conveyances according to the number of horses by which they are drawn; for variations in the qualities of the horses employed, in the nature of ground over which the conveyances may have to be used, in construction according to the positions in which they are adapted to carry the patients, and in other such circumstances, constantly occur to modify regulations formed on the subject from ordinary data. In practice we find carts drawn by two horses, which have been constructed to carry only two sick or wounded men lying, thus allowing one patient to one horse; we find others, with the same amount of draught, designed to carry two, or even three men lying, and in addition nine persons sitting, allowing even six patients to one horse. So we find wagons drawn by two horses designed to carry eight wounded men and a driver, or four and a half men to each horse; and wagons drawn by four horses, designed to carry ten wounded men and two drivers, or three men to each horse. These different arrangements serve to exhibit the varying amounts of accommodation which have been provided in different vehicles. Extended observation and experience can alone furnish a safe test of the proper proportions to be preserved for the conveyance of the greatest number of sick at the least possible expense of horses and drivers; extremes either way may, however, be avoided by keeping the precept on which these remarks are founded always in view. It should be borne in mind that calculations cannot safely be based on the power of draught possessed by horses or mules in England, on fair roads, or even, on moderately rough ground, for the power of draught obtained from animals in other countries, as well as the condition of the roads, may upset all calculations based on such data. They may, however, be employed to ground calculations upon, provided the whole ambulance establishment is thoroughly organized before starting, and not only the carriages, but the horses with harness fitted to them, skilled drivers, and all the necessary artificers, are also sent out complete and efficient, as is done with batteries of ordnance. This cannot be said to have been done with any ambulance establishments hitherto despatched on foreign service from England.

Variations in the capacities of different ambulance vehicles.

Draft-power of animals.

Whether sent so complete, however, or whether to a certain extent the ambulance establishments are made dependent for their movement on animals purchased abroad, every ambulance carriage should be provided with means for readily attaching to it additional animals in case of necessity. Unexpected difficulties will constantly arise on active service in campaigning to render this arrangement necessary, however well contrived and provided a conveyance may be.

Means of attaching additional horse-power necessary.

The terms upon which the prizes before alluded to were offered for the best ambulance wagons at the Paris Exhibition of 1867 laid down that each vehicle was to be drawn by two horses only, and

Capacity of the prize wagons at Paris.

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that it was to be capable of carrying two persons lying down and two seated, or eight persons seated when none were carried lying, together with a driver riding postilion. There does not appear to have been any obvious reason why only two patients should be carried in a sitting position when two were carried recumbent; a better proportion would have been four sitting with two recumbent. There would then have been capacity in each vehicle for six patients, or, the driver with an attendant being added, for eight persons in all, nearly the same weight as the carriage was directed to be adapted for when all the patients were carried sitting, and not in any case an over-load for two horses provided the vehicle itself be not constructed of undue weight, and the draft-power of the horses employed is of a proper average amount.

Capacity proper
for a wagon
drawn by two
horses.

Capacity for receiving eight persons, including driver and attendant, seems to be a fair estimate of what an ambulance vehicle drawn by two horses should possess; each horse will then be carrying three patients, and other things being consistent, it is only reasonable to believe that with such a load the transportation of the sick is not under ordinary circumstances likely to be interrupted.

3rd. Accommodation for recumbent as well as sitting patients.

—Remarks have already been made in a previous chapter on the general proportion of accommodation for patients in a recumbent position to that for patients in a sitting position desirable to meet the exigencies of a campaign. But in considering the disproportionate supply of each mode of accommodation as regards carts and wagons, when the vehicles are turned to full account and carry a load equivalent to the force of draught, we at once perceive that the allotment for the two kinds of accommodation must be determined in a great measure by the kinds of vehicles employed. Some conveyances are constructed solely to accommodate recumbent patients. It does not follow as a matter of necessity that separate vehicles should not be designed only for men to be carried in a recumbent position, and others for men sitting, as will be found to have been the case in several of the forms of vehicles hereafter described; but, taking all the circumstances of campaigning into view, and remembering the unforeseen accidents which occasionally occur to defeat all previous arrangements on active service, it appears to be certainly the safer plan to construct every carriage with a certain amount of accommodation for men requiring each position, whether lying or sitting. The accommodation for the recumbent patients need never be lost; when not required for appropriate cases it can always be made available for sick or wounded men who under ordinary circumstances would be able to sit up. By having both recumbent litters and seats in every conveyance, all kinds of casualties are provided for, and possible contingencies met, so far as the space at command in the vehicle admits. Under any circumstances, whether the conveyance be only for men lying

Some ambulance vehicles built only for sitting or recumbent patients.

Accommodation for both sitting and recumbent patients should be provided.

down, or of a mixed kind for both lying and sitting, it is difficult to provide for more than two patients lying at full length with safety and convenience; for military limitations as to the width between the wheels necessitate the litters for their accommodation being placed in the direction of the long axis of the vehicle, and in this direction more than two litters cannot be conveniently placed. The only exception is when a wagon is built up, as it were, into two stories, so that two recumbent patients may be placed above two others lying below, the sitting patients being all together at one or other end of the conveyance. This was the plan adopted in some of the four-horse ambulance wagons sent out to the Crimea. It has also been employed in certain two-horse wagons in the United States and in Italy, but it necessitated a greater height and a more considerable bulk in all directions than seems to be desirable in these vehicles. The position of the additional weight above, adds to the difficulty of construction so far as the preservation of the centre of gravity within the wheels is concerned when the vehicle has to pass over uneven ground. The risk of the vehicle being upset, and consequently of danger to the patients within, is, therefore, increased by requiring an upper tier of recumbent patients to be carried in an ambulance carriage. One form of cart has been constructed capable of conveying three men in a recumbent position, one between the wheels and two over them; but it was not found to answer on field service, and, when so employed, it was not fitted for carrying any sitters. On the whole, the limitations as to width, length, bulk, and weight, as well as the safety of the patients to be carried, seem to decide that provision for two men lying down cannot be exceeded with advantage, whatever the nature of the vehicle; while in a two-horse wagon, if due regard be given to economy, and the remaining available space of the vehicle be fully employed, the number of persons who can be at the same time carried sitting may be made to vary from four (two being sitting patients with severe wounds) to six (four being sitting patients with light injuries), the driver and an attendant being included in these numbers.

No vehicle to carry more than two patients recumbent.

Two-horse wagons not to hold more than two lying and six sitting.

4th. Portability of conveyance.—The necessity for being prepared to convey on ship-board all kinds of ambulance vehicles to be used in the British service has been already explained. Keeping this necessity in view it is obvious that the great amount of unemployed space included between the wheels, and within the sides of the bodies, of carts and wagons, and consequently their large bulk of outline, renders it especially important that such vehicles should be capable of being reduced in dimensions for stowage and safety on board ship. The sides, end-boards, and wheels must be so mechanically contrived as to be capable of being laid upon the floor of the cart, and thus to form one compact package of the whole. This may be accomplished either by complete separation of the several parts referred to, or by having certain portions previously connected by hinges, so that they may be folded down, while others are capable of being

Ambulance vehicles to be reducible in bulk for stowage on ship-board.

Plans of effecting this object.

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removed and placed conveniently upon them for package. Whatever plan be adopted experience has shown that the vehicles should be capable of being reduced to as compact a bulk as possible; that proper provision should be made for the care and maintenance in easy working order of hinges, bolts, or other mechanical means on which the power of folding together, separating, and connecting the several parts of the conveyance depend; that a fixed plan of package of the several parts of the conveyance in regular succession should be determined upon and invariably practised; and that the whole vehicle should be comprised in one and the same package, so as under all circumstances to be complete and ready for being put together for use without delay.

Execution of
repairs in the
field.

5th. Capability of repair, &c.—To effect this object a certain proportion of artificers, as well as of carpenters' and blacksmiths' tools, must be available. As the general care and conduct of the ambulance transport is placed, with the other transport of the army, in charge of the Military Train, these stores, it may be expected, and artificers, will be always found with that body. The Military Train will then be responsible for effecting the necessary repairs in case of damage, and restoration in case of loss of parts, of a conveyance. A certain number of spare wheels will be carried into the field, as these important parts require considerable time and particular labour for their manufacture. It is the special object of the equi-rotal system of carriages adopted in the British service that when the wheel of any conveyance is damaged it may be replaced with the least possible difficulty. Under this system a proportion of spare wheels of one size only need be carried for replacing the fore or hind wheel of any carriage which may become damaged; whereas, if the wheels varied in size, an increased number of spare wheels would have to be carried to provide for casualties among them. It is, however, a question whether the advantages of the equi-rotal system are not counterbalanced by certain objections. This question will be noticed elsewhere.*

Lightness an
essential quality
of ambulance
vehicles.

6th. Strength and weight of the conveyance.—The lighter the vehicle, consistent with durability, the easier will be the draught, and, consequently, the less will be the distress and injury of the horses during a campaign, and the greater the regularity and speed with which the purposes of the carriage are accomplished. An ambulance wagon does not require to have the specific weight and solidity of frame which are necessary in wagons that are constructed for being loaded with heavy materials, such as have to be carried in the general traffic of civil life, or in the store wagons used in campaigning. It must be sufficiently solidly constructed and carefully put together to be able to resist violent shocks from without, such as are to be met with from passing over rough and uneven roads, and from the ordinary accidents met with in campaigning. Yet it must not be forgotten that the

* See British ambulance wagon, p. 425.

very solidity and weight of the conveyance itself, if carried beyond a certain degree, will tend to increase the momentum, and therefore the violence of shocks to the weaker parts of its structure. If a heavy carriage be rapidly and carelessly driven down the declivity of a ravine and be suddenly brought up by a rock or bank which obstructs the passage onwards, it will frequently be severely strained in some of its parts, when a lighter vehicle would have escaped almost without injury. The principles on which attempts have been made to give the qualities indicated in this paragraph will be found to vary in the plans of each designer. To combine lightness with sufficient strength and accommodation constitutes one of the principal difficulties to be overcome in the manufacture of sick-transport conveyances, and how far the object is accomplished in any particular example can only be ascertained by careful examination and thorough practical trial of the vehicle after its construction.

Injurious effects of overweight.

7th. Carriage of water and surgical stores.—Several methods are adopted for the carriage of the drinking water. In some it is carried within the conveyance, in others in a barrel slung from the bottom. Wherever placed, it is essential that it should be handy for use at a minute's notice, that a given quantity should be procurable without waste, and it is further desirable that it should be kept cool. Various contrivances are also adopted for the carriage of the surgical stores. Sometimes the driver's seat forms a box in which they are placed; sometimes they are contained in a receptacle under the floor of the vehicle. However stored it is essential that these also should be systematically arranged, capable of being easily got at when required, and easily replaced, and that the compartment in which they are carried should be thoroughly protected against wet and dust. The surgical stores for a sick-transport wagon should only consist of such articles as are required for immediate protection, or for the first dressings of injured limbs and wounds; their specific nature has to be determined by professional authority. Two or three stretchers at the least should always accompany each ambulance wagon, and proper fixtures or straps should be attached to the vehicle for their reception and security. They are sometimes conveniently placed in receptacles on the outer surface of one of the sides of the cart; in some instances they are slung from the roof; in others certain situations on or under the floor of the vehicle are provided for them.

Carriage of water.

Carriage of surgical stores.

Carriage of stretchers.

Means of light should also accompany the wagon, in case of its being used at night. Two descriptions of light should be provided; one, a fixed lamp attached to the vehicle itself, the other a lantern that can be carried to any particular object a light may be required for. The lamp attached to the vehicle should be so placed as to give light to the interior, and at the same time to indicate outside by coloured glass, or other means, the nature of the conveyance. Lamps would probably also be required to assist the driver at night. A hand-lantern should also be ready for use; numerous casual circumstances may arise to cause it to be wanted at night time.

Carriage of light.

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Carriage of
stimulants.

If brandy, wine, or other stimulants are carried, they should be under lock and key in charge of an accountable attendant.

Canvas roofs.

8th. *Protection against weather.*—This is frequently obtained by a canvas roof and sides stretched over moveable supports and secured to the framework of the carriage. The material is light and efficient, resists a moderate amount of rain, and its employment facilitates package when the cover is not required for use, or when the vehicle is folded up for conveyance on board ship. Some vehicles are constructed with roofs of a more permanent nature, and are rendered quite impervious to moisture. On the whole, however, a strong canvas cover, with proper means for fixing it securely to resist the action of high winds, appears to answer the purpose of a roof best, if not to be the only kind of cover admissible, for vehicles such as British ambulance wagons, which have to be made capable of being reduced to comparatively small packages.

Double roofs
for hot cli-
mates.

Some Italian carriages were exhibited at the Universal Exposition of 1867 at Paris with double roofs, there being an interval of several inches space, from three to four, between the upper and lower roof. Openings were left in the middle of the under roof, through which the air from the interior of the vehicle could pass into the space just mentioned, from which it could again escape into the outer air through higher openings at the sides of the roof. A draught would thus be created as the vehicle moved along a road, and the ventilation of the interior be better assured. At the same time the double roof protected the inmates of the vehicle from the direct effects of the sun's rays, and therefore kept the interior cooler. A portion of the space between the two covers was in some instances turned to account by being fitted for receiving the arms of the wounded men carried in the conveyance. An arrangement of the kind described possesses many advantages for a vehicle destined for use in a warm climate, and not requiring to be taken to pieces for packing. Hence this plan has been taken advantage of by Surgeon-Major Dr. Francis in his ambulance wagon proposed for employment in India.*

9th. *Aeration of interior of vehicle.*—The wounded who have to be placed in a recumbent position are frequently in a half faint condition, suffering from laboured and imperfect respiration, and, therefore, especially feel the need of a constant supply of fresh air. Without due forethought and provision in this respect, the compartments for the reception of these patients will not improbably be so hedged in and covered over that the free access of air will be prevented, and the suffering of the inmates be much increased. Even want of protection against rain or cold can be borne with more impunity than want of sufficient movement of air. Various plans are adopted for insuring a sufficiently free access of this requisite, such as leaving the sides of the vehicle open or only protecting them by curtains that

* See the description of Locati's Voiture-Hôpital, and Dr. Francis' ambulance-wagon proposed for use in India, pages 400 and 415.

can readily be rolled up, providing jalousied openings when the sides of the conveyance are solid, and making openings in the roof and ends. The plans employed will be again referred to when the several carriages are described, but, as a rule, it may be said that the means have not hitherto been adequate to the need, especially when the recumbent patients are not only shut in by the sides of the vehicle, but the access of air is still further prevented, as usually happens, by the patients who are carried sitting, being placed on high seats in the fore part of the vehicle. In the British ambulance wagon the aeration of the interior litters is interfered with both before and behind by patients sitting at both ends of the vehicle.

Ventilation often insufficient.

10th. *Convenience for loading and unloading.*—The height of the part of the vehicle on which the recumbent patients are placed must be regulated, and suitable arrangements made, so that wounded or very sick men may be got into and taken out of the places assigned to them with the utmost facility. The urgent circumstances of the wounded men, and the not improbable hurry and condition of excitement of the bearers, if the wounds be of recent occurrence; the weakness, suffering, and irritability of other patients who have been some time under treatment, whether for wounds or other ailments, before their transportation; cause it to be very important for every obstruction to the ready transfer of sick and wounded into the conveyance to be avoided. Not only prolongation of suffering depending upon the movement, but accidents of a painful nature are not unlikely to occur if difficulty be met with, either in raising the wounded up into, or placing them in position in, the ambulance vehicles. A want of sufficient facility of loading and unloading formed one of the inconveniences of the vehicles used in the Crimea in which one tier of wounded was placed above another tier of wounded. The wounded destined to be carried in the upper tier could only be got into their places under any circumstances with difficulty, and, unless great care was taken, with risk of their slipping off the stretchers. The same objections equally applied when it was necessary to remove the inmates from these receptacles. The height of the upper receptacles for the wounded in such conveyances should never exceed the average height of the men who are to place the stretchers, upon which the wounded or sick men are lying, into them. It was laid down in reference to the prize ambulance wagon at Paris before adverted to, that the elevation of the benches intended for receiving the stretchers above the ground must not exceed three feet seven inches (1m. 10c.).

Need for ease of loading.

Risks when loading difficult.

11th. *Access to patients.*—The importance of the rule that there should be ready means of communication between the inmates of the conveyances, and the attendants or others who are in charge of them, will be at once understood, when the usual circumstances of the sick and wounded men who will be carried are remembered. On the one hand, the patients themselves should have the power of easily calling the attention of the attendants to wants which will inevitably arise from time to

Communication with patients during their transport.

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Attendants to
accompany
hospital wa-
gons.

time, particularly if the transit be prolonged; on the other, the attendants should have every facility for watching their patients, and, if necessary, for handing them water, or administering help in case of hæmorrhage or any other emergency.

If sufficient medical attendants be available there should always be one with every ambulance wagon of a convoy. Six or eight patients, two of them so ill as to render a recumbent position necessary, will certainly require frequent attention under the circumstances of their transport, and accidents may not very improbably arise that will render the prompt application of surgical aid of vital importance. If, however, it be impossible to spare one attendant for each wagon when several are moving together, arrangements should be made to ensure that ready means of communication are established between such attendants as are sent, and the patients over whom they are placed in charge. A patient should on no account be caused to feel that he is beyond the reach of help till the journey's end, but should understand the way of calling for assistance if he is in case of need, and have confidence that his call will be attended to. This isolation was one of the complaints of the recumbent patients shut up in the tiers of compartments of the Crimean four-horse ambulance wagon; these compartments were sometimes likened to coffins in consequence.

Seat for hos-
pital attendant.

A good plan for carrying the hospital orderly or medical attendant with an ambulance wagon was shown in some of the carriages exhibited at Paris. A seat, small in size, just sufficient to accommodate a person sitting was attached to the back of the vehicle on one side of the door leading into the conveyance. This was designed for the attendant, who, when seated, would have his feet resting upon one of the steps of the carriage. He would thus be in the same position as the conductor of an omnibus, easily supervising the persons in the vehicle, easily called if wanted, and as easily quitting his place to render assistance. In some instances this seat remained fixed in position, in others it was made capable of folding down, or of sliding away under the body of the vehicle, when not required for use. The spring folding seat adapted to the vehicles of the Paris omnibus companies for their conductors might easily be applied to sick-transport vehicles for similar purposes. When down it crosses the doorway, and by its means the attendant would be brought into even closer proximity to the patients than with the seat placed at one side of the entrance.

12th. Stowage of knapsacks, &c.—A soldier should never be separated from his kit in campaigning, and without the provision named under this clause, the knapsacks of the sick and wounded would not unfrequently be mislaid or even lost. The importance of providing means to ensure the safety of the fire-arms and accoutrements is also obvious, for under ordinary circumstances the vehicles will move over ground held by the forces to which the patients belong, and their arms will have to be carried with them. The articles of the Convention of 1864 entered into by the European powers to ensure the neutrality of

sick and wounded troops in time of war, stipulate that the wounded men with their private effects and all ambulance matériel necessary for their care and safety, are to be regarded as neutral and covered by full protection in consequence; but equally plainly lay down the rule that no war materials of any kind shall have part in the neutrality. All that will be necessary to prevent infringement of the stipulations when ambulance vehicles are moving over ground held by an enemy, as happened in Germany in 1866, will be to leave the places provided in the wagons for the arms vacant. The military authorities in such a case will make provision elsewhere for the care of the rifles or other weapons belonging to the sick men.

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Kits and fire-arms of sick and wounded soldiers in ambulance vehicles.

SECTION V.—ON THE COMPARATIVE MERITS OF CARTS AND WAGONS AS CARRIAGES FOR THE TRANSPORT OF SICK AND WOUNDED SOLDIERS, AND ON THE SEVERAL MODES ADOPTED FOR DRIVING SUCH VEHICLES.

Wheeled ambulance vehicles are met with of two forms, and these are most conspicuously indicated by the number of their wheels, viz., vehicles with two wheels and vehicles with four wheels. The former are called carts, the latter, which are in their nature only double carts, are called wagons. The carts are usually built for draught by one horse, the wagons by two or four horses according to the size and kind of vehicle. Provision, however, is usually made in both forms of vehicle for supplementing the regular amount of draught by additional horse power in case of necessity.

It has frequently been a matter of discussion which of these two forms is the most convenient and the most economical for the transport of sick and wounded under the circumstances of campaigning; just as in civil life the like question has been often discussed in respect to single-horse carts and four-horse wagons for the general traffic and farming operations of the country. I will mention the principal reasons which have been advanced against, as well as in favour of, the use of each kind of conveyance, so that they may be mutually compared side by side with each other. Of course, in considering the subject of the best forms for such conveyances, the circumstances of campaigning, of the soldiers who are to act as drivers or conductors, the necessity for carrying the carriages themselves on board ship, and other such matters incidental to the field service on which British troops are liable to be employed, and to which I have before adverted, must not be forgotten. The subject has generally been discussed with reference to single-horse carts, and to such four-horse wagons as were used in the Peninsular and Crimean campaigns. The arguments urged against the use of the latter, can only fairly be applied to wagons designed for draught by two horses when their weight, or the nature of the country, causes their power to be insufficient and renders the addition of two other horses necessary to make up for the deficiency.

Merits of carts and wagons differently estimated.

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This addition will be a matter of frequent necessity when the animals used with the wagons are inferior in size and strength to the English horses whose power of draught has been calculated upon in their construction. Four horses are appropriated to the present regulation wagon of the British service as its regular equipment for the field. (See description of this vehicle, page 419.)

Arguments in favour of the use of wagons for ambulance purposes.—1. Wagons are safer under all circumstances. A wagon cannot be upset so easily as a two-wheeled vehicle, owing to the fact of its resting securely upon firm supports at both ends, instead of only being balanced upon a central support. One of the horses may stumble and fall without risk of injury to the occupants of a wagon.

2. The motion of a wagon is less irksome and fatiguing to a patient than the motion of a cart.

3. The rolling of one or even of two wheels of a wagon can be stopped without difficulty by various mechanical contrivances, and the progression of the whole conveyance be greatly checked at any moment by the friction which follows between each locked wheel and the ground. The risk of accidents to the patients inside when they have to be carried down hilly roads with a steep descent can be thus materially lessened as compared with the risk they are subjected to when carts are employed.

4. Wagons render a less number of vehicles necessary in a campaign.

5. The cost of the equipment is less in providing a given number of wagons than the cost would be of providing a corresponding amount of accommodation for patients in two-wheeled carts.

6. A less number of drivers is necessary. An increase in the number of non-combatants with an army is always an evil when it can possibly be avoided, not merely on account of the expense entailed by the entertainment of the men themselves, but also on account of the additional provision of rations, tentage, and other incumbrances, and this evil is lessened proportionably with the lessening of the number of drivers.

Objections to the use of wagons for ambulance purposes.—

1. Wagons, as they have been usually built, and as is stated to be necessary to make them substantial and strong enough for their size, the weight they carry, and the usage they will be subjected to, are both cumbrous and heavy. When a wagon has broken down in a narrow pass, at the foot of a declivity, or on a bridge, it has proved itself to be a sufficient impediment to stop the progress of a whole force for a considerable time.

2. It requires time and practice to get a team of four horses to work well together; and, even when they have been well practised together, it is almost impossible to maintain with them a continued equality of exertion. One horse will pull hard, while another shirks his work as he finds opportunity; and thus calculations of power of draught, based on the multiplication of the power of draught of a single horse, become falsified in practice.

Safety of wagons.

Their kind of movement.

Economy of wagons.

Drivers with wagons.

Weight of wagons.

Teams of four horses.

3. The sudden occurrence of an injury or illness to one horse of a team paralyzes the usefulness of three others. If one of the four fail in health, the increased exertion exacted from the other three has a tendency to knock them up also.

Effect of injury to one of the team.

4. A wagon drawn by a team of four horses has either two drivers mounted or a driver sitting on a box. In either arrangement the art of driving skilfully can only be attained by proper instruction and long practice. An unskilful driver, especially in bad roads, who has not acquired the art, not merely of conducting the carriage, but also of connecting the efforts of the animals so that they may all pull together and evenly to a given purpose, will cause each horse to be quickly fatigued, will make under any circumstances but indifferent progress, and will not unlikely disable the wagon before a long time has elapsed.

Conducting a team.

5. The capacity of wagons cannot be subdivided. Though only one sick or wounded man may require to be carried, the transport vehicle designed for the carriage of eight or ten men must be employed for the purpose. If a regiment be divided into several detachments, the means of transport allotted to the regiment cannot be divided in proportion.

Capacity of wagons not divisible.

6. The concentrated weight in wagons cuts up roads more than lighter conveyances, though the latter are more numerous.

Effect of wagons on roads.

7. If a wagon be built to be drawn by only two horses, one in shafts, the other attached to a swingletree with the driver postilion fashion, the mounted animal is caused to walk in a kind of trot, and its power of draught is considerably interfered with.

Power of draught of riding horse in wagons.

Arguments in favour of carts for ambulance purposes.—

1. Carts, from their less bulk and comparative lightness, are less likely to be injured or to break down on service than wagons; they are therefore more durable, and consequently in the end more economical, notwithstanding that, owing to the greater number required, they may cost more at first. Should such an accident occur as a breakdown, or should it be upset, a cart can be righted or removed out of the way of a column in a few minutes by three or four soldiers. Their lightness also makes them more manageable in other ways. They can pass over bye-roads which would not be practicable for large wagons. They are moved with greater speed than wagons. They go up-hill more easily, and with less distress to the animals drawing them. The efforts of a few men can help the passage of a cart through a temporary difficulty, over an obstruction, up the slope of a ravine, and such like impediments, when they would be fruitless on a heavy wagon.

Durability of carts.

Advantages resulting from the lightness of carts.

2. When a cart drawn by one horse is used, the horse should be led. Any steady soldier can be taught in one or two lessons to manage and lead the horse as required.

Art of leading a single-horse cart easily learned.

3. It is an advantage for the horse to be led instead of being driven. The expenditure of force in carrying the weight of a mounted driver is thus saved, and it is no hardship for the conductor to walk his day's march, as he will be relieved of the

Advantages of leading.

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- knapsack and appointments which the infantry soldier has to carry the same distance.
- Economy in draught. 4. One horse acting independently will exert his strength more equally in drawing his load, and cannot shirk his work without making his failure at once obvious to the conductor.
- Effect of injury to the horse. 5. If the animal in a single-horse cart meets with an injury that disables him completely from work, or dies, it alone is disabled, and its own proportion of transport only is delayed; if he is only sick or lame, he can be weighted accordingly.
- One conductor may lead several carts. 6. In case of necessity one conductor can take charge of several carts, by each horse being connected by a guiding strap, or rope, three or four feet in length, to the tail-board of the cart in front.
- Less waste of labour with carts. 7. The use of carts obviates the inconvenience attached to wagons of not being able to subdivide their capacity. A certain number of carts can always do the work of a wagon, at the same time that they can be separated to do the work required by a detachment, or meet the wants of one or two sick or hurt men, without unnecessary waste of labour.
- Care of horses with single-horse carts. 8. It constantly happens, where one-horse carts are employed, that a partiality grows with acquaintance between the animal and its attendant. The man's inclination then, as well as his duty, leads him to do whatever work is necessary with the most ease to the horse intrusted to his keeping, to look carefully after the rations allowed for him, and to do all in his power towards preserving the animal's health and strength. Besides, the man knows that the condition of the horse will be a test of the attention he has given to it.
- Number of single-horse carts necessary for a campaign. 9. The objection to carts on account of the additional number of vehicles and drivers required when they are used is more apparent than real, for if it be true that single-horse carts are more durable in campaigning than wagons, then a proportionally less total amount of hospital conveyance for a campaign may be estimated for with propriety at its commencement.
- Load carried in one-horse carts. 10. It is stated that the weight which can be conveniently conveyed by four one-horse carts is considerably greater than that which can be carried by a wagon drawn by four horses. Mr. McAdam, the grandson of the inventor of the modern system of road-making in England, has strongly advocated that single-horse carts should be used in farming operations as a much more convenient and economical method of conveyance than the wagons which have been generally used.* One of his reasons is that four single-horse loads are found practically to exceed the load conveyed by four horses in a team. According to his observations a well formed English cart-horse, of 15½ hands high, in good condition, can draw 25 cwt. over any hard road, independent of the weight of the cart, which should not exceed seven cwt.; so that
- Comparison with loads carried in four-horse wagons.

* Mr. McAdam's views on this subject are fully explained in a pamphlet entitled "Observations on single-horse carts," printed by H. E. Carrington, Bath, 1844.

four such loads would equal five tons of loading, while the weight usually carried by a four-horse wagon is 3 tons 15 cwt. The one wagon is about 5 cwt. lighter than the four single-horse carts together; consequently while, on the one hand, 5 cwt. in the carriage is thus saved, on the other, 1 ton 5 cwt. in the load is lost, or a clear loss of 1 ton in cartage results when the four-horse wagon is used.

Objections to single-horse carts.—These have been already referred to in the arguments urged in favour of the use of wagons. Instability of one-horse carts.

The most powerful objection is that two-wheeled vehicles are insecure and liable to be upset by careless driving, by accidental irregularities of ground, by horses falling, and by the absence of any mechanical means for checking undue progression of the vehicle when its rate of movement becomes accelerated from going down a steep road. The radical source of the risk of accidents arising from the causes just named is the instability which necessarily results from the conveyance being poised on a single axle and pair of wheels instead of being maintained in position, independently of the animal between the shafts, as wagons are, by supports placed both in front and behind the body of the vehicle.

Another objection to the use of carts for ambulance purposes arises from the intimate and rigid connexion between the shafts and the bodies of these vehicles. The shafts and body of a cart form one piece as it were, and, as a consequence, when the horse within the shafts trots, or moves in any pace quicker than a walk, the body of the cart is lifted up and down with every step of the animal. Even at a walking pace, the movement, although not so objectionable as when the horse is trotting, is still greater than the movement of a four-wheeled vehicle, owing to the different manner in which the shafts are attached to the bodies of wagons; not, however, so much so as of itself to form a sufficient cause of rejection for hospital use. Motion of one-horse carts.

The remaining objections are, firstly, the number of carts required, and consequently the greater outlay of money at starting to supply the wants of an army; and secondly, the number of men required for their care and conduct throughout the campaign. These objections have been considered in previous remarks.

General Conclusion.—It will be observed from these remarks that the most serious defect of the two-wheeled carts, and that which has chiefly prevented their general adoption, has been their want of stability. On the other hand, the strongest objections made to the four-wheeled wagons which have been hitherto employed in the field have been based on the impediments arising from their cumbrous size and weight, and the number of horses required to act in combination for their draught. Want of stability, or, in other words, liability to be upset, must always be a fatal objection to any vehicle, more especially to one which is destined to carry disabled men who are deprived of the power Instability a fatal objection to any vehicle.

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Training of
drivers.

of aiding themselves under any circumstances. Were it not for the conviction that this serious defect is inseparably connected with carts, a conviction deduced from experience, there can be little doubt but that the general advantages possessed by two-wheeled over four-wheeled vehicles in campaigning would have ensured their adoption for purposes of ambulance transport. It may be a question how much faulty construction, especially in the relation of height to width, has been the cause of the want of stability complained of; and also how far want of systematic training of the drivers, carelessness or neglect of common precautions, may have led to the accidents on account of which the use of two-wheeled vehicles has been so generally condemned for sick-transport purposes. But, on the other hand, the question also arises how far regular training of drivers, and care and prudence in conducting the vehicles, are attainable in the English service; and whether the absence of these to a certain extent must not always be provided for in the construction of carriages with which such drivers will be employed, both as regards their form and massiveness. In time of peace, the transport establishment, both of vehicles and men, will always be certainly reduced to the lowest limits; on war breaking out, this nucleus will have to be largely and comparatively suddenly increased, and at the very time that the demand for military labour is increased in all other directions. Under these circumstances it is difficult to determine how a careful, reliable, and well disciplined establishment of drivers for service in the field can be obtained; for men, to possess these qualities, must have a thorough knowledge of the means necessary for preserving the health and strength of the animals and of their management, as well as of the construction and use of the vehicles drawn by them, and must also have a certain amount of military training. If such men could be obtained there can be little doubt that lighter carriages than those now constructed might be entrusted to their care, without additional risk of breakage; with as much security to the patients carried in them as is attainable by larger and heavier carriages; and with all the advantages which have already been enumerated as appertaining to lighter vehicles in respect to facility of movement and administrative economy.

Unwieldiness a
grave objection
in ambulance
vehicles.

Unwieldiness and over-weight, on the other hand, are serious evils in a machine the very nature of which requires that it shall be easily packed away, easily handled, easily taken on board ship and out again, and readily moved over all sorts of ground, under every difficulty of weather, and even in spite of obstructions by an enemy, with a certain amount of celerity; or, at least, if not with celerity, with such a regularity of pace that there shall be the least possible risk of its journey being interrupted, or not being accomplished in the time calculated upon. The evils of over-weight and cumbersomeness of ambulance vehicles, the impediments such vehicles are liable to meet with in their progress, the accidents they are liable to be disabled by in campaigning, are sufficiently made manifest in the accounts of

the failure of the four-horse spring wagons in the Peninsular war, and, still later, their failure in Bulgaria, the Crimea, and, in some instances, in the United States.

The regulation ambulance wagon of the British service has been contrived with a view to obviate the leading defects above mentioned. The instability arising from the use of only two wheels has been avoided by the addition of two other wheels; at the same time the capacity, and proportionably the weight, have been reduced, so as to do away as far as possible with the objections arising from bulk and unwieldiness, and to admit of the conveyance being drawn under ordinary circumstances, with fair roads, by two instead of by four horses.

The British ambulance wagon.

The experience in the United States during the late Civil war has tended to a similar kind of improved conveyance. The heavy four-horse wagons as well as the light single-horse carts employed at the commencement of the war gradually fell into disuse, and were succeeded by four-wheeled vehicles of a lighter description drawn by two horses. The latter was the form of wheeled carriage for sick-transport purposes generally adopted in the United States towards the conclusion of the war.

United States' wagons.

It is generally admitted that the regulation ambulance wagon of the British service still requires improvement, especially as regards lightness of draught. Allusion has already been made to the fact that the degree of solidity and strength derived from massiveness given to any conveyance must be influenced, to some extent, by considerations of the character and ability of the drivers to whose management the vehicles are to be intrusted; and no doubt the massiveness of the present ambulance wagon has been increased from this consideration as well as from other causes. When the knowledge, dexterity, and discipline of conductors cannot be sufficiently relied upon, unnecessarily rough and careless usage may be expected, and must be provided against accordingly. When they are well disciplined and thoroughly educated in their duties, the construction of the conveyance may be regulated solely by a calculation of the weight it will have to carry, and the services it will have to perform. It remains to be seen whether the superior training which is given in the present day to the men who, in case of future war, will have the conduct of the ambulance vehicles of this country under their charge, will allow the construction of sick-transport carriages in respect to solidity to be solely based upon these latter considerations, and their strength and weight to be proportionably diminished. The increased facilities of communication by land and sea, the great development of machinery and manufacturing power, render the restoration of losses and facilities for the repair of injuries to vehicles greatly more easy than they have ever been; but without full confidence that a thorough knowledge of their duties and regular habits of discipline are possessed by the men in whose charge these articles of field matériel are placed, there will always be hesitation to lessen the amount of solidity which has hitherto been considered necessary to resist the shocks to which

British ambulance wagon requires improvement.

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such conveyances are rendered liable from careless driving in campaigning.

Riding and driving compared with driving from a box.—The draft horses in the ambulance wagons of the British service are driven postilion fashion. One horse is harnessed in shafts, the other, the near or riding horse, is loose, being attached by traces to a swingletree. The shaft, or off-horse, carries the driver's kit, the forage, water-bottle, &c.

Objections to
riding and
driving.

Effect on the
riding-horse.

Effect on the
driver.

In the United States, and in some countries on the continent of Europe, such vehicles are usually driven from a box. It is a question which plan offers the most advantages. There are some obvious objections to the system of riding and driving employed in the British service. The riding horse is encumbered by the weight of its rider, and its power of draught is proportionally diminished. Every pound added to the weight upon a horse tells upon its powers of endurance, as is well illustrated in weighting horses on a race-course. But it is not merely the weight which the riding horse has to sustain that is to be taken into account when comparison is made between it and another horse which is unfettered by a rider. We must also remember that the natural means of meeting the increased demands which are made on certain portions of the animal's physical economy under exertion are greatly impeded by the manner in which the weight is applied. The effects of the saddle and its tightened girths, with the addition of a weight of a hundred and fifty pounds upon it, though not perhaps very observable at an ordinary pace, tell on the powers of respiration, and on the organs of circulation of the animal all the time it is drawing its load, but especially on prolonged or on excessive exertion over bad roads, or in going up hill; and they proportionably shorten the time during which he can maintain his working power. His work fatigues him more all the time it is being done, and, when done, he is left in a less favourable state for quickly recovering from his fatigue. The plan of riding and driving is also more fatiguing to the driver than driving from a box. In posting, the post-boy does not return as a postilion, but drives back from the box, thus easing both himself and the horse. Another disadvantage is that in case of necessity it is not easy to replace the military drivers. Civilians, as a rule, cannot ride and drive; they are not used to it; and in the absence of trained drivers from any cause this may cause inconvenience.

Command over
the horses.

On the other hand, those who are trained to ride and drive state that they have more command over their horses, and that they can bring them where they wish more easily than if they drove by reins. It is said that when driving from a box has been tried in the service, more accidents have occurred than when the plan of riding and driving has been followed. But here again it must be taken into account that the horses and drivers with whom the experiment of driving from a box has been tried in military service have both alike been previously trained and used to the other system.

In considering this question, partly owing perhaps to the influence of a desire for uniformity of system in military service, there does not appear to have been drawn sufficient distinction between the circumstances connected with driving an ambulance wagon, and those of driving a carriage used for ordnance transport. An artillery gun on service is liable to pass over ground of the most broken and irregular kind, and therefore, to be subjected to conditions under which driving by reins with safety from an elevated position would be impracticable. The most experienced driver could scarcely maintain his seat on a box under such circumstances, and certainly could not have proper command over his horses. Accidents would be of constant occurrence. But when riding and driving under similar circumstances, it is comparatively easy for the driver to maintain his seat. In the rapid turning and manœuvring too of artillery, the closeness of the riders and drivers to their horses enables them to work them with more speed and precision than they could do if they were further away. The special conditions of artillery, therefore, cause the system of riding and driving to be more effective for the work that has to be done, to be safer for the drivers, and to give more security against overturns and other accidents.

Riding and driving essential for manœuvring gun-carriages.

Why essential.

But the carriages employed in transporting sick and wounded, or hospital stores, would never be taken over such ground as that above alluded to, nor are they required to be manœuvred as ordnance vehicles are. They would scarcely ever be driven over any other than made roads. The general principle is that the wagons will be brought up and remain stationary at the nearest convenient spot to the place of fighting for receiving the wounded. The men with stretchers, whether hand or wheel stretchers, and the mules with cacolets and litters, can follow the troops down ravines, up steep slopes, and over ploughed fields with impunity; they are designed for such purposes; and the wounded will be brought on them to the ambulance wagons to be afterwards carried still further to the rear. Under these circumstances it appears that it would be a wiser plan to economise the strength of the horses, and to devote it entirely to the draught of the loads behind them. This would be accomplished by driving from a box, for the objectionable expenditure of force, and the unfavourable condition for making exertion in which a horse is placed when carrying a rider, would be avoided. Moreover, it has been suggested that if the driver drove from a box, he would be made more sensible of the amount of jolting to which the vehicle was subjected on any particular occasion, and consequently would be induced to drive more cautiously when necessary for the sake of the patients.

Ambulance vehicles not subject to same conditions.

But to drive from a box expertly and carefully necessitates special training, and it must be confessed that, under present circumstances, there would be no little difficulty in getting men in military service to be so trained. The system of riding and driving in the service has become so firmly established that, as

Special training for driving with reins.

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The shaft system.

Uneven exertion of the two horses.

Advantages of pole system.

in introducing any other novelty, there would first be the labour to be got over of getting out of the system which this new plan was intended to replace. If the difficulty of training and fitting men for the duty could be overcome, there can scarcely be a doubt that it would be advantageous to introduce the system of driving from a box, so far as ambulance conveyances are concerned, on account of the many economical advantages it presents, as compared with the system of riding and driving.

The use of poles compared with that of shafts for ambulance wagons.—The same reasons that make the plan of driving from a box more suitable than the present plan of driving employed with the regulation ambulance wagons, also lead to the conclusion that the use of a pole would be more advantageous than the use of shafts. Under the present system, so far as the draught is concerned, the labour is very unevenly divided between the two horses. The horse in the shafts, or off-horse, has the weight of the wagon chiefly thrown upon it. In taking the wagon over an obstruction it is the off-horse which lifts the wagon; in going down-hill the weight of the wagon falls on the same horse; in backing the same thing happens. With a pole this labour would be equally divided between the two horses.

The pole system has other advantages over that of shafts. If a horse fall he is more easily got up again with the former than when he is in shafts, and, in case of breakage, a pole is more easily repaired than shafts. It has been also stated that spare poles are more easily carried than spare shafts.

For these reasons, although the shaft system may be necessary for the rapid manœuvres and other circumstances of artillery, the pole seems to be the best suited for the circumstances of ambulance vehicles.

The international committee of delegates from the societies for aid to wounded in time of war, in arranging the terms on which their prize was offered for the best two-horse ambulance vehicle at the Universal Exhibition of Paris in July 1867, specified, among other points, that the carriage was not to be built for being driven by a coachman. It was to be conducted by a postilion, and the reason given for this arrangement was to prevent a coachman taking a place which might be occupied by a sick man.

But if it be admitted that the advantages above described are gained by the system of driving from a box, it is obvious that they are too important to be sacrificed to an object which can be attained as well by other means without such a sacrifice. When once the number of patients to be carried has been determined, a place can be provided for a driver without trenching upon their allotted accommodation. The same argument might be employed for driving all passenger carriages, including those in civil life in which each seat represents a money value, postilion fashion. The proper place for the coachman's seat, with due regard to the requirements of the fixed number of patients to be carried upon an ambulance vehicle, is a question of construction that the carriage builder will probably solve without much difficulty.

Remarks on the Ambulance Carts and Wagons selected for Description.

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A description of particular conveyances, both two-wheeled and four-wheeled, will now follow. The patterns about to be described have been selected for one or other of the following reasons, or for several of them combined:—Either the carriage is noteworthy from historical associations; or it possesses some characteristic features of construction which have been supposed to fit it particularly for use in the field; or some alleged special advantages as regards the wounded intended to be carried by it; or it affords an example of some design which experience has proved to be defective, so that a notice of it is calculated to be useful as a means of preventing wasteful repetition of an unserviceable contrivance; or it is the kind of vehicle authorized for use in the British army or in the service of some foreign country.

The subjoined classification offers a convenient arrangement for describing the various forms of conveyances above referred to, and is therefore adopted in the pages which follow:—

Classification
of sick-trans-
port carts and
wagons.

- (A.) Two-wheeled conveyances constructed solely for the carriage of sick and wounded.
- (Aa.) Two-wheeled conveyances combining particular adaptations to fit them both for the carriage of sick and for transport of stores.
- (B.) Four-wheeled conveyances constructed solely for the carriage of sick and wounded.
- (Bb.) Four-wheeled conveyances combining particular adaptations to fit them both for the carriage of sick and for transport of stores.

SECTION VI.—TWO-WHEELED CONVEYANCES, OR SICK-TRANSPORT CARTS.

The following is a list of the two-wheeled ambulance vehicles which will be noticed in this section:—

(A.) TWO-WHEELED CONVEYANCES CONSTRUCTED SOLELY FOR THE CARRIAGE OF SICK AND WOUNDED.

- | | | |
|----------|---|---|
| French - | - | 1. Larrey's voiture d'ambulance volante à deux roues (flying ambulance cart). |
| " - | - | 2. La voiture Macou. |
| English | - | 3. Guthrie's hospital conveyance carts. |
| " | - | 4. Tufnell's military field cart. |
| " | - | 5. Royal Carriage Department ambulance jaunting car. |
| " | - | 6. Colonel Clerk's hospital cart. |
| " | - | McAdam's sick-transport carts— |
| " | - | 7. No. 1. For two patients in a recumbent position. |
| " | - | 8. No. 2. For two patients with fractured thighs. |

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- | | | | |
|---------------|---|-----|--|
| English | - | 9. | No. 3. For four patients in a sitting posture. |
| United States | | 10. | Coolidge sick-transport cart. |
| " | | 11. | Another United States' sick-transport cart. |
| Italian | - | 12. | Voiture d'ambulance suspendue du Dr. Cantoni, or equilibrium ambulance cart. |
| East Indies | - | 13. | Common Indian cart, or bandy. |
| " | | 14. | Indian hackery. |
| " | | 15. | Indian hospital cart. |
| " | | 16. | Inspector-General Macpherson's hospital cart. |

(Aa.) TWO-WHEELED CONVEYANCES COMBINING PARTICULAR ADAPTATIONS TO FIT THEM BOTH FOR THE CARRIAGE OF SICK AND FOR TRANSPORT OF STORES.

- | | | | |
|---------|---|----|--|
| English | - | 1. | Cherry's field cart for commissariat or hospital service. |
| " | | 2. | Mr. Butcher's field cart for commissariat, ammunition, and sick-transport service. |
| " | | 3. | Maltese cart, with folding litters. |

DESCRIPTION OF PARTICULAR CARTS.

Sick-transport carts of the first category.—The ambulance carts named in the foregoing list will now be separately described; those included under (A.), viz., "two-wheeled conveyances constructed solely for the carriage of sick and wounded," being first noticed.

Vehicles of
Larrey's am-
bulance volante.

1. *Larrey's voiture d'ambulance volante à deux roues (flying ambulance cart).**—I have already described in the chapter on the history of the modern system of ambulance transport the important innovation made by Baron Larrey in the medical service of armies by the introduction of his flying field hospitals (ambulances volantes) in the year 1797. The ambulance volante included not only the means of keeping up the materials necessary for the surgical treatment of the wounded with the troops in advance, but also the means of carrying away the wounded from the field of action after their wounds had been dressed. This latter service was accomplished by means of two sets of vehicles, one being two-wheeled carts for two patients lying at full length, of very simple construction, which, while solid, yet according to Baron Larrey's description, were very light, and capable of rapid movement. They were designed for draught by two horses. The other set was four-wheeled, for four patients recumbent, and designed for draught by four horses. The two-wheeled vehicles were suitable for flat countries; the four-wheeled were designed for use in mountainous countries. These vehicles were maintained in use until the year 1811. The following description refers to the former kind.

* Model No. 1301 in the Mus. of Mil. Surg. at Netley.

The body of each cart had the form of an elongated cube, rounded at the upper part. Both the front and back were fitted with folding doors which met in the middle on being closed. On being opened, these doors admitted of being thrown back far enough to leave the whole of the space between the sides clear of any obstruction. The greatest facility was thus afforded of getting patients in and out of the carriage; for their ingress and egress could not only be effected at the back of the cart, but could also be materially facilitated by assistance from the front. Each side was pierced by round openings for air and light, with sliding shutters inside; there appear also to have been spaces for the admission of air at the two ends, between the folding doors and the covering of the roof. The floor of the interior of the cart was formed by two moveable frames, each furnished with a horsehair mattress and pillow covered with leather. These frames were caused to slide easily upon the two lower side-beams and a central partition within the cart by means of little iron castors. Each frame was also furnished with four iron handles fixed in the wood of its sides; these were for the purpose of receiving straps, or the belts of the soldiers, to assist in carrying a wounded man upon the frame in the same way as upon a stretcher. The sides of the interior of the cart were padded for a foot in height from the floor; there were also several pockets for carrying bottles or other articles necessary for the sick. Each cart was drawn by two horses; one in shafts, the other attached to a swingle-tree; the driver sat on the latter.

These vehicles were not carried upon springs, but were suspended *from* springs by straps at the four corners, as shown in the sketch. Excessive movement, upward or lateral, was restrained by straps and chains connected with the framework to which the springs were fixed.

The illustrations which follow of Larrey's flying ambulance cart are copied from sketches in the memoirs of the eminent military surgeon by whom the vehicle was invented.

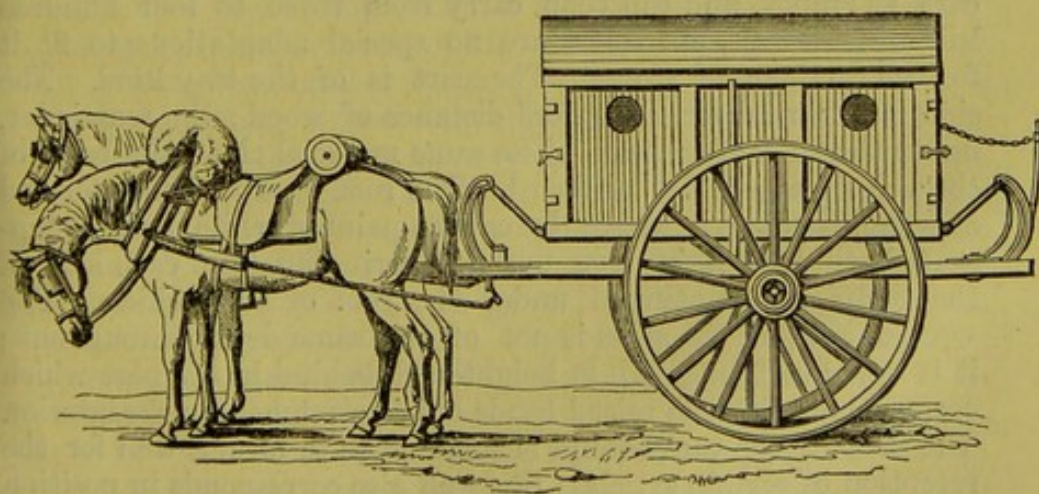


Fig. CXIII.—Side elevation of Larrey's "*voiture d'ambulance volante à deux roues*," or flying ambulance cart.

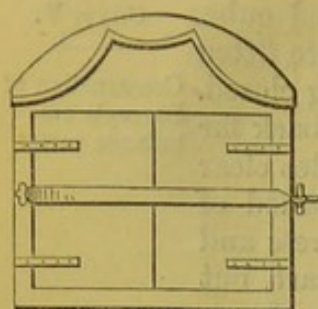


Fig. CXIV.—End view (front) of Larrey's flying ambulance cart.



Fig. CXV.—Interior of Larrey's flying ambulance cart.

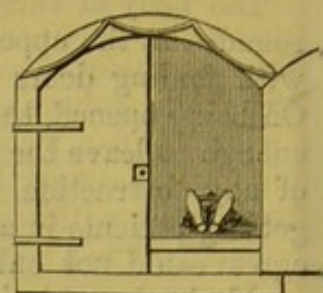


Fig. CXVI.—End view (back) of Larrey's flying ambulance cart.

2. *La voiture Macou*.—This two-wheeled vehicle was exhibited by the French Government in the Park of the Universal Exhibition at Paris in 1867. It has not yet been introduced into the general service of the French army, but it has been employed in Algeria and in Mexico. It was not used in the Crimea, nor in the Italian campaign of 1859. Although not forming part of the regular train equipment, however, of the French army, it was found so serviceable in Mexico, as it had been previously in Algeria, owing to its lightness, ready mobility, simplicity of construction, cheapness, and other advantageous qualities, that, according to information given me at the time of my visit to Paris in 1867, the Intendance Department have been engaged in trying to make further improvements in it, with a view to its introduction for general use in the French military service.

Construction of the Macou cart.

The *Macou* carriage is so called from the name of its inventor. It has been designed for carrying two wounded men lying recumbent upon two stretchers, together with the driver on a seat in front. It is drawn by one mule. The stretchers are of peculiar construction, and are described elsewhere (see page 157). If necessary they can be taken out altogether and placed on the roof of the vehicle. When thus removed and placed outside, the cart is empty, and can then carry from three to four hundred kils. of materials, but there are no special adaptations to fit it for the carriage of stores. The cart is of the tray kind. The sides are formed for a limited distance of wood; the remainder, up to the roof, of canvas. The same material closes the back of the vehicle above the tailboard. The roof is solid, being formed of wood, is covered above by canvas painted white, and is supported on four light iron uprights springing from each side of the body and continued under the roof of the vehicle. The wooden part of the sides is not of the same depth throughout; it is lower in front, and is heightened behind in the part which corresponds with the raised heads of the stretchers in the interior. The floor of the cart behind is sunk, so as to form a well for the reception of certain articles; this well also corresponds in position with the raised parts of the two stretchers. When the tailboard is lowered the knapsacks of the patients lying on the

stretchers can be readily placed beneath the raised stretcher-heads into the well just described. Under the floor in front are placed, on one side, a water barrel; and on the other a box for surgical materials. The seat for the driver is in front, and simply consists of a semicircular board with an iron rail; it is supported on three iron legs, one on each side fixed to the front board of the cart, the third in the centre behind fixed to the piece of wood that divides the two stretchers. The seat is thus within the body of the vehicle. An inclined footboard for the driver is placed across the shafts.

The following are the dimensions of the body of the cart:—Length from front to back 6 feet 4 inches, outside measurement; depth of wooden side at the back 1 foot 1 inch; ditto in front about 11 inches; width 3 feet 9 inches; height from floor to roof about 5 feet 10 inches; depth of well at back of cart 7 inches; width at top about 17 inches; height from ground to floor about 4 feet. The weight of the pattern at the Exhibition was officially stated to be 295 kils., and its cost price 300 fr., or 12*l*.

The wheels are high, about 4 feet 10 inches in diameter. The springs are modified elliptic springs, and are applied to the vehicle in a somewhat peculiar manner. One end of the spring is fixed to the under surface of the shaft, which is prolonged on each side to the back of the cart. The point of fixation is just behind the line of position of the axle. The spring proceeds backwards and forms a joint with an under portion, similar to the joint of an ordinary double elliptic spring. The under portion of the spring convexing downwards then passes through an opening in the axle where it is firmly fixed. Curving forwards and rising upwards the spring terminates by passing through a square staple fixed underneath the shaft in advance of the position of the axle. This end of the spring is not fixed, but plays freely in the staple just mentioned, pressing against the under surface of the shaft, which is protected from the effects of friction by the upper portion of the iron staple. The effects of pressure upon this spring when a weight is placed in the body of the cart are at the back of the spring to bring the upper and lower arcs nearer together by the action of the joint; the fore part of the spring at the same time moving forwards under the shaft within the staple, by the sides of which all lateral movement of the end of the spring is restrained. These springs are said to have made the motion of these vehicles as easy over the bad roads in Algeria as that of an ordinary carriage over good roads. But on trial in the Exhibition grounds at Paris a very different conclusion with regard to them was come to by the Committee who made the examination. The motion was there found to be so great and accompanied with so much shaking of the body of the cart as to cause the Committee to condemn them for ambulance purposes. It is only right to add, however, that the trials were made very hastily, and were conducted with a preconceived opinion of the unfitness of any two-wheeled vehicle for carrying sick or wounded persons.

The springs of
the Macou cart.

Trials of the
Macou cart.

CHAP. V.

Mr. Guthrie's
description of
ambulance
carts.

Guthrie's hospital conveyance carts.—The carts known under this name were built according to the directions of Mr. Guthrie, the author of the celebrated commentaries on the surgery of the Peninsular war. The practical experience of this eminent surgeon gained during long service in the field gave great weight to his suggestions on the form of transport to be despatched with the army proceeding to Turkey. Accordingly, twenty carts, ten built for patients sitting only, and ten for both recumbent and sitting patients, were built at Woolwich on Mr. Guthrie's plan, and were sent out with the brigade of hospital conveyance, the constitution of which has been previously described.* A description of Mr. Guthrie's sick-transport carts, as well as of the hospital store-wagons and their contents which accompanied them, was published in the form of a pamphlet† about the time the brigade was despatched to the east, and the following account of these conveyances is extracted from that source.

"Each cart is drawn by two horses, one in shafts, the other affixed by an outrigger—although, when loaded, it can be drawn by one horse; and, in a difficult country, a third and fourth horse can be attached to the wheelers, for which provision is made. The cart weighs $10\frac{1}{2}$ cwt., the stores $1\frac{1}{2}$ cwt. The carts can, if necessary, keep up with horse artillery on any service; the first principle of military medical conveyance being that wherever a gun can go a spring cart should be able to follow.‡ The cost of a cart is computed at the arsenal at Woolwich to be 25*l*.

Contents of
Guthrie's carts.

"The hospital conveyance cart runs on two wheels corresponding with those of the artillery. It is covered with white painted canvas, has curtains of the same material all round, and an apron attached to the footboard before and behind. Each cart carries under the seat in front a small chest of utensils, two sets of iron splints in boxes, a small box of surgical stores,§ with a strap attached for the convenience of carriage, a lantern for oil, pickets and ropes for the horses, a pickaxe, spade, saw in a case, ten stretchers with appropriate slings, two empty ten-gallon casks hung underneath for water, a bag containing a hammer, nails, two brass cocks for the water casks, and four horse shoes, a filter made of gutta percha (Owen's patent) in a wicker case and sling, capable of yielding near fifty gallons of clear water every twenty-four hours when in use, and weighing eighteen pounds, a funnel and a pint drinking cup, a water bucket for the horses, and a small camp-kettle for three men. Two spare springs and a spare axle are carried for every three carts in the store-wagon.

"Ten of these carts have round tops or covers, ten have flat ones. The ten round-topped carts have seats inside, and will

* See page 36.

† Op. cit., p. 36 *ante*.

‡ The correctness of this principle has been already questioned in the opening observations on this class of conveyances.

§ The contents of the box of medicines and surgical sundries attached to each of the carts, as well as of the box of utensils, are given in the pamphlet from which this description is quoted.

carry sixteen persons; the ten flat-topped carts carry two stretchers on vulcanized springs and rollers on the floor of the cart, and nine persons before and behind, in all eleven, while a twelfth may be added on a stretcher slung to the roof. These carts might also have side seats, to be raised if necessary when the stretchers on the floor are not required. On drawing out two iron supports at the end of each cart, the front seat, which is moveable, makes a table when placed upon them for operations or other purposes. The carts are lettered "hospital conveyance carts," and are numbered from "1" to "20."

"The firelocks and knapsacks of the wounded soldiers may be carried below the carts, the barrels of water and the stores being left at the field hospital. The barrels are provided with proper cocks and moveable keys to prevent waste, and should be placed under the charge of a person competent to superintend the distribution of the water. When the carts are fully employed carrying sick or wounded the conductors are to lead the horses. A great advantage is derived from the construction of these carts, that whilst they will carry many persons with little motion at an ordinary pace they will also convey one person without inconvenience, and at a trot or gallop the movement can be borne for a time without complaint, unless under very disadvantageous circumstances of broken ground."

These twenty carts were designed for two divisions of the army, one cart being for each of the six regiments of a division, and to



Fig. CXVII.—Guthrie's flat-topped Hospital Conveyance Cart. For carrying two patients lying on spring stretchers on the floor, and a third, if required, in a stretcher slung from the roof, with room also for nine persons sitting on seats before and behind. The second horse is not shown in the drawing.

CHAP. V.

Failure of
Guthrie's carts.

Reported
causes of this
failure.

remain with it under all circumstances. The remaining four were to be in reserve, the whole being under the charge and superintendence of the principal divisional medical officer.

The Guthrie carts were used in Bulgaria, but were reported to be a failure, and their use was soon abandoned. The cause of their failure will be best shown by quoting the following remarks concerning them by a medical board which was assembled in camp before Sebastopol in January 1865, pursuant to instructions from the Director-General of the Army Medical Department in London for the purpose of reporting generally on the qualities of the sick-transport conveyances then in use in the Crimea. This board, which was composed of the principal medical officer in the field, Inspector-General Dr. Hall, and three experienced medical officers of high rank, thus reported:—

"The two-wheeled carts upset so frequently when tried in Bulgaria that only one was brought to the Crimea by Captain Grant, the commandant of the Ambulance Corps, and that has seldom been used for the conveyance of sick or wounded. It was found that the weight of the two-wheeled cart was apt to throw the animal in the shafts down on descending hills; at least, that was the complaint the drivers made. Some fault might, perhaps, attach to them, as few of them are skilful drivers; but, at all events, the accidents were so numerous that the carts were seldom employed after the first trial."

There can be no doubt the suggestion made by the Board, that the accidents which these carts had met with were probably partly due to the fault of the drivers, was founded in fact. The pensioners who were placed in charge of the carts at the time they were in use in Bulgaria, were rendered utterly incompetent by their habits of drinking for the duties which devolved upon them. The inefficiency of these men has been previously referred to.* It appears to be a matter of regret that a further trial was not given to these conveyances after a corps of trained and disciplined conductors had been found, for the question as to the amount of failure which was due to the construction of the vehicles themselves, and the amount due to the carelessness of the men who had charge of them, was thus left unsettled. At the same time, it certainly appears as if too much had been attempted to be done in these conveyances, especially as regards the number of patients carried; moreover, the addition of the stretcher slung from the roof must have interfered with the necessary stability of the conveyance when used on any but moderately level ground.

Construction
and contents of
Tufnell's field-
cart.

Tufnell's Military Field Cart.—This cart was designed by Professor Jolliffe Tufnell, of Dublin, and was based on the same principle of construction, and had the same outward appearance as an Irish "outside car" or "jaunting car." It was, however, of larger dimensions than the cars in ordinary use in Ireland.†

* See Chap. 2., page 38.

† Model No. 1305, in the Mil. Surg. Mus. at Netley.

The "well" of the cart was divided into two compartments, an upper and lower compartment. At the top of the upper compartment a stretcher was carried, ready to accommodate a wounded person in a recumbent position. This stretcher was easily detached from its supports, and on being lifted out, could either be carried by handles, which were hinged to its four corners, or, these handles being depressed, could be used as a bed or operating table. A drawer, extending the whole length of the car, occupied the bottom of the lower compartment of the well. This drawer contained an assortment of medical comforts, surgical materials, blankets, and other articles. A space existed between the drawer and the stretcher above, and here were stored iron rods which could be used as standards for supporting a waterproof cloth and forming a cover for the cart in case of need. This cover when removed from the car was capable of being set up in a field, and of being used as a tent. Another tent complete, of the bell form, was carried in the same part of the car. The seats on each side of the well afforded, under ordinary circumstances, sitting room for three men sitting, but the end boards of the seats were so arranged that they could be let down to any desired angle, or even could be completely lowered so as to be on a level with the rest of the seat. By this arrangement

Capacity of
Tufnell's field-
cart.

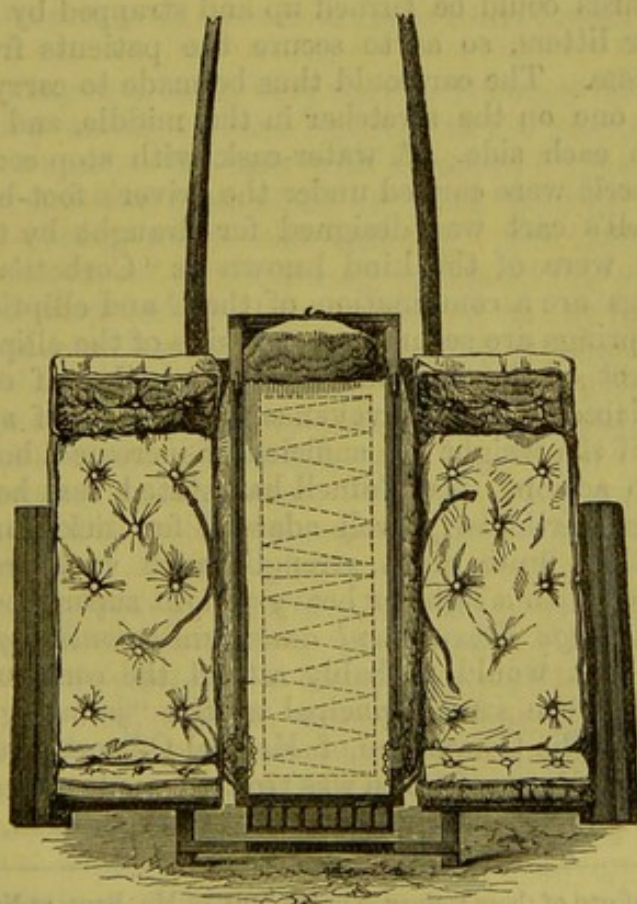


Fig. CXVIII.—General view of Tufnell's Military Field Cart. The cart has been turned up so as to show the stretcher in the "well," and the two cushioned side-seats, at one glance. The two foot-boards are seen to project on each side.

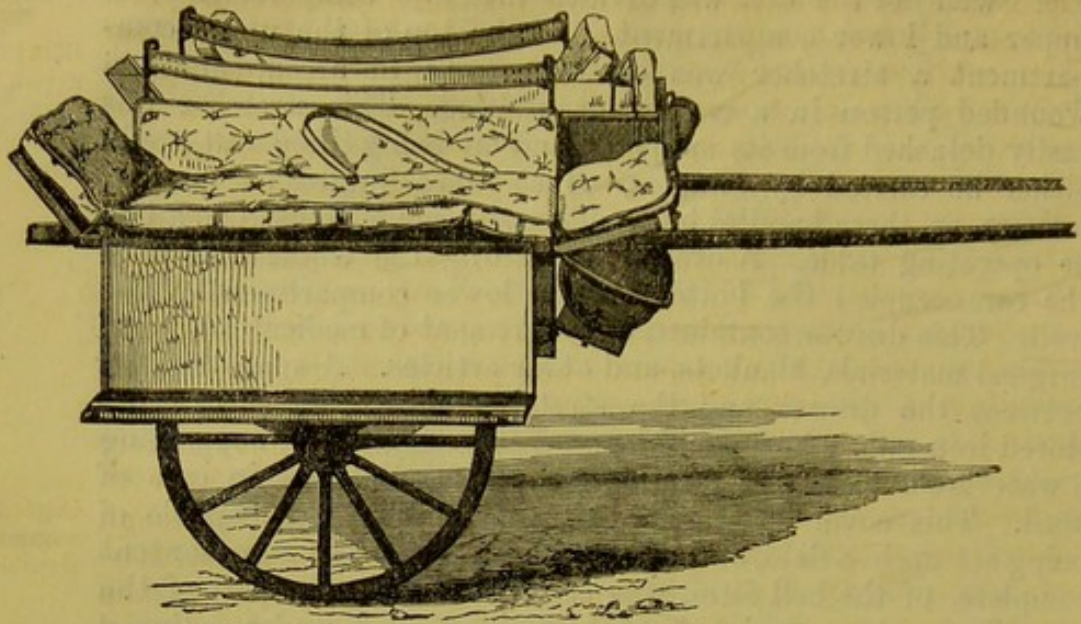


Fig. CXIX.—Side-view of Tufnell's Military Field Cart.

they could each, on an emergency, accommodate five men sitting, or be used as a litter with a sloping head-rest, for receiving a patient in the recumbent position. In this last-named case the foot boards could be turned up and strapped by the side of the seats or litters, so as to secure the patients from risk of falling off them. The car could thus be made to carry three men lying down, one on the stretcher in the middle, and one on the long seat on each side. A water-cask with stop cock and two drinking vessels were carried under the driver's foot-board.

Springs of
Tufnell's cart.

Mr. Tufnell's cart was designed for draught by two horses. The springs were of the kind known as "Corbett's springs."* These springs are a combination of the C and elliptic principle. The two C-springs are secured on each side of the elliptic springs, and the effect of the combination is such that, if only a light weight be placed on the conveyance, the one set of springs only acts, while, if the weight be sufficiently increased, both sets are brought into action. Mr. Tufnell has stated that he has found these springs particularly well adapted for sick-transport carriages, as they unite great strength with very great ease of motion, either with a light or heavy weight superimposed.

Woolwich am-
bulance jaunt-
ing-car.

Royal Carriage Department ambulance jaunting-car.—The advantages that would probably attend the construction of a conveyance on the same principal as the "jaunting-car" were pointed out by the Committee of Medical Officers in the Crimea, to whose proceedings reference was recently made when describing Mr. Guthrie's cart.† Apparently on this suggestion, an ambu-

* A pattern of one of these springs is in the Mus. of Mil. Surg. at Netley.

† Vehicles constructed on the same principles as the Irish jaunting-cars have been recommended for the carriage of sick and wounded in campaigning by many distinguished Army Medical Officers; among others, by Dr. Robert Jackson in 1812, and by Dr. Millingen in his "Army Medical Officers' Manual," published in 1819.

lance conveyance was constructed in the Royal Carriage Department at Woolwich, after the fashion of the Irish car. It was unprovided with many of the appliances and adjuncts which Professor Tufnell's conveyance carried. The Woolwich pattern was fitted with india-rubber springs instead of steel springs, and differed in other details of construction from the Tufnell cart. Its weight was about 7 cwt. This car when completed was examined and approved by the Director-General of the Army Medical Department, Dr. A. Smith. Subsequently a supply of them were made in the Royal Carriage Department, and sent out to the Crimea, there being nearly eighty of them reported to be in charge of the Land Transport Corps and Ambulance Corps together in October 1855.

Defects of jaunting-cars as ambulance vehicles.—Unfortunately in practice these jaunting-car vehicles were found to have the same fault as had been attributed to the Guthrie carts, they were liable to be upset. This liability was attributed to the lowness of the wheels and to the narrowness of the track between them. The lowness of the wheels had also the objection of impeding the progress of the carts when they were required to pass over deep soil. They were also reported to be jolting unless heavily weighted.

Sick-transport
jaunting-cars
on service.

In October 1855 a medical board in the Crimea reported as follows on the results of the use of these conveyances at the seat of war:—

"The jaunting-cars being very narrow between the wheels are consequently unsafe, and are reported to the Board to be very liable to be upset. The cars, with a fair load, appear to travel very easy, but are complained of, when persons are carried singly, as being rough and shaking." Sir John Hall, in forwarding the report of the Board, expressed his opinion that cars of this description would be very useful on the line of march in carrying men who were compelled to fall out for sickness or footsore, as they could easily mount and dismount from it. The same fault, however, of liability to be upset was found at Aldershot, to which camp one of the Irish cars with india-rubber springs had been sent for trial. The principal medical officer Surgeon-Major O'Flaherty, reported concerning it on the 8th of November 1855:—"This cart is not a good one, it is unsafe from being top-heavy. The breadth of the body is too great for the length of the axle, so that a trifling elevation of the wheel is apt to overturn the whole machine." Dr. O'Flaherty considered, however, that an ambulance cart on the Irish car principle might be so constructed as to be free from the liability to be upset, and that such a conveyance would "be found to be the easiest and best description of one-horse carriage for removing a number of sick or wounded men, who, although unable to walk, could sit up."

Dr. Dartnell, the Principal Medical Officer at Chatham, to which station one of these conveyances was also sent for trial in the year 1855, reported that "observation led him to conclude

CHAP. V.

Origin of the
ordnance hos-
pital cart.

Its construc-
tion.

“ it to be well suited for service with a regiment on the line of march, but that it was not found suitable to meet the wants of a garrison, such as Chatham, in carrying sick and wounded men from one hospital to another, or from the railway station to the hospital or barracks of the garrison.”

Colonel Clerk's Hospital Cart.—This cart for several years formed part of the equipment of batteries of field artillery, but its use has recently been discontinued. It was introduced during the period of the Crimean war. When it became evident that the hospital carts constructed on the principle of the Irish jaunting-car, and issued to troops and batteries in the year 1855 were faulty and liable to upset, Captain H. Clerk, then Assistant Inspector of the Royal Carriage Department, proposed for the consideration of the Ordnance Select Committee a cart of a new construction. The lowness of the wheels, and the narrowness of the track, had seemed to be the chief causes of the liability of the carts on the jaunting-car principle to be upset, and to avoid this fault Captain Clerk's cart was constructed with five feet wheels, and the ordinary track of five feet two inches. It was adapted for the conveyance of six men in a sitting posture, three in front and three behind ; and there was a locker between the seats for holding the men's knapsacks, together with medical and surgical requisites. By raising up the sides of the locker, and causing them to rest on the sides of the cart, supports were formed for carrying two men lying at full length instead of the six men sitting. The cart was suspended on india-rubber springs. Its weight was nine hundred weight and a half. The inventor stated that “ the load being carried very low, it is very difficult to upset, and, by folding up the head and tail boards, it makes a very convenient light baggage and store-cart, and would be found very serviceable as a substitute for the present store-cart issued to the lieutenant-colonels of divisions of Royal Artillery on service.” The cart in question is represented in the following drawing:—

The cart was examined by the Ordnance Select Committee on the seventh of February 1856, and after full consideration of the advantages claimed for the vehicle by its inventor, and after practical trials of it, the Committee reported as follows:—“ The Committee, assisted by Major Maude, Dr. Halahan, and Dr. Dods, have examined this cart, and driven it over some of the roughest parts of the arsenal. The officers who assisted them, thought very favourably of the cart, both as to its ease and convenience. The Committee believe that this cart would realize the expectations of Captain Clerk, and recommend its adoption in the service for the purposes proposed. It is very well schemed, simple, effective, and particularly easy.” The Committee who thus reported, consisted of several superior officers of the Royal Artillery and Engineers, and Professor Wheatstone, F.R.S., was a member of it. It is certainly calculated to make one very modest, and circumspect in expressing an opinion on the practical merits of an invention, to find after so

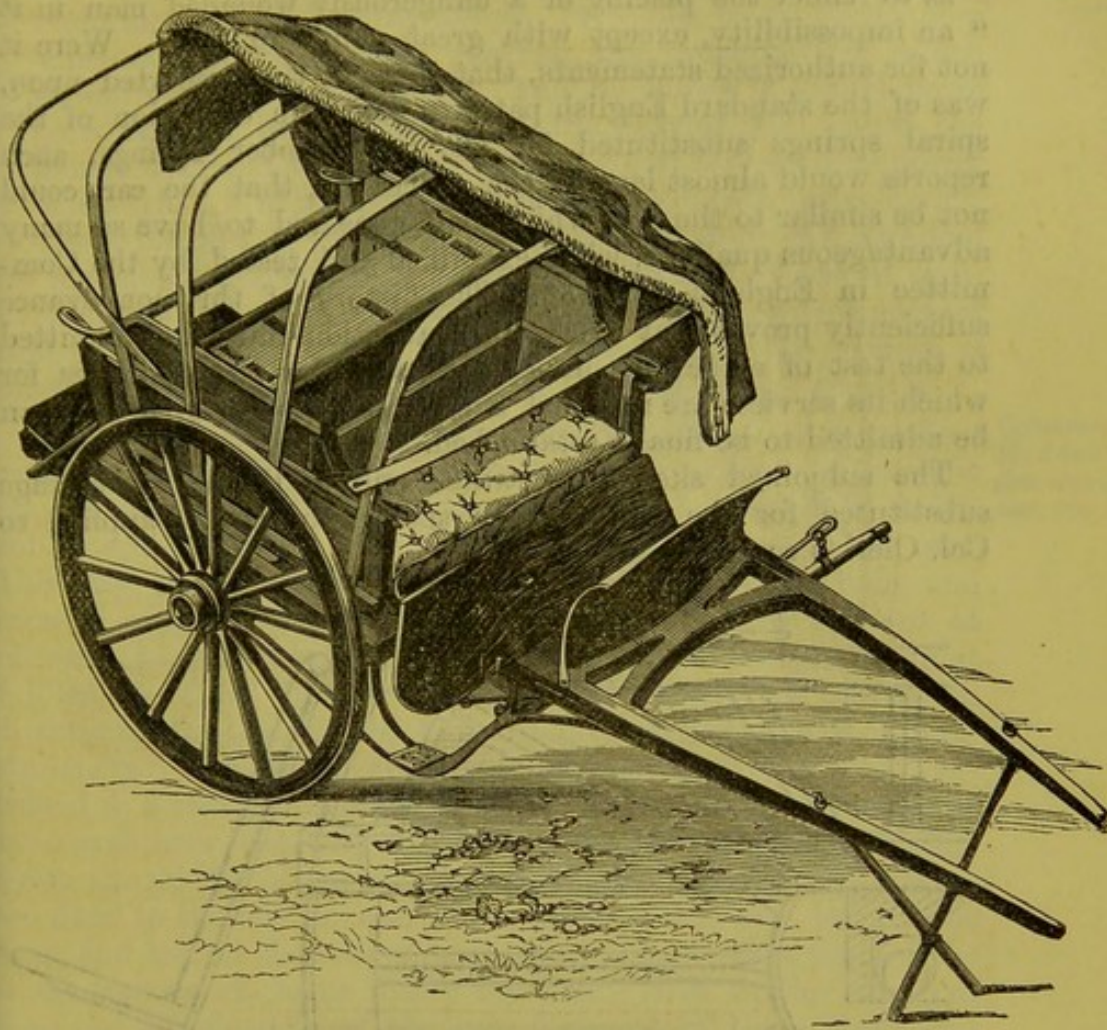


Fig. CXX.—Colonel Clerk's Hospital cart.

careful an inquiry, and by such eminent judges, that the anticipations of the Committee have not been fulfilled on actual service. It is in India that the failure of these hospital carts, which were sent with the batteries of Royal Artillery that proceeded to the East at the time of the mutiny in 1857, has been particularly brought to notice. The india-rubber springs were not found to be suited for use in the hot climate of that country, and "volute," or spiral springs were substituted for them, but proved to be too weak. Other faults were found with the cart, so that it was strongly condemned by several boards of inspection, which were ordered to report upon it in the commencement of the year 1866. Not only were the springs reported to be insufficiently strong, but the cart was said to be unnecessarily heavy in its framework and wheels, and to afford very little accommodation in proportion to its size. The framework of the tilt was reported to be too frail and insecure, so that it would be destroyed if the cart had to pass through a thickly wooded country, while the height of the step and cart made it

Its failure on
service in
India.

CHAP. V.

difficult for a man in good health to get into it, and was "such" as to render the placing of a dangerously wounded man in it "an impossibility, except with great pain and risk." Were it not for authorized statements, that the cart thus reported upon, was of the standard English pattern, with the exception of the spiral springs substituted for the india-rubber springs, such reports would almost lead to the conclusion, that the cart could not be similar to the one which had appeared to have so many advantageous qualities, when examined and tested by the Committee in England in 1856. The history of this conveyance sufficiently proves that every such invention must be submitted to the test of actual use under the particular circumstances for which its services are required, before its fitness or otherwise can be admitted to be finally established.

The subjoined sketch illustrates one of the volute springs substituted for the india-rubber springs originally applied to Col. Clerk's conveyance:—

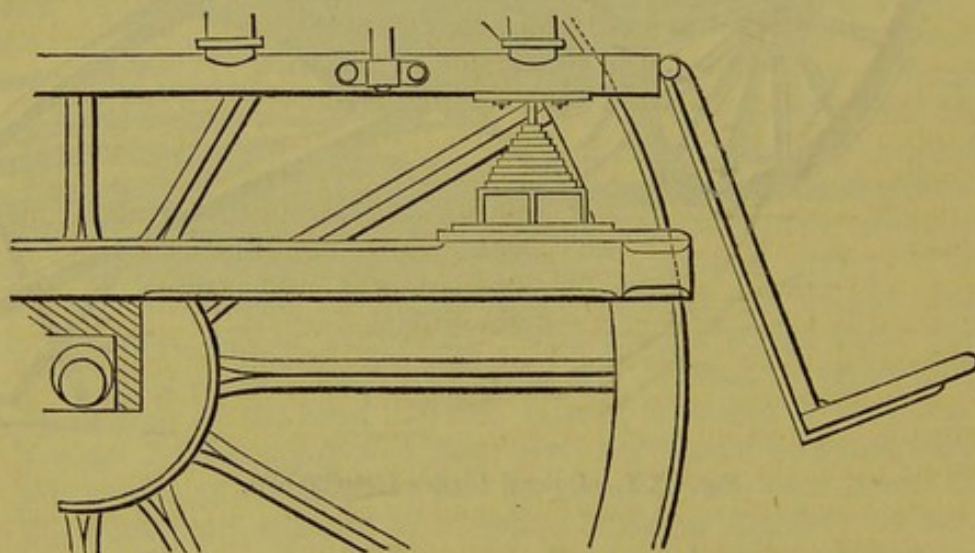


Fig. CXXI.—Sketch showing one of the volute springs fitted to Col. Clerk's Hospital cart in India.

Mr. McAdam's
views on sick-
transport carts.

McAdam's Sick Transport Carts.—The three forms of cart which follow are all constructed for draught by a single horse. Mr. McAdam, the inventor of these carts, has been already referred to with reference to the views which he published on the advantages of single-horse carts for agricultural purposes. Mr. McAdam has expressed similar views respecting ambulance conveyances in an unpublished letter, a quotation from which will best explain the advantages supposed by him to be possessed by his system. "As I fix a cart load," he writes, "at from five to seven hundredweight of goods, so I would determine that an ambulance conveyance should not take more than four men sitting, or two men recumbent. If their numbers be increased, you require a stronger carriage and of greater weight, which, added to the greater number of men, will demand a second horse on which a driver must be mounted; and as such a

“ carriage could not itself be much less than from eight to
 “ eight and a half hundredweight, it would be proportionably
 “ unmanageable in case of accident, the probability of which
 “ should never be lost sight of. And by adding a second horse
 “ to a cart, as now attached in the service, you cause the
 “ mounted animal to walk in a trot, and greatly lessen its power
 “ of draught; if it be placed in front, you elongate the column.”

The principles on which the vehicles designed by Mr. McAdam for recumbent patients are constructed differ from those of ordinary carts, inasmuch as the body of each of these conveyances, or that part in which the patients are arranged to be carried, is placed *below* the axle-tree, instead of being supported *above* it.

*McAdam's cart, No. 1, for two patients in a recumbent position.**—The body of this conveyance forms a sort of shallow tray, which is placed under the axle and suspended by india-rubber springs from the sides of the square frame of the cart. This tray, the two ends of which are hinged to the floor, and capable of being lowered from the sides or fixed to them at pleasure, is designed for the reception of two patients lying at full length. The patients may be either placed upon mattresses directly on the floor of the tray itself, or carried upon it in box-stretchers. The axle of the cart is made of iron, and is not continued in a straight line between the wheels, but is cranked so as to arch over the tray in which the wounded men are lying. From the middle of the axle four light wire-rope braces or stays are fixed to the four corners of the frame of the cart, two at the front and two at the rear of each side. These stays connect the whole framework more firmly together. Still further in front than the attachments of the two foremost of these stays, and resting upon the framework of the cart, which it crosses from side to side, a locker is placed; this is designed for holding the kits and fire-arms of the two soldiers who are carried in the cart.

Construction of
McAdam's
sick-transport
cart, No. 1.

The manner in which the tray is suspended is as follows:—The under surface of the floor of the tray, both in front and in rear, is crossed by a flat bar of iron, each end of which projects upwards beyond the floor and terminates in a bent hook. In this way, four iron hooks project from below the four corners of the tray, at the same time that the iron bars, of which they form part, are made subservient to strengthen and firmly support the tray itself. Corresponding with the four iron hooks of the tray are four others, which are fixed to the under surfaces of the two side-frames of the cart. Elastic springs are connected between these hooks respectively, and the tray then becomes suspended from the sides of the cart. The effect is, that when the cart is in motion and a jolt of the wheels and axle is caused by an obstruction on the road, the jolt is communicated through the stays directly to the sides of the framework of the cart; but the continued communication of the concussion from the framework to

Suspending
springs of this
cart.

* Model No. 1312 in the Mil. Surg. Mus. at Netley.

CHAP. V.

the tray in which the patients are carried is interrupted by the spring suspenders which are placed between them.

The following sectional sketch will convey an idea of the construction above described. As the near wheel is not seen in the sketch, the lower part of the cranked axle which would be connected with it shows itself as if it were in contact with the tray, from which in the cart itself it is completely detached.

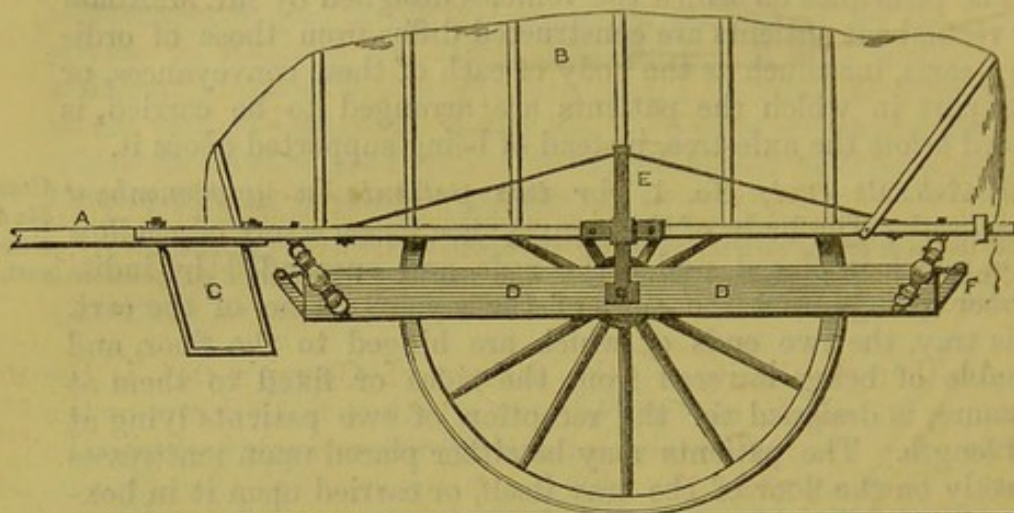


Fig. CXXII.—Sketch to show the construction of McAdam's ambulance cart for two recumbent patients. (A) part of shaft, (B) cover, (C) locker for kits and arms, (D) a slung tray in which the men or stretchers are laid, (E) cranked axle and stays, (F) end of tray partly lowered, held up by its chain.

Suspending
chains of
McAdam's
cart, No. 1.

As additional means of safety to the patients in case of breakage or any accident to either of the suspenders just described, four chains are available for being carried from the upper corners of the tray to be attached to the same hooks of the frame which hold the india-rubber springs. These chains are permanently fixed at one end to each of the four corners of the sides of the tray; their other extremities are free. They are also used for another purpose. When the end boards of the tray are lowered

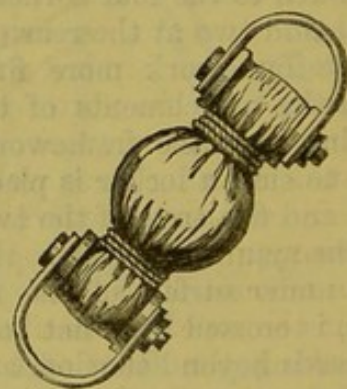


Fig. CXXIII.—Enlarged drawing of one of the india-rubber springs shown in Fig. CXXII.

the free ends of the chains can be connected with hooks attached to their four corners, and they then serve to hold up the ends and to limit the distance to which they are lowered, so that they may not pass beyond an inclination slightly below the level of the floor of the cart. The end-boards when raised again are secured by wooden bolts; the free ends of the chains may then be unhooked from them and again hooked to the suspending hooks of the framework in common with the elastic suspenders.

The usual hoops for supporting a canvas cover over the patients are attached to the sides of the frame of the cart.

A model of a cart made on the principles just described was submitted by Mr. McAdam to the Committee on Hospital Conveyance in 1855. The observations of the Committee led them to express their opinion that the objects aimed at by Mr. McAdam were much better attained in the Maltese cart fitted with Holmes's folding box-litters, while this latter conveyance had some peculiar merits, rendering it of more general utility in campaigning, which were not possessed by the cart invented by Mr. McAdam.

*McAdam's cart, No. 2, for two wounded men with fractured thighs.**—The general construction of this cart as regards the framework, wheels, and cranked axle, is similar to that of the preceding cart just described.

Construction of
McAdam's
sick-transport
cart, No. 2.

The wounded men are also carried in a tray as they are in McAdam's No. 1 cart, but in this instance the tray is not suspended from the sides of the framework but from the ends of a steel single elliptic spring, or bow-spring, of the ordinary kind used in carriages. This spring is caused to turn on a pivot which is placed above the axle, but closely connected with it by the intervention of two iron upright supports. Its motions are restrained and regulated by a semicircular bar of iron which passes under the axle, and turns with each change in position of the spring. The ends of the spring correspond very nearly in length with the ends of the swinging tray, and have on their upper surfaces a series of deep notches. On one of these notches at each end a strong rope is secured, and the two ends of this rope are fitted with metal rings which are intended to be connected with two iron hooks secured to the two corresponding corners of the upper part of the tray. Both ends of the tray are thus held up by ropes which play freely from their points of suspension at the ends of the steel bow-spring above. Owing to this arrangement, as the cart moves along, the tray maintains its horizontal position, whatever inequalities of ground it may pass over, for the line of gravity is constantly preserved by the effect of the spring from which the tray is suspended turning on its pivot, and the yielding movement laterally of the ropes connecting the two together. The litter in fact turns on an universal joint, and is kept level much in the same way as a swinging lamp is kept level on board ship. At the same time any jolting which may be caused to the wheels and axle is almost wholly expended upon the elastic spring, and but trifling oscillations pass from it along the ropes to the body of the vehicle which contains the patients.

The spring sus-
pension of this
cart.

Like McAdam's cart, No. 1, this cart is furnished with a locker in front to receive the knapsacks and arms of the wounded men. It is also supplied with hoops and a canvas cover. The drawing which follows will serve to convey a notion of the general appearance of this vehicle.

* Model No. 1311 in the Mil. Surg. Mus. at Netley.

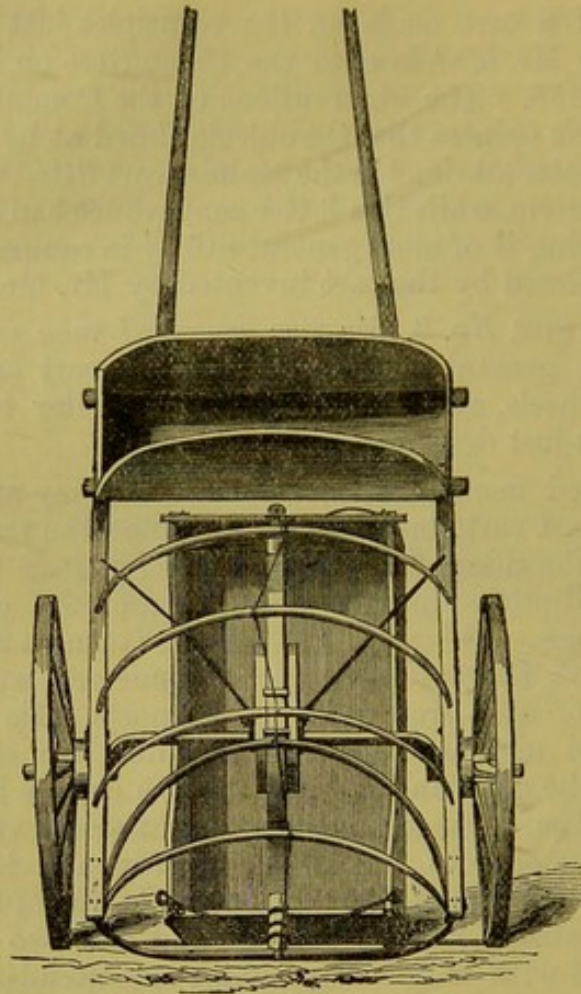


Fig. CXXIV.—McAdam's sick-transport cart for two men with fractured thighs. The cart has been turned up on its end, so as to show at one view the cranked axle and the longitudinal spring from the ends of which the tray for the patients is slung within the frame of the cart.

Construction of
McAdam's
sick-transport
cart, No. 3.

*McAdam's cart, No. 3, for four patients in a sitting posture.**
—In this conveyance the body is slung within the square frame of the cart by four india-rubber springs, and the whole is built on the plan of what are commonly called "Albert" carriages. An open oblong space is left through the body of the carriage for the axle, in this case a straight one, to play in. Were it not for the india-rubber suspenders the part of the carriage forming the boundary of this perforation would rest on the axle, and the carriage be so supported. On each side of the space just described in the body of the cart are two lockers for knapsacks and accoutrements. These lockers have a raised partition between them, and while they serve to carry the kits they also form the seats for the patients, who sit upon them back to back, two on the front and two on the back locker. The seats are thus nearer the ground than they would be if the whole of the body of the carriage were placed above the axle. Between the shafts, just in

* Model No. 1313 in the Mil. Surg. Mus. at Netley.

front of the part of the carriage where the driver's seat is usually placed, another locker is provided for carrying the men's firelocks. The india-rubber springs are of the same kind as those described with McAdam's cart, No. 1, and are connected in a similar manner from the sides of the frame to the four corners of the body of the cart slung within it. A cover to the cart is provided.

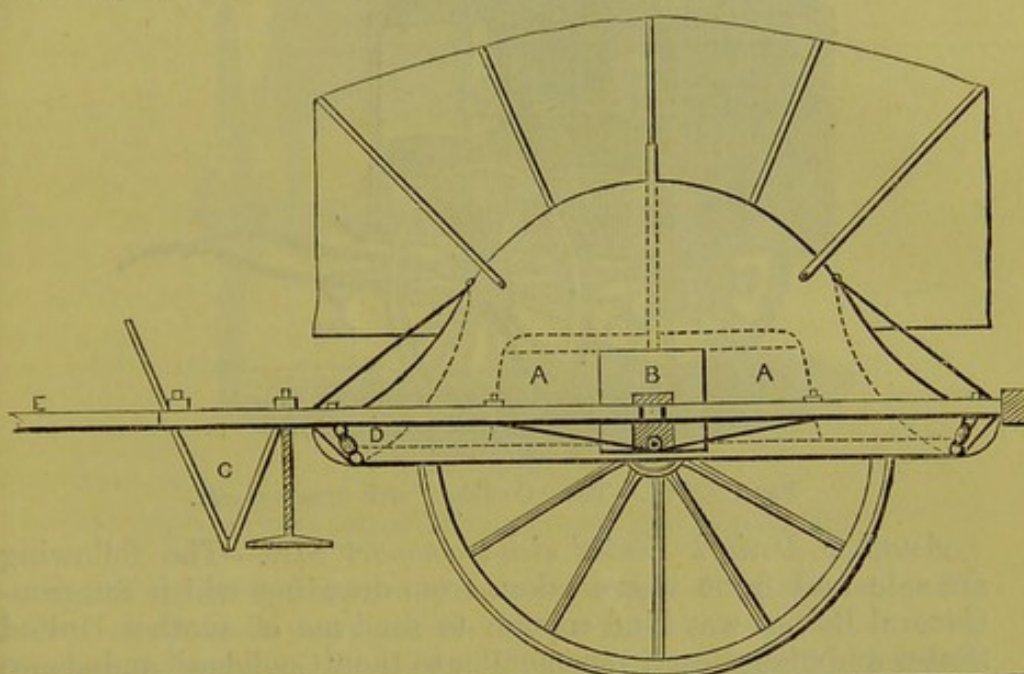


Fig. CXXV.—Sketch to show the construction of McAdam's cart for four patients sitting. (A) lockers for kits; (B) open space through the carriage for the axle to play in; (C) locker for firelocks; (D) india-rubber springs by which the body is slung in the square frame of the cart; (E) part of shaft.

Coolidge sick-transport cart.—It is stated in the reports issued from the Surgeon-General's Office, Washington, in November 1865, that "one-horse ambulance carts, designed by Surgeon-General Finley and Surgeon Coolidge, were employed at the beginning of the war, but their use was subsequently abandoned."*

Construction of
the "Coolidge"
cart.

The carts referred to in this quotation were intended to be drawn each by a single horse under ordinary circumstances, but they were drawn by two horses, tandem-fashion, on bad roads. They were made to transport two wounded men lying down. The two patients were separated by a low partition which traversed the long direction of the cart. On the floor, on each side of the partition just mentioned, two framed stretchers were fitted, and on these the two patients were placed. These stretchers were made capable of being folded up in three directions, so that the patient's head and trunk could be raised nearly into a sitting position, or his legs bent and raised. The stretchers could be used as hand-litters on being removed from the cart.

The "Coolidge" carts were found to be too frail for the rough roads on which they were employed. Another practical objection

* Circ. No. 6, W.D., Surgeon-General's Office, Washington, p. 83.

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met with was the excessive elasticity of the springs, the body of the cart being tossed about to such an extent in consequence as to add greatly to the sufferings of the patients transported in it.

The small sketch which follows is copied from the illustration given in the report already quoted.

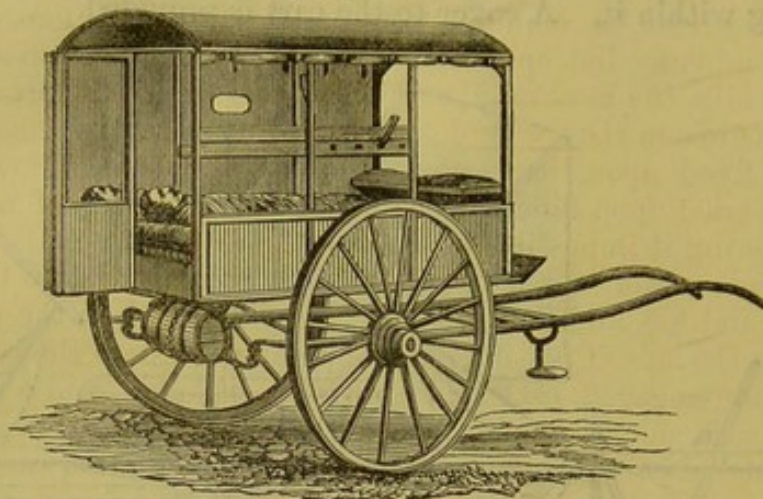


Fig. CXXVI.—The "Coolidge" sick-transport cart.

Another United States' sick-transport cart.—The following are side and front views taken from drawings which Surgeon-General Barnes was kind enough to send me of another United States ambulance cart, very similar to the "Coolidge" ambulance cart, and, like it, discarded as useless. The height to which the body of the vehicle is raised above the axle, and the form and arrangement of the springs, sufficiently show that as a sick-transport conveyance the same faults must have existed in this cart as those which have just been described to have been experienced in the use of the "Coolidge" cart.

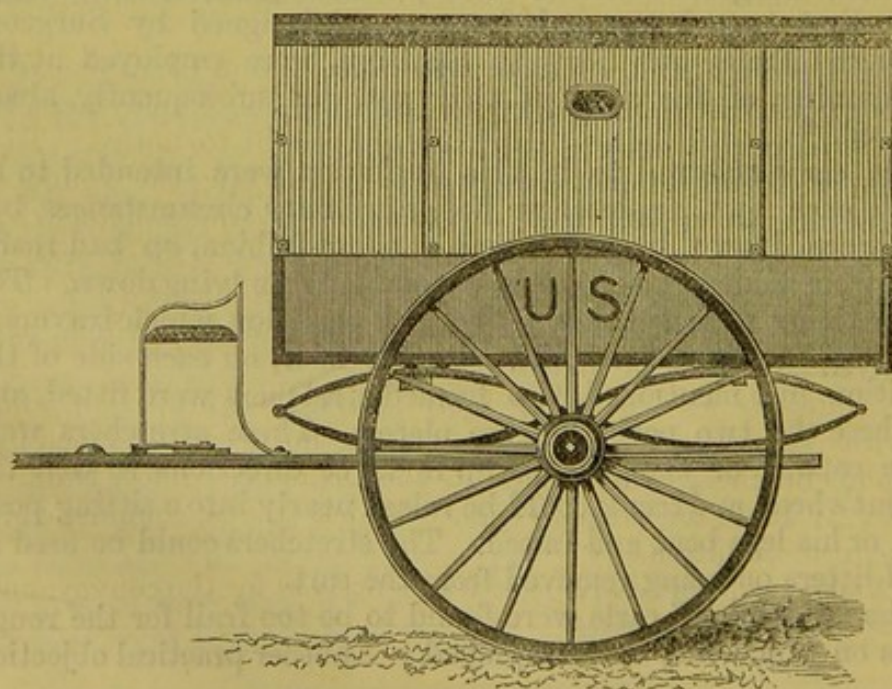


Fig. CXXVII.—Side-view of United States' sick-transport cart.

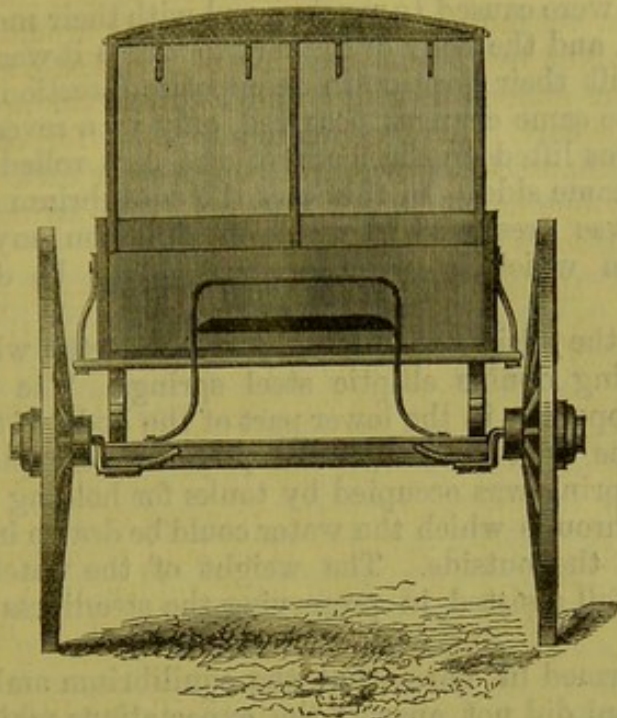


Fig. CXXVIII.—Front of United States' sick-transport cart.

Voiture d'ambulance suspendue du Dr. Cantoni, or equilibrium ambulance cart.—This was a two-wheeled ambulance carriage designed by Dr. Michel Cantoni, a surgeon in the Sardinian army, and first used in the Italian campaign of 1859. It was constructed for the conveyance of two badly wounded soldiers in a recumbent position. In this carriage the same object was aimed at as was sought for in McAdam's cart, No. 2, viz., the maintenance of a perfectly horizontal position of the body of the cart under all the circumstances of uneven and roughly surfaced roads. The mechanism by which this end was endeavoured to be attained in Dr. Cantoni's cart was entirely different from the universal joint and pliable suspension apparatus, described to have been employed in McAdam's conveyance.

In Dr. Cantoni's cart the shafts were prolonged for a short distance behind the wheels, and were made to serve as a support for a square frame, the four corners of which reached nearly as high as the four corners of the roof of the vehicle. The sides of this frame were concave, the ends convex. The body of the cart was carried within this frame, and at the same time was supported upon it by a peculiar contrivance. This contrivance consisted of a frame which projected from the roof and surrounded the ends and sides of the cart. It was adapted to act as a counterpart to the frame supported upon the shafts. To the upper frame near the corners, eight small wheels were fixed, two on each side, and two at each end. The upper surfaces of the shaft frame were adapted for receiving these wheels, and they turned upon them as the wheels of a railroad carriage turn on its rails. The effect of this contrivance was, that when the shafts and the frame fixed upon them were tilted upwards, the little wheels attached to the

Construction of
Cantoni's equi-
librium sick-
transport cart.

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upper frame were caused to revolve, and with their movement the upper frame, and the body of the cart to which it was fixed, were caused to shift their position in an opposite direction. In going down hill the same changes occurred, only in a reverse way. If one wheel was lifted up the body of the cart rolled downwards toward the same side. In this way the equilibrium of the body of the cart was preserved in whatever direction any part of the frame within which it was supported might be depressed or elevated.

To lessen the jolting the shafts were connected with the axle by intervening double elliptic steel springs. The axle passed through an opening in the lower part of the body of the carriage, but below the floor on which the patients were placed. Each side of the spring was occupied by tanks for holding water, there being taps through which the water could be drawn in convenient positions on the outside. The weight of the water when the tanks were full assisted in preserving the steadiness of the conveyance.

I was informed in Paris that the equilibrium ambulance cart of Dr. Cantoni did not answer the expectations which had been entertained concerning it, but I was unable to ascertain the particular causes of its failure.

Primitive construction of the common bandy of India.

*Common Indian cart or bandy.**—This is perhaps the simplest form of two-wheeled conveyance employed in any country. Each wheel is generally constructed of three separate pieces of flat wood, and these are of such a shape that when they are united together the whole forms a solid wheel with a circular outline. They are simply joined together by pegs of wood, nothing of the nature of a tire being employed to bind them together. These wheels are commonly called "log-wheels." They are connected by a wooden axle, which passes through openings in their respective centres, wooden pegs again answering the purpose of lynch-pins. Two long poles of wood are fixed horizontally upon the axle. The ends of these poles *behind* the wheels are stretched widely apart by a cross-piece, while the ends *in front* of the wheels are brought closely together, and lashed tightly to each other by half-tanned hide cords. Thus, the two side-poles and the cross-piece at the back together form a triangle, and this constitutes the frame of the cart. At the point of the triangle the yoke is fixed for a couple of oxen. Upon this frame, projecting partly beyond the base of the triangle, and extending to some little distance in front of the wheels, is placed the body of the cart. It is broad behind and tapering in front, corresponding in general form with the frame on which it rests, and consists of bent strips of wood tied together by a lacing of split bamboo. As an additional support to the body of this conveyance, three stakes or upright pieces of wood are fixed in each of the shafts at certain intervals to strengthen it on either side.

* Model No. 1302, Mus. of Mil. Surg. at Netley. The Ceylon bandy is a similar vehicle. *Bandy* is the common Tamul word for cart.

These supports are fastened together at their upper ends by cross pieces of wood, or sometimes by ropes, and thus they are not only strengthened, but an easy means of supporting a cover over the upper part of the cart from side to side is afforded.

This conveyance is often used by the wives and families of soldiers when regiments are on the march in India, especially in the Goojerat country. Some soft material is laid upon the floor of the conveyance, and as a further protection a cover is arched over it. Like the hackery next to be described, too, it has often been employed in the conveyance of sick and wounded when better means of transport have not been available.

Indian hackery.—The hackery is the cart in common use among the natives in Bengal and other parts of India. Its construction is somewhat more advanced than that of the bandy just described. The wheels are not log wheels, but consist of a nave with from four to six broad spokes inserted into separate pieces of wood, or felloes, to form the circumference. The several parts of the wheels are very heavy, roughly hewn, and rather loosely pegged together by pieces of wood. No iron enters into the composition of the cart. The frame of the cart rests directly upon the wooden axles, and is usually irregularly triangular, sometimes quadrangular in form. The sides and ends are very rudely constructed. Each cart is drawn by two oxen.

Construction of
hackeries.

Like the bandy, the hackery not only forms one of the ordinary hired means of conveyance for heavy stores when troops are marching in India, but it is also frequently used to supplement other lighter and handier means of transport for those who fall sick or become wounded. They were very extensively employed during the Sikh campaigns and during the time of the Indian mutiny for carrying the sick and wounded along the main roads, some of the cotton quilts or mattresses stuffed with hemp of the country or straw being employed to soften the concussions for which no means are provided in the cart itself. Their rate of progress is very slow, and this, together with the circumstance of the wheels and other parts being joined so loosely together, causes violent concussions to be by no means so frequent during their movement as might be expected, or as would be the case were the wheels more firmly and rigidly constructed. After a hackery has been some time in use it is liable to be temporarily disabled by the loss of part of a wheel or some such accident; but on the other hand, the very simplicity of construction which leads to this liability, proportionally renders repair of the damage or restoration of the lost part an easy task. The native driver never finds himself at a loss to remedy occurrences of this kind in whatever part of the country they may happen. If a wheel-spoke or even an axle break down, the driver goes to the nearest tree and with his axe soon hews out of it a substitute for the disabled piece, and after an hour's delay or so the vehicle is able to proceed on its journey.

Hackeries
easily repaired
in case of acci-
dents.

Colonel Robertson, C.B., of the Military Train, has informed me of a plan which he adopted for improving hackeries as means

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Col. Robertson's plan of utilizing hackeries left without bullocks.

of carriage for the sick and disabled of a force which he was accompanying up country during the period of the Indian mutiny. It was no uncommon circumstance at that period for the native owners of bullock-hackeries which had been pressed into military service to desert with their bullocks during the night, leaving their rude hackeries in camp behind them. Colonel Robertson found himself with a number of hackeries without bullocks from the cause mentioned. Determined not to lose their services, however, he removed the upright posts which formed the sides of the hackery, and then placed across the triangular floor an oblong platform made of bamboo, fastened together by rope. Along the middle of this platform he caused an upright partition of the same materials to be erected, and so divided the platform into a double bench or couple of seats with a back in the interval between them. Upon the seats and over the back some cotton quilts were thrown, and thus means were afforded of carrying men either in the sitting or recumbent posture. Colonel Robertson now removed the wheels and axle from another hackery, and upon this second axle pinned the small tapering end of the frame of the first hackery. The effect of this was, that the improved hackery not only now rested on four wheels, but the forepart of the vehicle was enabled to make a half-turn to either side. A strong rope was attached to the front axle, and cross pieces of bamboo secured to it at intervals. Some coolies, about twenty in number, were now obtained for each of these converted hackeries, and in this way the vehicles were drawn on for a day's march; the coolies being paid and discharged, and relieved by others, at each halting station, in the same manner as travelling by coolie-dâk is done in India.

Construction of the Madras hospital cart.

*Indian hospital cart.**—This is a simply but substantially constructed cart for the conveyance of four men sitting, authorized for use in certain parts of India. It is especially employed in the Madras presidency, where, according to rule the sanctioned amount of carriage consists partly of dhoolies and partly of carts. They are made for draught by two bullocks. There are two seats for the wounded or sick men, and these are slung within the body of the cart in such a way that the patients sit back to back, two on each seat. There are no springs to the vehicle; direct concussion is only interrupted by the seats being slung instead of being fixed within the cart. A flat foot-board is provided for the native driver, who either sits cross-legged upon it, or with his legs hanging down on each side of the pole behind the two oxen. The wheels are broad and low, and are placed so that the larger proportion of the weight of the conveyance falls in front of the axle and rests on the necks of the oxen. The upper part of the framework of the cart is open, but the interior is protected against the effects of sun and rain by curtains of rather heavy painted canvas continued from the roof and hanging down loosely. No means of keeping the curtains open or shut are

* Model No. 1303 in the Mus. of Mil. Surg. at Netley.

provided. They can be thrown upwards upon the roof, and if the day be calm they will probably remain there, but if windy they are liable to be blown down again and to flap backwards and forwards to the annoyance of persons inside. The conveyance is only suited for the slow kind of draught of which bullocks are capable; a rapid movement would cause the carriage to be intolerable even to strong and healthy persons. It has the advantage of capability of easy repair, at the same time it is built so as to offer considerable resistance to the shocks it is likely to be exposed to when passing over deep or bad roads. By taking away the seats two men can be carried lying at full length on the floor of the cart, but from the description already given, it is obvious that the jolting must then be excessive. There is nothing to break the force of accidental concussions excepting any straw or other soft materials that may be placed in the cart for the men to lie down upon. Among soldiers in India this cart is familiarly spoken of as the "bone-breaker," a designation which sufficiently shows the estimation in which it is held among them as a carriage for sick persons.

The illustration shows the general appearance of the Indian hospital cart.

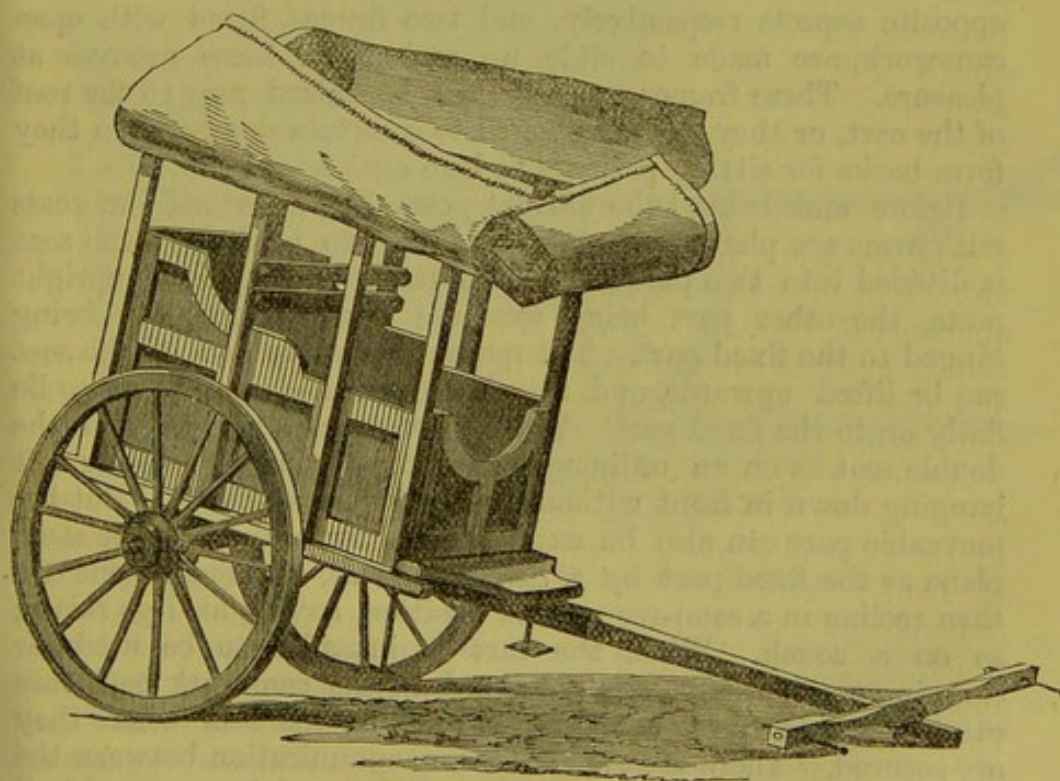


Fig. CXXIX.—Indian hospital cart for draught by two bullocks. The side and end curtains are thrown over upon the roof of the vehicle.

*Inspector-General Macpherson's Madras cart.**—This cart was designed to replace the Indian hospital cart just described,

* Model No. 1304 in the Mus. of Mil. Surg. at Netley.

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Capacity of
Macpherson's
Indian sick-
transport cart.

over which it possesses many advantages. It is less heavy in construction, and is suspended from two axle springs. As regards amount of accommodation, it is adapted to convey two men in a recumbent position, or one recumbent, and two sitting up back to back, or four men sitting or semi-recumbent back to back, together with the driver. It is provided with shafts, as well as with a pole, and can be drawn either by a single horse or pair of bullocks, according as circumstances may render most convenient.

Construction of
Macpherson's
cart.

The body of the vehicle is formed with a double floor. The lower floor is separated from the upper by a space which is intended to receive medical stores, the men's knapsacks, accoutrements, or firelocks. This space is open at both ends, but is closed at the sides. The upper floor forms the support for the beds of the patients when they are placed in a recumbent posture, and equally supports the seats for them when they are carried sitting. The mechanical construction employed to effect these several purposes is peculiar. An upright post rises from the middle of the upper floor to the roof or frame which supports the awning of the cart; and two upright posts, at the same distance from the front and back of the cart as this central post, are fixed upright close to each side of the cart. These pillars are grooved on their opposite aspects respectively, and two frames, fitted with open canework, are made to slide up and down these grooves at pleasure. These frames can therefore be raised near to the roof of the cart, or they can be lowered to a certain depth when they form backs for sitting patients to lean against.

Before and behind the upright posts just described four seats with arms are placed, two in front and two behind. Each seat is divided into two parts, one part being fixed to the upright posts, the other part being rendered free to move by being hinged to the fixed part. The moveable part or flap of the seat can be lifted upwards, and may be so far folded back as to lie flatly on to the fixed part. Thus a patient can sit either on the double seat as on an ordinary arm-chair, or the flap may be left hanging down in front without causing inconvenience. But the moveable part can also be extended and maintained in the same plane as the fixed part by a catch in front, and the patient can then recline in a semi-recumbent position, having his legs raised, as on a couch. When the cart is intended to be used for carrying two patients wholly recumbent the canework backs are caused to slide up in their grooves towards the roof where they are secured. There is now an open communication between the two seats in front and the two behind the upright posts. If all the moveable flaps are now raised and secured, each of the front and corresponding back seats will be united in one plane, and thus a sufficiently long support is afforded on each side of the central upright post, and between it and the two side posts, for the reception of a patient lying on a mattress or ordinary stretcher.

The sides of the cart are protected by awnings. These awnings

consist of four wooden flaps, two on each side, formed of light frames covered by canvas. They extend along the whole length of the cart. These flaps can be separately opened or shut at pleasure, and can be kept open at any necessary angle by iron stays. Ventilation may thus be maintained through the cart, at the same time that the glare of the sun is shaded from the interior. The front and rear curtains are made to hang down loosely from the roof, but can be rolled and kept up when necessary. In the ordinary Madras hospital cart all the curtains which are used to exclude the glare of the sun necessarily at the same time exclude circulation of air; and, as before mentioned, it is very difficult to keep them open under any circumstances.

The weight of Macpherson's cart as constructed at Madras was seven hundredweight.

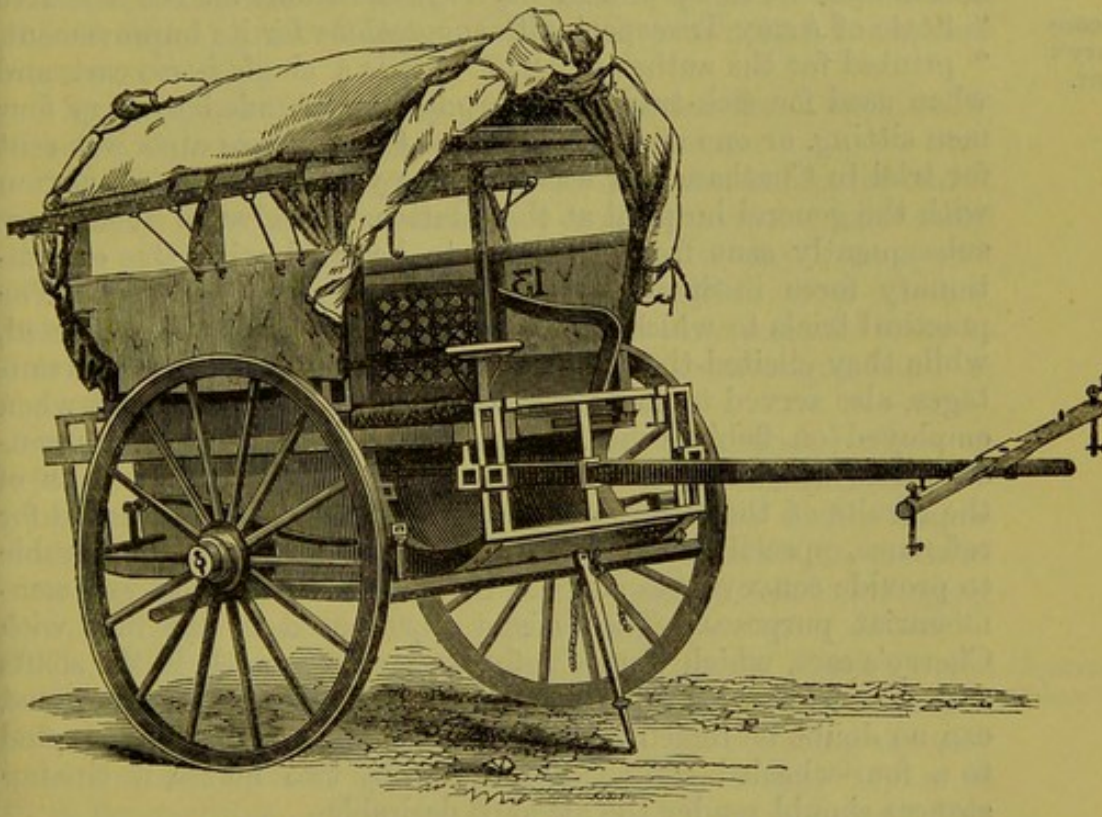


Fig. CXXX.—Inspector-General Macpherson's Madras cart.

In 1859 this cart was sent out for trial under the directions of the officer commanding the first battalion of Madras Artillery at St. Thomas' Mount, and, though found to be very easy for the inmates, was ascertained to be faulty in some details of construction, and not light enough for the draft power assigned to it. After being tried for several days over the roughest ground in the neighbourhood, the report made of the cart was, that as a "horse-ambulance vehicle, when full, it had too much weight "behind the axle, which distresses the horse a good deal; "besides which, it is so near the ground in rear that it would "often be brought up by obstacles, such as large stones, roots, "and stumps of trees. It would certainly need two horses (one

Trials of
Macpherson's
cart.

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Experience
of Cherry's
field cart.

" as a leader), or one very large English horse. It is, however, " very easy in its movements over rough ground, far better than " anything in the service at present in the shape of sick-carts." When used with bullocks it is described as a very comfortable conveyance, more so than when drawn by a horse; " but," it is added, " it is also very heavy over bad ground for one pair; the " men had often to get out and help it over difficulties." The drivers are stated at the same time to have been very unskilful.*

Sick-transport carts of the Second Category.—The carts included under (Aa), viz., " two-wheeled conveyances combining " particular adaptations to fit them both for the carriage of sick " and for transport of stores," remain to be described.

Cherry's field cart for commissariat or hospital service.†—This ambulance cart was designed by Veterinary-Surgeon Cherry, and is referred to by him in his " Observations on the defective " State of Army Transport with suggestions for its improvement, " printed for the author in 1825." It is a single-horse cart, and when used for sick-transport purposes is intended to carry four men sitting, or one man recumbent. One of these carts was sent for trial to Chatham and was for some years in use in connexion with the general hospital at that station. Twelve of them were subsequently sent from England to be used with the expeditionary force in Spain under Sir de Lacy Evans in 1835. The practical trials to which Cherry's field cart was thus subjected, while they elicited the fact that it possessed very many advantages, also served to show the defects which existed in it when employed on field service. A particular description of its construction, which presents several special features, as well as of the results of the experience gained of its use, will be useful for reference, especially if in the future it should be thought advisable to provide conveyances adapted both for sick-transport and commissariat purposes. The defects experienced in the field with Cherry's cart, which were chiefly want of strength in the shafts and wheels, and its being fitted as a single-horse conveyance, can no doubt be remedied, and its peculiar mechanism adapted to a four-wheeled conveyance drawn by two horses, if circumstances should render the attempt desirable.

Mr. Cherry has not described the construction of his conveyance in the pamphlet previously referred to, but has enumerated the following as its advantages:—

Alleged advantages of
Cherry's carts.

" 1. It is provided with flexible springs for light loads, which, by a simple contrivance, are protected from injury when weighted by heavy loads. This admits of more ease in cases of sickness that require an entire carriage than can be derived from stiff wagon springs.

" 2. It is fitted to receive and suspend a stretcher for patients that require a recumbent posture.

* Report from officer commanding first battalion Madras Artillery, St. Thomas's Mount, 11th July 1859, No. 378.

† Model No. 1351 in the Mus. of Mil. Surg. at Netley.

"3. It is provided with commodious seats, and with a support for the back of patients who are able to sit up.

"4. It is more spacious than the wagon,* and therefore admits of patients alleviating pain by change of posture.

"5. Three of these carts may be equipped and supported for less money than one wagon.

"6. In moving patients singly, a wagon can, of course, take but one, while its proportion of carts will take three, and in moving them collectively carts will carry twelve men at a much less expense than attends a wagon carrying eight; in each case, as regards carts, with less pain to the suffering individual.

"7. They take to pieces and may be made to occupy but very little room, either in a store or on board ship.

"8. As each cart requires but one horse, they may be brought into active usefulness at a very short notice, since any man is able to lead a horse without any previous instruction or expense whatever.

"9. The general simplicity of equipment admits of their being attached to, and embarked with, single regiments.

"10. These carts are equally applicable to commissariat transport. The mode of arrangement for each service being extremely simple, every Government carriage may be at any time appropriated to the conveyance of sick or wounded officers or soldiers, thus affording means of transport for this very essential duty to a much greater extent than can be derived from wagons, and at the same time saving large sums of money.

"In short, it is much easier to the sick or wounded officer or soldier, much more convenient and efficient for the military hospital service, and much less expensive than the spring wagon, with the additional advantage of being applicable, as occasion may require, to the conveyance of stores of all kinds belonging to every other branch of the public service."

The principal peculiarity in the construction of Cherry's cart is the mechanism by which the vehicle is enabled to be employed either as a cart with springs, or with the body resting directly upon the axle without the intervention of the springs, so as to fit it for carrying either wounded men or heavy stores. This mechanism, which is placed beneath the cart, but manipulated by a lever, one end of which projects behind the cart, consists of two moveable blocks sliding upon the axle so as to be transferred at pleasure, either under the framework on each side, or within the hollow space beneath the floor of the cart. The handle of the lever by which the movement is effected is furnished with a stirrup-shaped iron loop, and this enables it to be secured to either one or other of two hooks which project from the two corners of the hinder part of the cart. The following drawings, showing the blocks moved under the framework on each side, as well as within the framework, of the bottom of the

Construction of
Cherry's carts.

* The wagon here referred to is the spring wagon which was in use during the Peninsular war.

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—

cart, and also the mechanism by which the blocks are shifted, will best explain the arrangements just described.

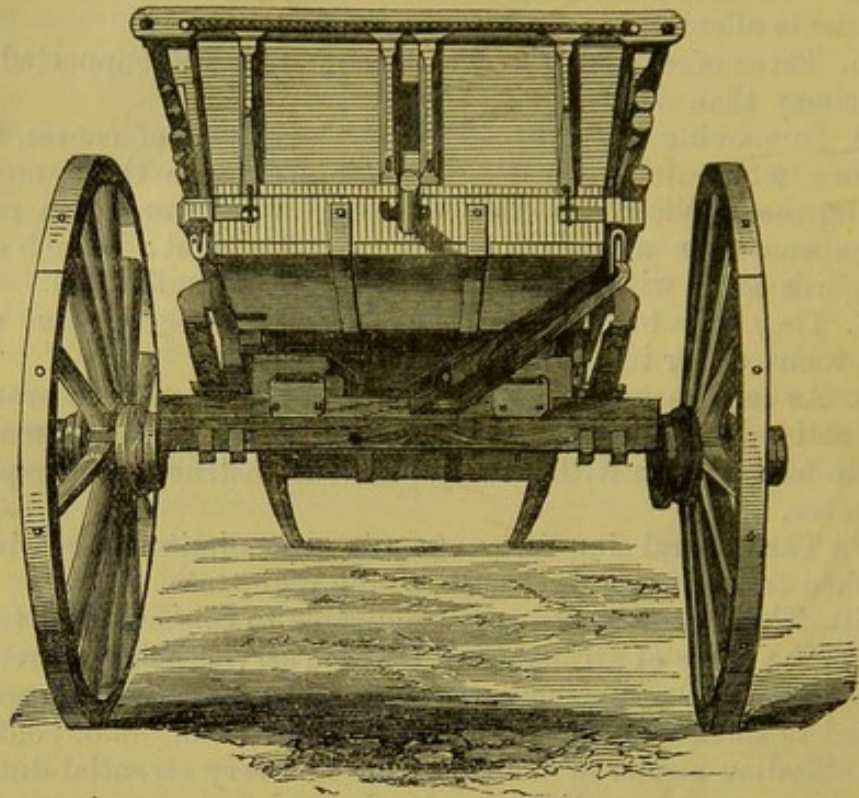


Fig. CXXXI.—Cherry's Field Cart. The body of the cart is resting on the blocks and axle, not on the springs.

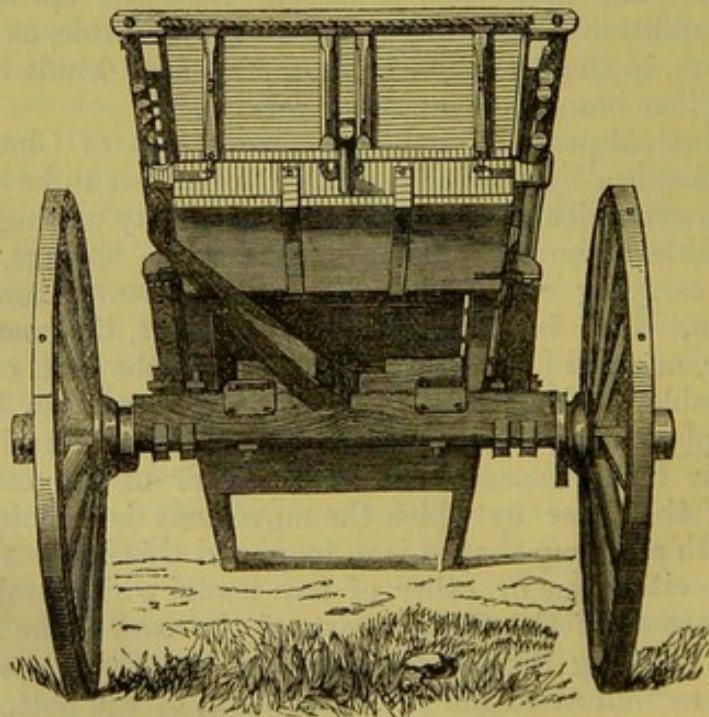


Fig. CXXXII.—Cherry's Field Cart. The body of the cart is resting on the springs, the axle-blocks being drawn within the sides of the cart-frame.

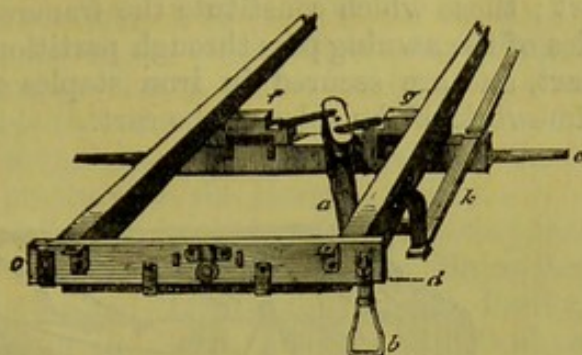


Fig. CXXXIII.—The mechanism by which the blocks are shifted. *a*. The lever, and *b*, the stirrup-shaped loop attached to its handle. *c, d*. Positions of the hooks at the back of the cart for receiving the handle of the lever. *e*. The axle. *f, g*. The axle-blocks and their connexions with the lever by which their position is shifted. *k*. Part of the spring on the right side of the cart.

Another peculiarity in the fittings of Cherry's cart is the manner in which the stretcher for a patient lying down, or the seats when the men are carried sitting, are suspended within the cart. They are slung by the following means:—Closely connected with the upper borders of the sides and ends of the cart is a continuous piece of strong rope. This rope runs along the *inner* surfaces of the two *sides*, but along the *outer* surfaces of the two *ends* of the cart. They are passed through openings made for their passage in the two ends. An apparatus is provided for bracing up this rope according to circumstances. The seats for men sitting, when not so employed, form portions of the floor of the cart, which is partly double, or rather, is provided with two wells for the reception of various articles. The planks covering these wells are removable, and at each end they are fitted with two curved pieces of iron, of a shape to fit them for securely grasping the rope fixed to the sides of the cart. A certain amount of elasticity is afforded to the seat by its suspension from the rope, as described, but a further provision is made for breaking the force of concussions by the cart, when used as a sick-transport conveyance, being arranged to rest only on the springs. When a man is to be carried in a recumbent position, the seats are not removed from the floor, but the poles of a regulation stretcher are looped to the two side ropes, and so an easy litter is obtained for the carriage of the patient.

Mode of suspending the seats or litter in Cherry's field-cart.

The arrangement by which the men are carried sitting is shown in the following sketch. The two side ropes are indicated by the lines proceeding from *a*; *b b* represent the two planks used as seats, which have been taken from the two wells marked *c c* in the floor of the cart. The drawing also shows the manner in which the covering of the cart is supported. The poles which form the support are carried on the outside of the two sides of the cart. The ends of these poles are seen in Figs. CXXXI. and CXXXII. When mounted, the poles and cross-piece which form

CHAP. V.

the ridge of the cover are supported within staples fixed to the ends of the cart; those which constitute the framework for supporting the sides of the awning pass through partitioned openings at the upper part, and are secured in iron staples on the lower part, of the framework of the sides of the cart.

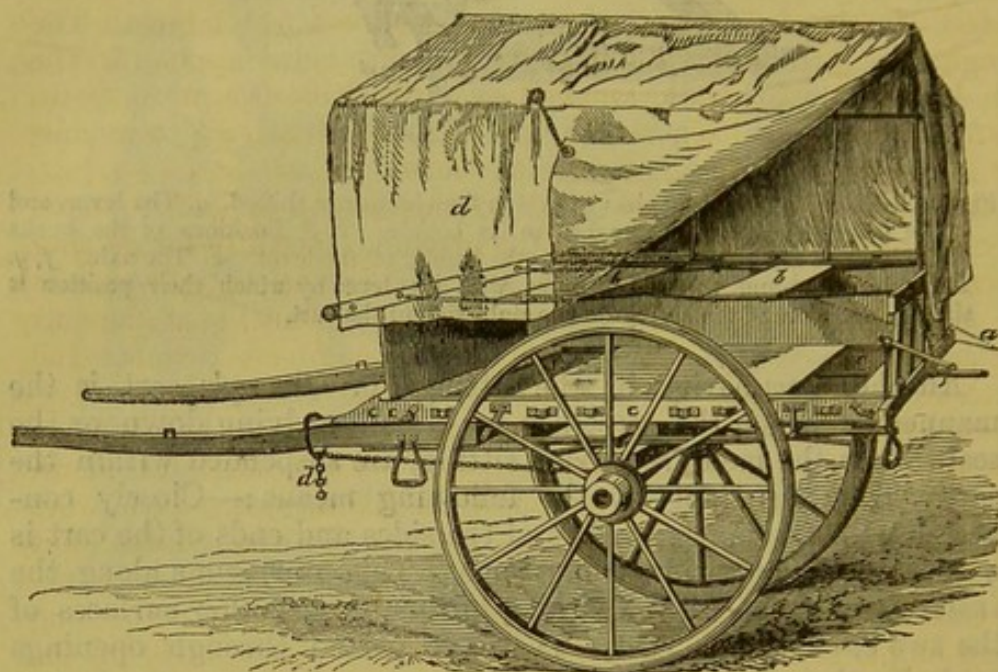


Fig. CXXXIV.—Cherry's cart arranged for the carriage of four patients sitting. *a*. The two side ropes. *b b*. The two planks employed as seats, removed from, *c c*. Two wells in the bottom of the cart. *d*. The cover of the cart.

It has been before mentioned that one of Cherry's carts was sent to Chatham for trial and observation. After it had been in use for some time at that station, Inspector-General Dr. James Forbes, the principal medical officer, reported upon it as follows. The report was dated the 26th of March 1820.

Experience of
Cherry's cart
at Chatham.

"The cart fitted up by Mr. Cherry has been carefully and minutely examined by myself and the other medical officers of this hospital (Fort Pitt), and we are fully of opinion that it is perfectly adapted for the purposes for which it is intended, viz., the easy and comfortable conveyance of sick and wounded men, at the least possible expense of men and horses.

"The facility with which it is taken to pieces and again put together, as well as the simplicity of the whole appointments, and the ease with which they may be repaired by such workmen as are to be found in every regiment, are also strong recommendations.

"I have some doubts whether the springs are of sufficient strength to resist the shocks that must be frequently met with in bad roads, even with the weight they are intended to carry;

this, however, is a matter of detail of easy alteration should it be found requisite or proper.

"A trifling change in the mode of suspending the seats was pointed out to Mr. Cherry, which he is to carry into effect.* It is also desirable that the means of attaching, in difficult roads, a second horse should be provided, perhaps in the same way that is at present practised in the Horse Artillery.

"It is impossible to conclude without stating that Mr. Cherry's cart has been carefully examined by Major-General D'Arcy, Colonel Christie, and Lieutenant-Colonel Pasley, and by the medical officers of the Navy, Marines, and Dockyard, who have all expressed their approbation of its convenience, simplicity, and ingenuity."

After further observation, Inspector-General Forbes again reported in November 1822:—

"After a trial of more than two years, I have not seen any reason to change the favourable opinion I at first formed of the cart. I consider it as a model of simple ingenuity, perfectly calculated to answer every purpose for which it is intended, and it will, I am sure, be found a most valuable addition to the material of our armies on any future active service.

"Its lightness, the small space it occupies when taken to pieces, and the facility with which it may be put together and brought into use, are great advantages."

But the more important, because more practical, trial was that which was made of these carts on active service, when they were used with the expeditionary army in Spain; and the following observations on their employment, with some valuable reflections incidentally introduced on the subject of sick-transport in general, have been recorded by Mr. Alcock (now Sir Rutherford Alcock), who was the principal medical officer with the Force:—†

"Twelve of Cherry's carts were sent out with the British auxiliary legion, at Mr. Guthrie's recommendation; they were employed on several occasions in the neighbourhood of Victoria, and in all the actions in which the legion was engaged in Guipuscoa.

Cherry's carts
with the British
legion in
Spain.

"Upon the whole they were found serviceable, and much may be said with justice in their favour; but they are also liable to objections of some importance.

"Small as they are in size, calculated only for four wounded capable of sitting upright; in heavy roads they become too much for one horse or mule, unless a very powerful one. It is rare also that a single draft-mule will draw well; it was almost invariably necessary to employ two whenever we turned off the main road.

* The conversion of a right-angled hook into a curved one.

† "Notes on the Med. History and Statistics of the British Legion in Spain." 1838, p. 39.

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Experience of
Cherry's carts
in Spain.

"The shafts and the wheels seemed scarcely proportionate in strength to the work of the cart; in heavy roads they broke down in several instances, and at each time either in the shaft or the wheel. It is precisely in such situations, in narrow, deep, and hilly roads, where there is no possibility of flinging a broken down vehicle out of the direct line of march, that such an accident is sure to cause great delay and confusion, by rendering it impossible for anything in the rear to pass or advance a step. Any other accident would only be to the detriment of the four wounded. One of the nature pointed out may affect the march of a whole column, if more than one move by the same line, and at all events interfere with the closing up of the rear for hours, and of course, if an active enemy be hanging on the skirts, is likely to compromise all that may thus unavoidably be detached from the column.

"There seems to me another objection relative to the wheels, but upon which I speak less confidently. Speed can never be an object in these carts, but rather a capability of progression, however slow, under the worst circumstances of time, roads, and weather; this is of the last importance. It appears to me, therefore, that if at the same time that the wheels were made stronger, they were also somewhat increased in width of rim, they would cut less deeply into heavy roads, and be less liable to stick fast and create a stoppage, which—however short it may be, as all military men know—is among the worst evils which can befall a column en route.

"As to the remedy proposed however, it will be for abler mechanics than myself to determine how far it is calculated to answer the end.

"The mechanism and construction of the carts in many other points—the slinging of the cot, the covering, and the mode by which the cart may be used, either with springs or without—are excellent. As to the general question of how far they are adapted to supply the transport for wounded, required by an army on active service, I have formed an opinion unfavourable to their general, perhaps, I should rather say, exclusive use.

Sir Rutherford
Alcock's views
on sick-trans-
port in general.

"A general action, even when but a few thousand men are engaged on each side, if well sustained, will often produce from five hundred to a thousand wounded. To remove this number from the field, supposing one half to be slight, and this is a very favourable proportion, the number of carts would be enormous, sufficient to fill a town of themselves, and extend and encumber a line of march for miles.

"A single campaign, however, is sufficient to prove to any one the importance of having means readily available for the transport of wounded from the immediate scene of action, without allowing a legitimate excuse for any part of the effective force being so employed. In all armies there are a sufficient number of men who, although they may have passed their previous lives

without manifesting any sympathies for the misfortunes of their neighbours, suddenly on a field of battle become wonderfully compassionate to a wounded comrade ; and never is this sympathy so strongly displayed perhaps, as when there is a check or the probability of a reverse,—precisely the moment when their presence in the front, and not their sympathy for their comrades going to the rear, is required. As battles are not generally fought upon plains, but upon some vantage ground, often steep or wooded hills, the most rapid and effective mode of withdrawing the wounded from the scene of action to any point in the rear previously fixed upon, has seemed to me to be the following, which was tried upon different occasions, our deficiency of mules alone rendering it impossible at all times.

“A brigade of mules, say twelve to each column of two thousand rank and file, and four of Cherry's carts placed on the main road, or by the side if possible, at the point nearest to the centre of the column engaged, each mule having a bât-man and a chair or seat on each side, (commonly used throughout the Peninsula, and forming a part of the pack-saddle,) will in most cases be found capable of picking up the wounded within a few yards of their post, and without delay. The carts, from the smallness of their size, may often approach close to the rear of the force engaged, and pass along its line although there be only a cross road, or even none at all ; and they would thus take up at once officers and men with fractured limbs, or who may be otherwise too seriously wounded to be able to ride or sit. These are the means of transport from the immediate scene of action, for at or near the point, from which they started should be a relay of spring-wagons, capable of containing at least from twelve to fourteen wounded, and conveying them to the first ambulance or hospital station.

“In this manner Cherry's carts might be employed with great advantage.”

In this report not only the particular qualities of Cherry's carts are considered, but the general question of the employment of single-horse conveyances is incidentally brought to notice. The necessity of having distinct conveyances for carrying the wounded from the field of action itself, by hand or by mule litters, by mule cacolets, &c. to the wheeled conveyances, and the necessity of having different kinds of this latter class of vehicles to which reference is made in the report, are also subjects which are considered elsewhere in this work.

*Mr. Butcher's field cart for commissariat, ammunition, and sick-transport service.**—This was a single-horse cart designed by Mr. John Butcher, Storekeeper, in the Ordnance Office, Dublin, in the year 1849, for the conveyance of sick troops, commissariat stores, or ammunition.

As a sick-transport carriage it was contrived for the conveyance

* Model No. 1352, in the Mus. of Mil. Surg. at Netley.

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of six men sitting, or two recumbent, with the driver; as a commissariat cart it was capable of carrying ten tents, with poles and appliances complete; as an ammunition car, twelve quarter barrels of ammunition or 6,000 rounds.

Construction of
Mr. Butcher's
cart.

To fit the conveyance for the carriage of ammunition, special protection as well as means of separating the barrels became necessary; these, including two partition boards, one wadmilt, and one cover, were carried in a drawer under the body of the cart. Sundry other articles were also carried in this drawer, including caps with straps to secure five pairs of tent poles, which were placed under the cart, in spaces along each side of the drawer, when it was used for commissariat purposes. The top of the cart was made of four planks of wood, each two of these frames being themselves hinged together as well as to the framework of their respective sides of the cart. A folding lid, divided down and opening along the middle, was thus formed. This top was employed as a flat roof when ammunition was being conveyed; each half of it was raised, folded upon itself, and secured so as to heighten the sides of the cart, when it was used for commissariat purposes; and again, each half was folded downwards within the body of the cart to form seats when men sitting were to be conveyed. The direction for adapting the cart for the conveyance of sick men lying down, was to pull out the drawer fourteen inches, and to drop the tailboard upon it, securing the two together by certain buckles and loops provided for the purpose. A platform would be thus formed long enough to receive two patients lying down. Bail hoops, three in number, were provided, and a cover

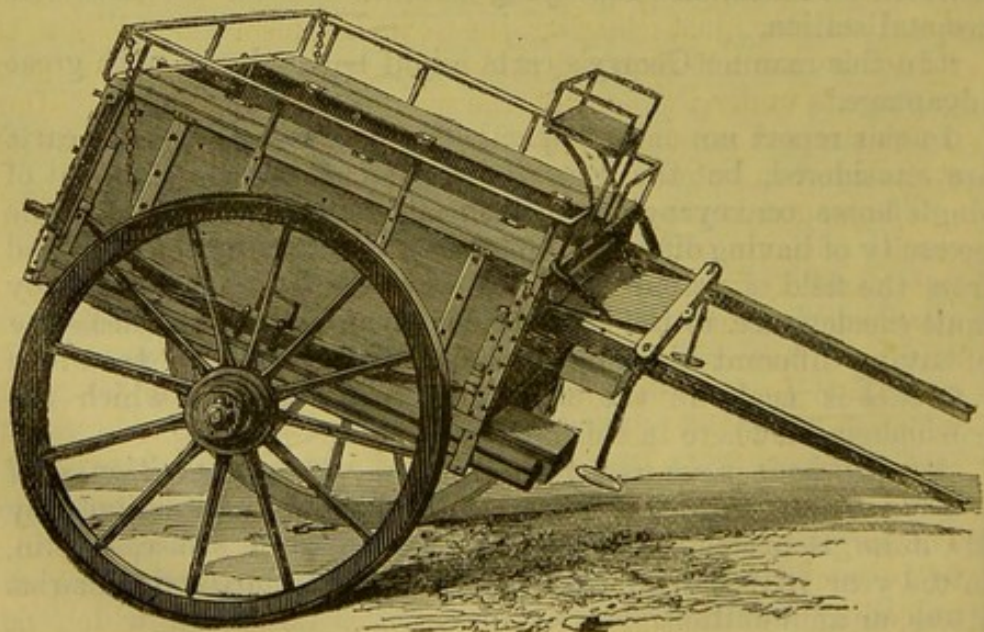


Fig. CXXXV.—Mr. Butcher's Field-cart for Commissariat, Ammunition, and Sick-transport service.

for protection when the cart was used as a sick-transport conveyance. The bail hoops were carried strapped in front of the cart, the cover folded up in the drawer under the cart.

I am not aware that this mixed cart was ever subjected to practical trial.

The following is the weight of the cart, together with the weights of the different loads it was constructed to carry, as furnished by Mr. Butcher:—

	With 12 Quarter Barrels of Am- munition, 6,000 Rounds, and Driver.	With 10 Rounds, Tents complete with Poles, Pins, and Mallets, and Driver.	With 4 Men fully equipped and a Driver.	With 6 Men fully equipped and a Driver.
	cwt. qrs. lbs.	cwt. qrs. lbs.	cwt. qrs. lbs.	cwt. qrs. lbs.
Cart complete (including the wadmilt, two covers, and the bail- hoops.)	5 2 24	5 2 24	5 2 24	5 2 24
Driver - - -	1 2 0	1 2 0	1 2 0	1 2 0
Load as described in each of the above columns.	5 3 4	5 3 16	7 0 16	10 2 24
Total - - -	13 0 0	13 0 12	14 1 12	17 3 20

Maltese cart with folding litters.—This conveyance consists of an application of two of Holmes' folding litters, (see page 154), to the kind of cart which is in ordinary use in Malta, and in some respects peculiar to that island. The Maltese cart is a conveyance used for the carriage of all kinds of packages and stores, whether light or heavy, and is drawn by one horse. It is exceedingly simple in its construction. Two long and strong shafts are firmly secured to an axle-tree which connects two very high wheels. The shafts are raised by blocks placed upon the axle, so that they rest about the height of a foot above it. Cross-bars of wood, each about one foot broad, are nailed at intervals upon the part of the shafts which lies between the wheels and also a little distance beyond this portion, both in front and behind. The shafts and the interrupted floor just described, without any further addition, constitute the frame or body of the vehicle as it is used for the common purposes of civil life in Malta.

To adapt it for carrying the folding litters, four upright iron supports, each about two feet in height, are inserted into cross-pieces bolted upon the upper surfaces of the two shafts, at nearly equal distances in front of and behind the wheels. Two broad and strong cross-boards are next suspended between the iron uprights or standards, one between the two standards in front, the other between the two in rear, by means of Fuller's india-rubber springs. The folding stretchers are then laid upon and secured to these two boards. The sick or wounded by this arrangement are slung, as it were, in the cots, and they escape the

The Maltese
cart.

Manner of
slinging the
stretchers
upon it.

CHAP. V.

Trials of this conveyance.

ill effects of the concussions communicated to the framework of the cart when in motion, as the shocks they would otherwise receive are broken by the intervention of the elastic springs. A barrel for four gallons of water, and a grease tin are strapped underneath the cart. Arrangements also exist for carrying the muskets and knapsacks of two men beneath the cart. The usual draught is by one horse, but an outrigger and swingle-tree are provided to attach a second horse if necessary.

One of the Maltese carts with folding litters was tried for some time at Aldershot, and in November 1855, the principal medical officer at the camp, Deputy Inspector General O'Flaherty, reported upon it as "affording a very easy way of placing a patient upon a cart, and permitting him to recline, as it were, in a bed, on either his back, or on either side, in comparative comfort. It travels safely, easily, and for the removal of two bad cases, I cannot fancy a better vehicle. The land transport men who drive this cart, and those who have ridden in it, speak of it as being well adapted for the purposes it is intended to accomplish."

Twenty-five of the Maltese carts with folding litters complete were sent for the service of the army in the Crimea on the 18th of August 1855.

The following illustrations show the manner in which the box-litters are slung upon the cart under description.

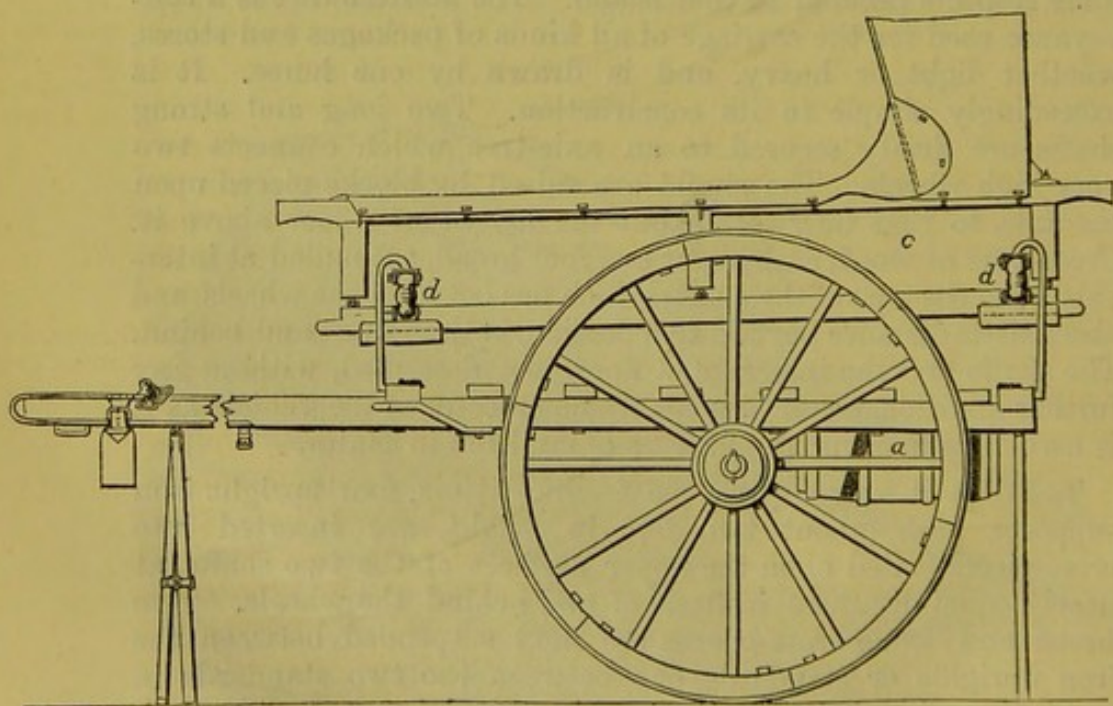


Fig. CXXXVI.—Side elevation of the Maltese cart, with folding litters. *a.* Water-barrel. *c.* Folding litter. *d.* India-rubber springs.

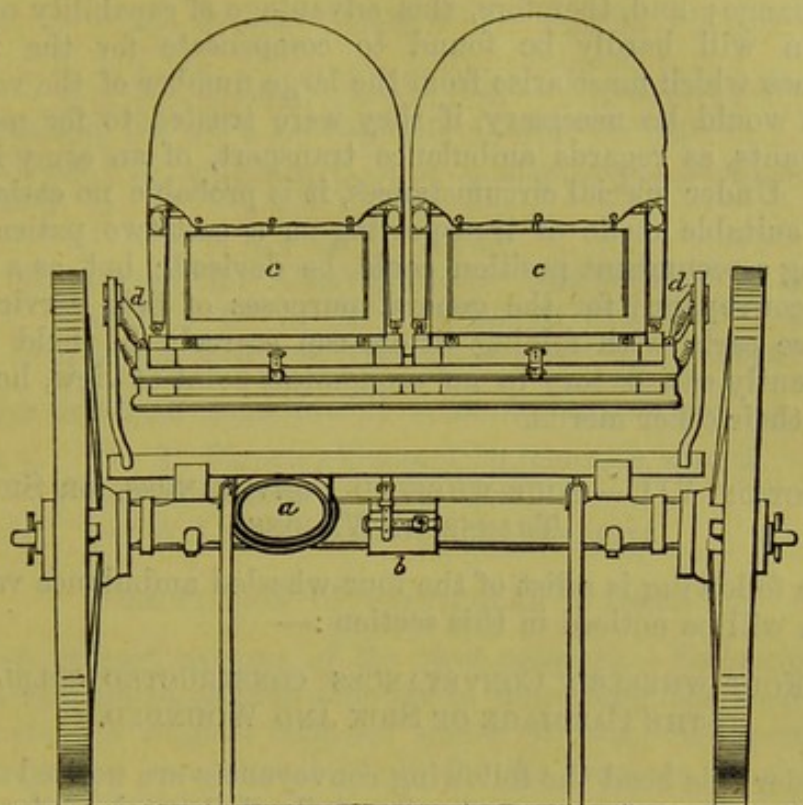


Fig. CXXXVII.—End view of the Maltese cart, with folding litters. *a*. Water-barrel. *b*. Grease-tin. *c*. Folding litters. *d*. India-rubber springs.

While admitting the easy mode of transportation obtained for patients by the arrangement of the Maltese cart and its slung box-litters, there can be no doubt that a serious objection to the use of this conveyance is the comparatively little work effected by the power applied to it. The appropriation of a cart and horse, and over broken ground, of two horses, to the conveyance of only two wounded men,—for there is no accommodation for patients sitting,—involves the necessity of so large a supply of vehicles and animals to meet the wants of field service, as inevitably to lead to a more economical form of carriage being sought for. One argument that has been frequently and strongly advanced in favour of these vehicles is, that, when not required for ambulance purposes, they may be employed for almost any of the general transport purposes of an army for which carts are used, simply by removing the stretchers and their supports, and that as readily, on an emergency arising, they can be restored to the condition of ambulance conveyances, merely by placing the stretchers upon them. But the carts cannot be used for carrying stores without the complete removal of the litters and their supports: there is no provision for their stowage with the cart itself. Hence many practical difficulties would arise in campaigning to prevent the conversion of the vehicle from one purpose to the other according as the need might arise to require

Remarks upon
the Maltese
cart with fold-
ing litters.

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the change; and, therefore, this advantage of capability of conversion will hardly be found to compensate for the inconvenience which must arise from the large number of the vehicles which would be necessary, if they were trusted to for meeting the wants, as regards ambulance transport, of an army in the field. Under special circumstances, it is probable no easier and more suitable mode of transporting on a cart two patients requiring a recumbent position could be devised; but, as a transport conveyance for the general purposes of field service, the Maltese carts with folding litters can scarcely be held to be sufficiently satisfactory in an economical point of view, however great their other merits.

SECTION VII.—FOUR-WHEELED CONVEYANCES, OR SICK-TRANSPORT WAGONS.

The following is a list of the four-wheeled ambulance vehicles which will be noticed in this section:—

(B.) FOUR-WHEELED CONVEYANCES CONSTRUCTED SOLELY FOR THE CARRIAGE OF SICK AND WOUNDED.

Under this head the following conveyances are noticed:—

- | | | |
|----------------|----|---|
| French - | - | 1. Larreys' voiture d'ambulance à quatre roues |
| " - | - | 2. Voiture d'ambulance à quatre roues (modern). |
| " - | - | 3. Arrault's wagon. (Fourgon pour le transport des blessés de M. Arrault.) |
| United States. | 4. | The Tripler sick-transport wagon. |
| " | 5. | The Wheeling, or Rosecrans, sick-transport wagon. |
| " | 6. | Other American sick-transport wagons tried but discarded as failures. |
| " | 7. | The Howard sick-transport wagon. |
| " | 8. | The Rucker sick-transport wagon. |
| " | 9. | The Rucker sick-transport wagon, modified by Dr. Evans of Paris. |
| Swiss - | - | 10. Sick-transport wagon employed in the Swiss army. |
| Italian - | - | 11. Locati's vettura d'ambulanza, or voiture-hôpital. |
| " - | - | 12. Voiture simplifiée d'ambulance Locati. |
| " - | - | 13. Baron Mundy's, or the first prize ambulance wagon at the Paris Exhibition of 1867. |
| Prussian - | - | 14. Neuss's Prussian ambulance wagon. |
| " - | - | 15. Voiture d'ambulance à quatre roues, appt. au Quartier Général de Sa Majesté le Roi de Prusse. |
| Turkish - | - | 17. The Araba. |
| Indian - | - | 18. Macpherson's Indian-sick transport wagon. |
| " - | - | 19. Currie's Indian sick-transport wagon. |
| " - | - | 20. Dr. Francis' proposed ambulance wagon for India. |

- British - - 21. Spring-wagon in use during the Peninsular war.
 " - - 22. British hospital wagon, regulation pattern.
 New Zealand 23. New Zealand sick-transport wagon.
 Cape of Good Hope } 24. Cape of Good Hope sick-transport wagon.

(Bb.) FOUR-WHEELED CONVEYANCES COMBINING PARTICULAR ADAPTATIONS TO FIT THEM BOTH FOR THE CARRIAGE OF SICK AND FOR THE TRANSPORT OF STORES.

Under this head the following examples are noticed :—

- British - - 1. Director-General Dr. Smith's wagon.
 " - - 2. Flanders wagon.
 French - - 3. Caisson d'ambulance Français.

DESCRIPTION OF PARTICULAR WAGONS.

Sick-transport wagons of the first category.—Following the same arrangement as that adopted in describing the sick-transport carts, the wagons included under (B), viz., "Four-wheeled conveyances constructed solely for the carriage of sick and wounded," will be first noticed.

Larrey's "voiture d'ambulance volante à quatre roues." This wagon was constructed and suspended on the same plan as Larrey's two-wheeled cart already described,* being only increased in length and width, so as to admit of its receiving four instead of two recumbent patients. It was drawn by four horses, and conducted by two drivers riding postilion. The same proportion of patients to draft power and to drivers was therefore maintained in the wagon as was employed in the ambulance cart. The wagon opened, however, on one of its sides, the left, instead of at the two ends. The opening was made as wide as possible by two doors sliding in grooves up to the ends of the conveyance, and thus the full complement of wounded men could be placed on the floor of the interior while still lying down, and arranged in their places without much difficulty. The floor was fitted with a fixed mattress, and the sides were padded up to the same height as the carts. Beneath the wagon was suspended a grating which could be carried like a handbarrow in case of need. It was employed with the wagon for the reception of various articles and to assist in fixing the centre of gravity. The front part of the vehicle turned on the axle, and the fore-wheels were made sufficiently small to pass under the body, to facilitate the movement of rotation. The wounded men lay on the mattress on the floor in the long direction of the conveyance, their legs meeting and a little crossing each other in the middle. There does not appear to have been any steps taken to separate the patients or to prevent them from coming into contact with each other, and the construction altogether was of a very simple kind.

* See page 340.

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Sick-transport wagon used with the army in Paris.

Its construction.

Construction of Arrault's wagon.

Its seats and litters.

Voiture d'ambulance Française à quatre roues (modern).—At the Exposition of 1867, the French Government exhibited an ambulance wagon differing very little from an ordinary omnibus. It is one which has been designed specially for transporting the sick of the garrison of Paris and its neighbourhood from the barracks to the hospitals. It has never been introduced into the general service of the French army, nor has it been employed on active field service. The pattern exhibited consisted of an interior compartment entered from behind, and a coupé in front, communicating with the interior by a glazed door in the partition separating the two divisions of the vehicle. The seats in the interior were placed longitudinally, and would accommodate eight patients sitting or two recumbent. The coupé seat was placed transversely, and was intended to carry two sick men and two infirmiers. The total charge was, therefore, ten sick and two infirmiers. Room was provided in a well beneath the vehicle for the arms and kits of the soldiers carried. If not required for patients, this vehicle could carry, in case of need, 500 kilo. of materials, but the benches were not removable, and there was no special adaptation to fit it for a store-transport wagon. Any other omnibus would answer this purpose equally as well. The weight of the vehicle was officially stated to be 930 kilo.; the price, 1,200 francs, or 48*l*. The opening behind was ascended to by folding iron steps, and was objectionably high, being four feet and a half from the ground. There was a central door for admission on ordinary occasions; but, if necessary, the whole of the back, being hinged on each side, could be thrown open. Without this arrangement it would have been scarcely possible to have effected the entrance of patients requiring admission in a recumbent position. Five rather small windows were provided, two on each side and one in the door behind, but these hardly appeared to be sufficient for purposes of ventilation. It was a vehicle quite unsuited for campaigning purposes, being evidently designed for the special service in which it was habitually employed.

Arrault's ambulance wagon (Fourgon pour le transport des blessés de M. Arrault).—A model of this wagon was exhibited by the Central French Committee at the Universal Exhibition of 1867; there was no full-sized pattern of it shown. It resembled Baron Larrey's ambulance cart in the manner by which access was gained to the interior; the two ends, before and behind, being converted into folding doors for this purpose. There was a louvred ventilator in the middle of the roof; and the roof itself, being hinged on one side, was rendered capable of being raised and partially opened to admit sunlight and air. Its peculiar feature, however, was the internal arrangement for carrying the patients. For this purpose, eight folding litters of framed canvas (*fauteuils-cacolets*) were placed transversely within the interior of the wagon, four on each side. The design in placing them transversely, was to turn the floor space to greater advantage, particularly when the patients were carried recumbent. Each litter, when folded up, formed a seat; when unfolded, it

acted as a bed for a patient lying at full length. Thus the wagon was arranged to carry eight patients sitting, all the seats being then occupied; or four patients recumbent, when two only of the litters on each side were used. A hand-lift hung down from the roof over each chair. Although there was no opportunity of testing the qualities of this vehicle, an examination of the model sufficed to show its unpractical nature. The transverse arrangement of the recumbent patients would cause the access of attendants, if required, to the two in the centre to be very difficult. To open the roof, as designed, would evidently also be no easy matter; and when the roof and ends were closed, the ventilation inside would be very defective. The following illustration, which is copied from a pamphlet by M. Arrault, descriptive of his contrivances,* affords a general idea of the appearance of the interior of this conveyance. In the sketch the seats appear to be wholly resting upon the floor of the wagon; but in the model shown in Paris, although there were similarly shaped frames and legs to them, the seats themselves were suspended from the sides of the vehicle, evidently with the intention of modifying the effects of concussions during its movement.

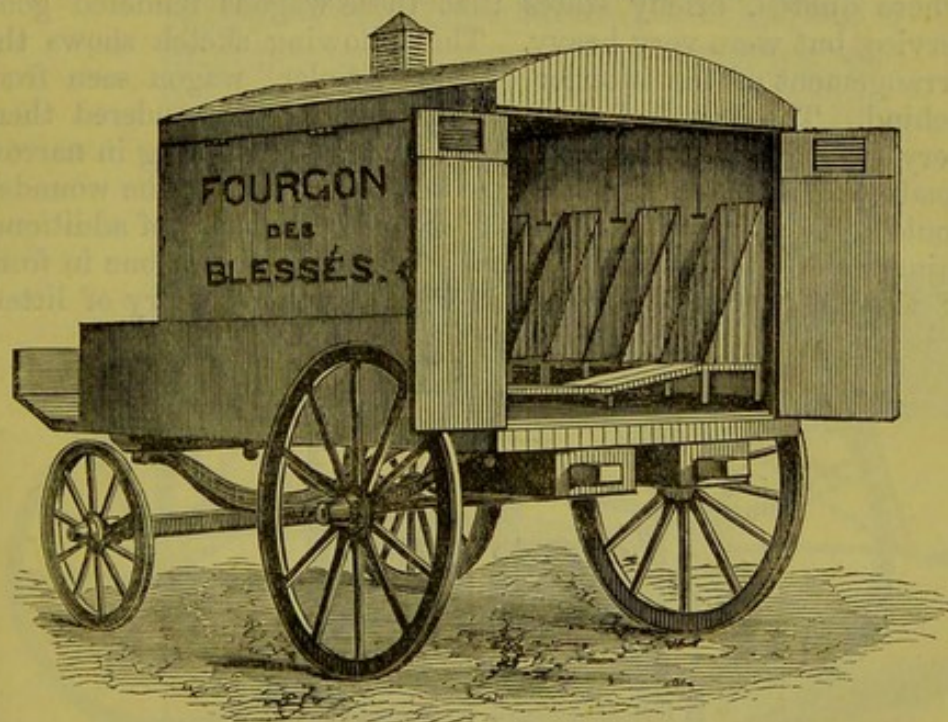


Fig. CXXXVIII.—Sketch to show the interior arrangement of Arrault's ambulance wagon.

United States' sick-transport wagons. — Several forms of ambulance wagons were employed, or experimentally tried, during the late war of the rebellion on the American continent, and of some of these the present Surgeon-General of the United States has been kind enough to send me illustrative engravings. These drawings include the wagons known under the names of

Sick-transport
wagons of
several forms
employed in
the United
States during
the late war.

* Appendice de la Notice sur le Perfectionnement du Matériel des Ambulances Volantes, par Henri Arrault, Paris, 1867, p. 4.

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Arrangement
of the litters
in the
"Tripler"
wagon.

the "Tripler," "Wheeling," and "Rucker" wagons, as well as some others which were discarded as failures during the war. The last-named, the "Rucker" wagon, in a modified form, gained one of the prizes offered for the best kind of ambulance wagon at Paris in 1867. Another United States' wagon, designed for use during the war, but not one generally adopted in the army, has also attracted a good deal of notice. This is a wagon invented by Dr. Howard, of New York. These conveyances will now be severally described.

"Tripler" sick-transport wagon.—This wagon took its name from having been designed by Surgeon Tripler of the United States' army. It was one of the forms of sick-transport ambulance conveyances used at the early period of the war, and was subsequently abandoned from being found too cumbersome for general use. The Tripler wagon was drawn by four horses and was constructed to carry *eight men, all lying down*. The patients were placed on litters which were removable, and capable of being used as hand conveyances; they were laid in two tiers, one above the other, four on the floor of the conveyance and four on the platform or upper compartment. The Washington report, elsewhere quoted, briefly states that these wagons rendered good service, but were very heavy. The following sketch shows the arrangement of the interior of the "Tripler" wagon seen from behind. The length of these wagons must have rendered them very unwieldy and especially inconvenient for turning in narrow roads. It is indeed difficult to understand how the wounded could have been put in and out of them without risk of additional injury owing to the manner in which they were laid one in front of the other, and the height at which the upper story of litters was placed.

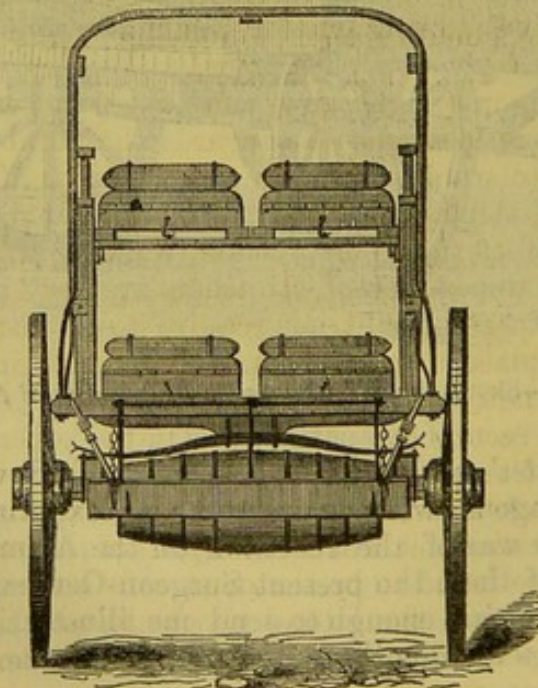


Fig. CXXXIX.—Rear view of the "Tripler" ambulance wagon, for the carriage of eight recumbent patients.

The "Wheeling" or "Rosecrans" sick-transport wagon.— This was the wagon most extensively used by the armies of the United States during the latter part of the late war in that country. The Washington report* states that it derived its name from having been first constructed at Wheeling, Virginia, according to the designs of General Rosecrans, and that it soon came into very general use. It differed in many respects from the wagon last described. It was light enough to be drawn by two horses, and was constructed to carry both sitting and recumbent patients; its capacity being for ten or twelve persons sitting, or for two or three sitting with two lying down. The two following drawings show the general form and appearance of this wagon.

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The "Wheel-
ing" wagon
mostly used
during the
late war in the
United States.

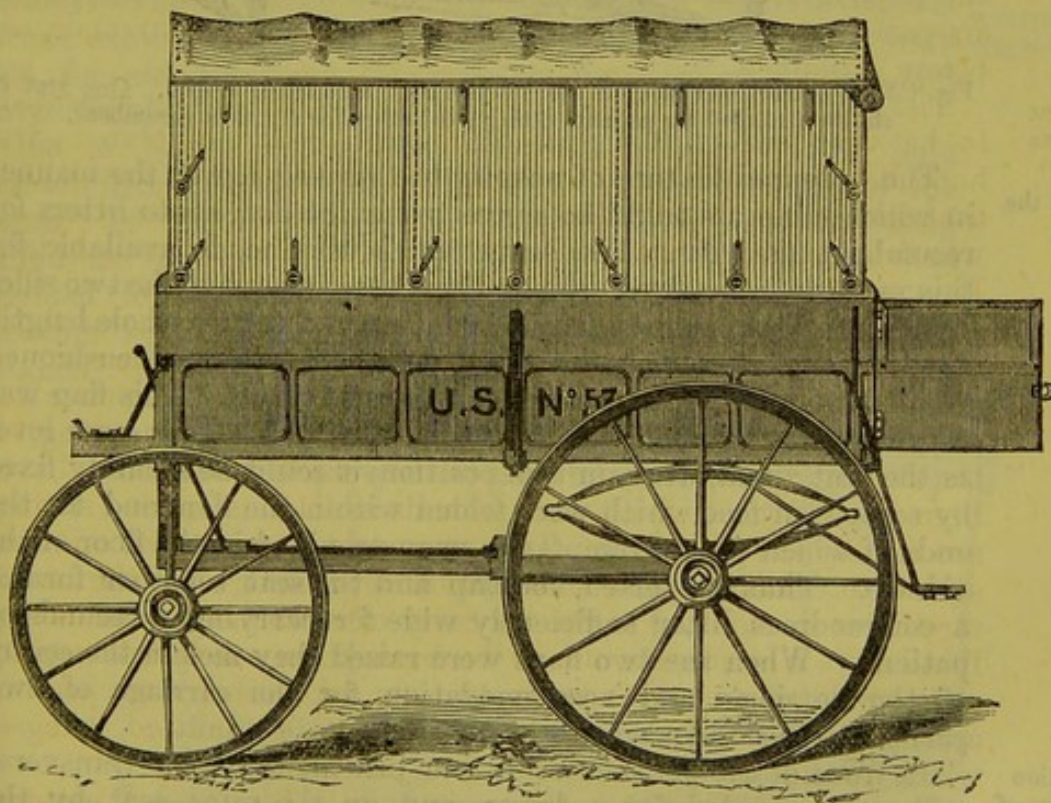


Fig. CXL.—Side elevation of the "Wheeling" ambulance wagon.

* Circ. No. 6. Ante cit. p. 84.

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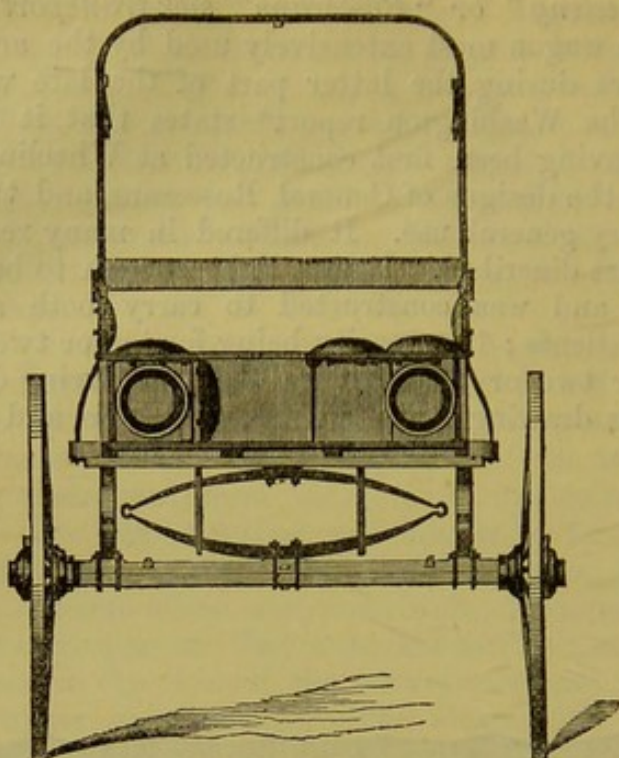


Fig. CXLI.—Rear elevation of the "Wheeling" ambulance wagon. One seat is shown arranged for patients sitting; the other for a patient recumbent.

Peculiar
feature of the
Wheeling
wagon.

The principal feature of novelty in this wagon was the manner in which the seats could be converted at pleasure into litters for recumbent patients. The seats, which were made available for this purpose, were two cushioned benches attached to the two sides of the interior of the wagon, and continued along its whole length. From each of these benches there depended a hinged cushioned flap, of exactly the same length as the seat itself. This flap was capable of being readily elevated and brought to the same level as the seat; and, when in this position, it could be securely fixed by some iron feet which were folded within the flap, and for the ends of which proper receptacles were provided in the floor of the vehicle. Thus supported, the flap and the seat together formed a commodious litter sufficiently wide for carrying a recumbent patient. When the two flaps were raised they met in the centre of the carriage, and accommodation for the carriage of two patients lying down was thus afforded.

Construction
and fittings of
the Wheeling
wagon.

In front of the benches or litters just mentioned a transverse seat was provided for a driver, and on the same seat by the driver's side there was room for two or three patients to be carried sitting. Under this seat there was a box containing various kinds of medical comforts, a camp kettle, lantern, and other articles for field use. A five-gallon water-tank was secured at the back of the carriage, in the space beneath one of the longitudinal benches, the tap being got at from the outside; in the corresponding space on the opposite side some stretchers were carried rolled up.

The weight of the wagon complete was between 700 and 800 lbs. The body, which was of the tray kind, was $7\frac{1}{2}$ feet

long by 3 feet 9 inches broad. It was supported on three double elliptic springs, two on the rear axle being placed longitudinally, one on the fore axle in a transverse direction. A spare spring was carried transversely behind. The cover was made of canvas stretched over a light frame of wood; curtains of the same material were provided for the sides. These could be opened or securely closed at pleasure. The fore wheels were 3 feet 5 inches in diameter, the hind wheels 4 feet 1 inch. The wagon was fitted with a break, the pressure being applied to the hind wheels by a handle worked near the driver's seat in front. A footstep at the back was provided to help patients to mount, or bearers to carry patients into the interior.

The principal objections made to this wagon appear to have been that it was too high from the ground, especially for getting recumbent patients into their places. The motion too was said to be uneasy, unless there was a full complement of persons sitting in the wagon. With only two recumbent patients the action of the springs was stated to be excessively troublesome.

Faults of the
Wheeling
wagon.

Other American sick-transport wagons tried, but discarded as failures.—The following drawings, sent me by Surgeon-General Barnes, exhibit two forms of four-wheeled wagons, which were tried for sick-transport purposes in the United States, but proved failures.

Unsuccessful
American sick-
transport
wagons.

One of these wagons was suspended between two long semi-elliptical springs placed on each side of the body of the wagon. It was constructed to accommodate patients sitting behind as well as with the driver in front, while room was provided for two recumbent patients between them. The drawings sufficiently explain the arrangement adopted in this instance.

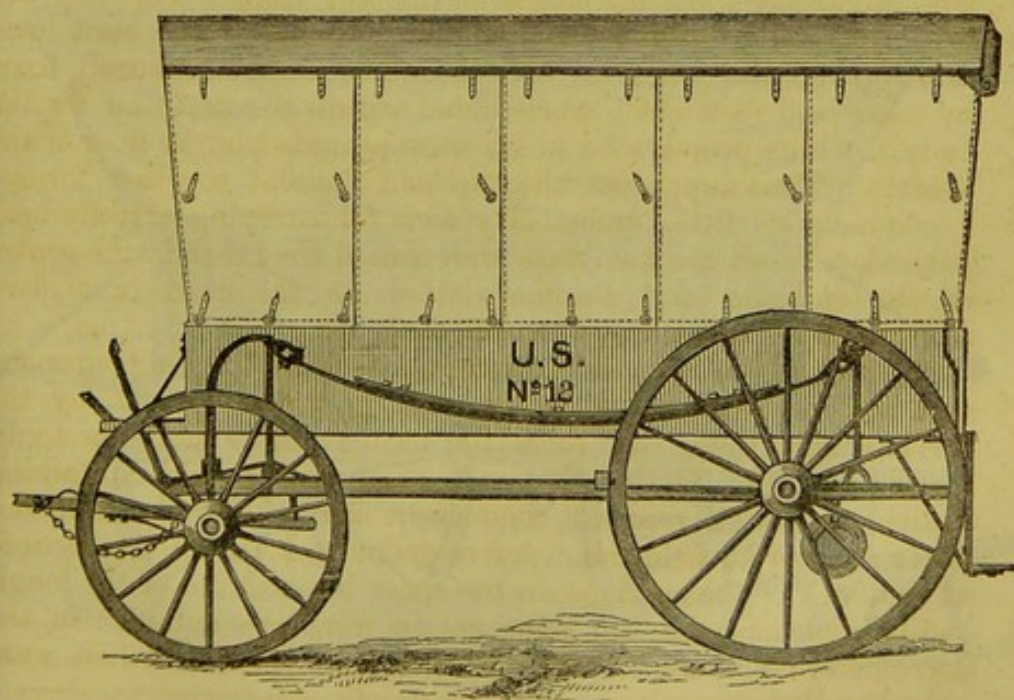


Fig. CXLII.—Side view of United States' sick-transport wagon suspended between two semi-elliptical springs.

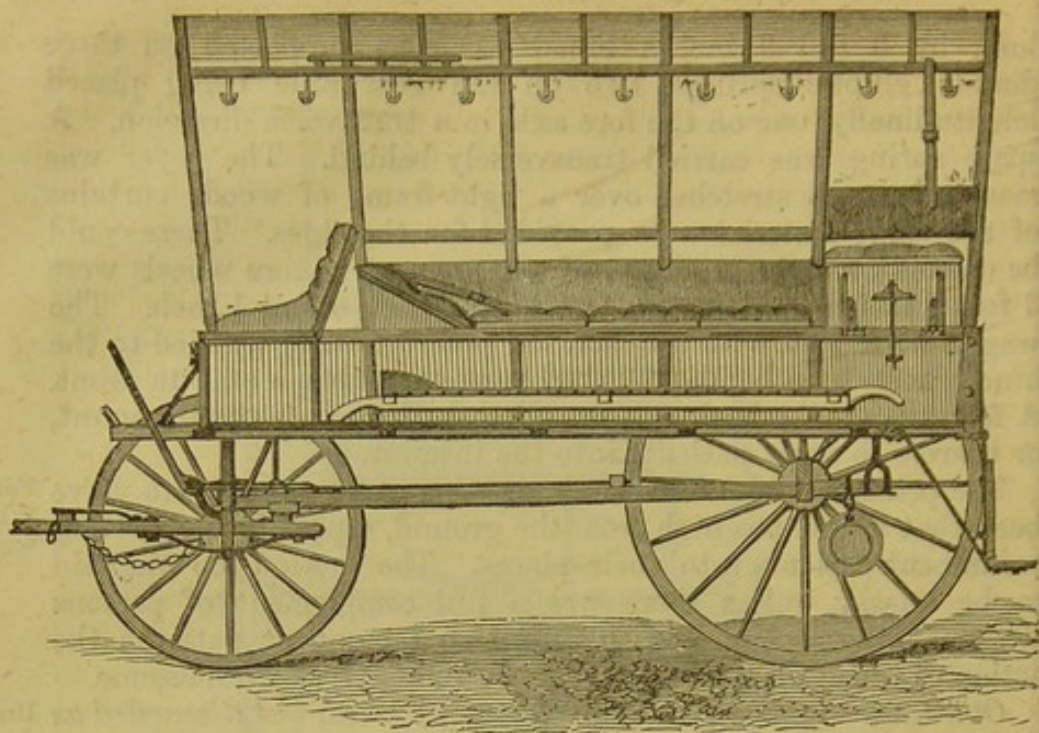


Fig. CXLIII.—Sectional view of United States' wagon suspended between two semi-elliptical springs.

The second wagon, referred to above, was supported upon four semi-elliptical springs, placed longitudinally below the body of the vehicle; but the chief point of interest connected with it is the plan of construction by which it was enabled to be opened at the sides, and elongated or closed at pleasure at both ends. No further particulars concerning this carriage, or the circumstances which caused it, as well as the preceding pattern, to be disapproved of when tried on active service, were sent to me.

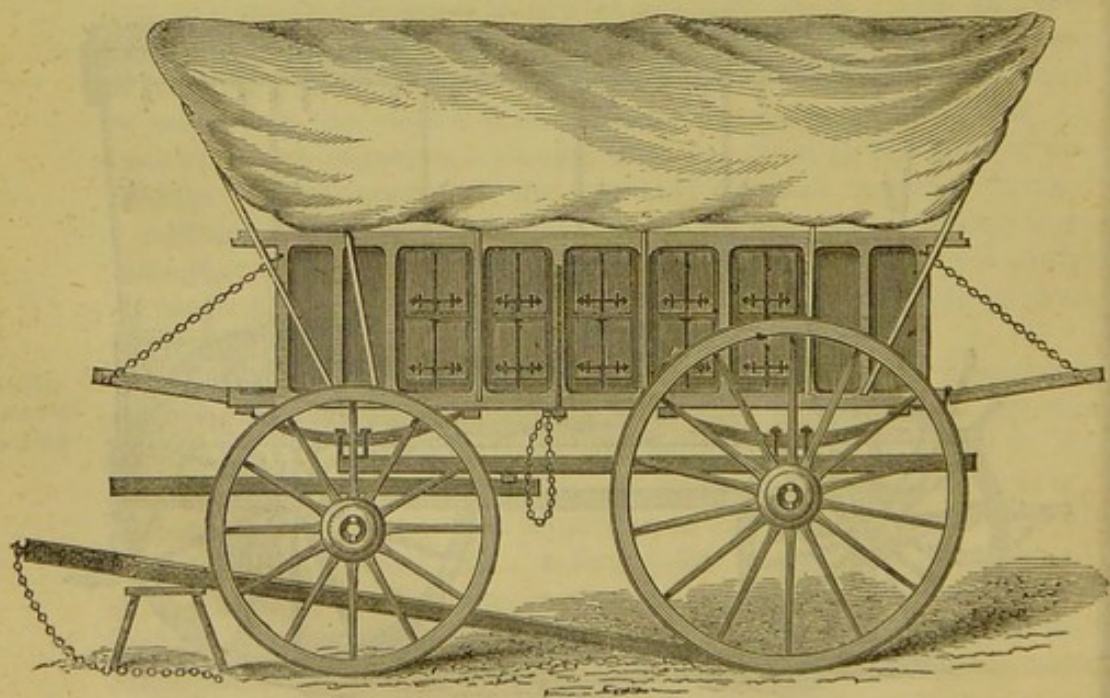


Fig. CXLIV.—Side view of United States' sick-transport wagon with side and end openings.

The Howard sick-transport wagon.—This American wagon was constructed after the designs of Dr. B. Howard, who served for some time in the United States army. It was not, like the preceding wagons, in general use with the armies of the United States, and is not alluded to in the Surgeon-General's report on the means of transportation of the wounded during the war. A full account of the construction of the conveyance, with a series of illustrative drawings, which appeared in one of the publications of the United States Sanitary Commission,* was kindly given to me by Dr. Howard himself, and it is from that source that the following account of the vehicle is chiefly derived.

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Peculiar
feature of the
Howard sick-
transport
wagon.

The distinguishing feature of Dr. Howard's wagon is the arrangement of its springs. Of these there are two systems, one of which may be called primary, the other secondary. The first system corresponds with the ordinary arrangement of outside springs, intervening between the body of a wagon and its axletrees; the second is within the body of the wagon, intervening between the floor of the vehicle and an internal frame designed for the support of the seats upon which the patients are placed when they are carried sitting, or of the litters, when they are carried recumbent. The first set are the wagon springs proper; the second set are called by Dr. Howard "counterpoise springs."

The primary springs are three in number, are made of steel, and are strong and semi-elliptical in form to limit their elasticity. Two of them are placed on the rear axle, one on the fore axle. The hinder springs have a direction corresponding with the length of the wagon, the fore spring is placed transversely; the object being to limit rolling as well as pitching of the body of the wagon in its various movements over uneven ground.

The following is the arrangement of the secondary, or counterpoise, springs. They are distinguished as perpendicular and lateral counterpoise springs.

The platform on which the seats and beds rest consists of a frame raised a few inches above the floor of the wagon. This frame, of which one side is shown in Fig. No. CXLV., is as long, but not so wide by about two inches, as the inside of the body of the wagon. There is, therefore, an interspace on each side of the interior of the body of the wagon, between it and the frame of the platform. These two spaces are marked *p p*, in Fig. No. CXLVI. Within them are placed four lateral semi-elliptical springs, two on each side, and direct contact between the frame and the sides of the vehicle is thus prevented. The springs are fastened at the centres of their arcs to the inside of the body of the wagon. The feet of these springs (*a a*, Fig. CXLVI.) play upon iron plates on the outside of the platform. A block of

* The Sanitary Commission Bulletin, vol. 1, Nos. 31 and 32. Philadelphia, February 1st and 15th, 1865.

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india-rubber is fixed on the side of the platform opposite to the centre of the arc of each spring, so that on the application of much force the shock may be received by the india-rubber blocks, which thus act as buffers.

The platform itself stands upon four iron stanchions (*d d*, Fig. No. CXLV.), each of which rests on a spring, like one of the lateral springs just described, but much stronger. The iron stanchions resting upon the steel springs, the feet of which play upon iron plates let into the floor of the wagon, are shown in Fig. No. CXLV. Each spring is restrained in its motion upward, by being held within an iron staple, and when by an unusual weight it is pressed heavily downward, the force is received by a block of india-rubber which is enclosed within the staple. By this arrangement an impulse communicated to the floor of the ambulance wagon, instead of being propagated directly to the beds or seats, causes a counteraction downwards of the platform springs. This counter stroke, if the force be very great, spends itself upon the blocks of india-rubber. "In this way, both laterally and perpendicularly," Mr. Howard states, "a constant poise is preserved, and what would otherwise be a very violent jar is reduced to little more than a vibration. The steadiness of the entire vehicle is preserved by the stout semi-elliptical springs beneath the body, and the delicacy regulated to any degree by the internal counterpoise springs within the body."

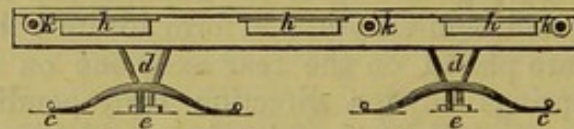


Fig. No. CXLV.—View of the perpendicular counterpoise springs on which the internal platform is supported in Howard's ambulance wagon. *d d*, iron stanchions; *e e*, india-rubber blocks and staples; *h h h*, sections of seats; *k k k*, rollers.

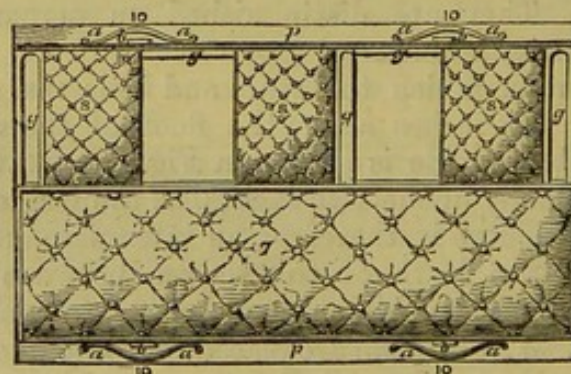


Fig. No. CXLVI.—View of the lateral counterpoise springs between the platform and body of Howard's ambulance wagon. *p p*, spaces between the sides of the wagon and the platform; *a a*, feet of lateral springs; *b b*, blocks of india-rubber; *8 8 8*, seats; *7*, litter in position; *9 9 9*, rollers, $\frac{1}{4}$ inch clear of cushions of seats, on which litter is rolled; *10*, springs.

Action of the springs in the Howard wagon.

The system of springs just described is ingenious, and they would appear calculated from their arrangement materially to lessen the severity of the jolts and oscillations to the occupants.

of the seats or litters in case of the vehicle having to pass over very rough ground. The springs are all of ordinary construction, and do not appear likely to suffer accidental injury, nor to present difficulties as to their repair or replacement in case of getting out of order. The supplementary india-rubber pads connected with the steel springs are not subjected to any stretching or strain, and are not therefore liable to become damaged in the same way as india-rubber springs when employed as *substitutes* for steel springs. The pads indeed are only of secondary importance. The same object that has been had in view in this instance through the so-called "counterpoise springs" was sought to be attained, in Director-General Smith's wagons, elsewhere described, by having the litters double-framed with intervening india-rubber springs; in M. Arrault's wagon by having the litters suspended from the inside of the body of the wagon; in Cherry's cart by connecting the seats and litters with ropes attached to the sides of the cart. It is to be observed, however, that Mr. Howard's system provides against the action of lateral as well as perpendicular impulse, which was not the case in any of the vehicles just named.

The Howard wagon is intended for draught by two horses. It is calculated to carry six patients sitting within the body of the wagon, and two sitting with the driver; or one patient recumbent and three sitting inside; or two lying inside. The seats are arranged transversely (8, 8, 8, Fig. CXLVI.), and are permanent; a moveable leather strap is provided as a back for the central seat, and the adjoining sides and ends of the wagon are padded for the four corner seats. When the stretchers are used for recumbent patients they are arranged to slide over the seats on wooden rollers placed within the frame of the platform before described, but just clearing the seats themselves. When the stretchers are not required they are carried in two shallow compartments under the floor of the wagon, and the floors of these compartments are also fitted with small rollers, so that the stretchers can be moved in and out of them with facility.

Fittings of the
Howard
wagon.

The wagon is provided with a special arrangement for affording ease to patients suffering from fractures of the lower extremity; two parallel iron bars, between which runs a roller with a hook attached for suspending a double inclined plane or other such suitable apparatus, being attached to the roof longitudinally over the situation for each litter. Water is carried in a tank, which is made to slide into a grooved bed in rear of the cart, where it is secured by an ordinary fastening. The tank is made of wood, lined with zinc, and bound with metal bands. The spigot protrudes through the tail-board of the wagon, so as to be readily accessible, and is protected during loading and unloading by the upper section of the tail-board, which falls down over it. Some of the details of construction which have just been described may be observed in the two following illustrations.

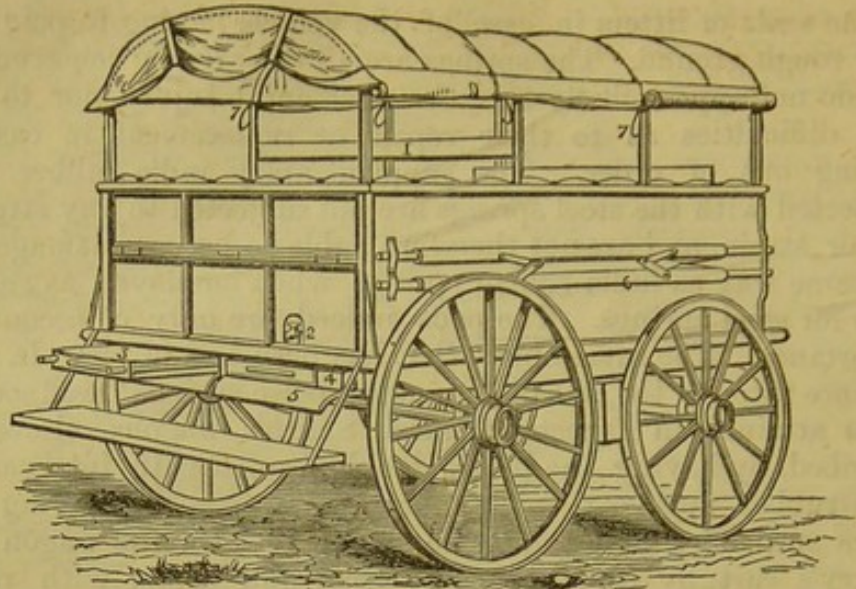


Fig. CXLVII.—General view of Howard's sick-transport wagon. (1, leather moveable back for middle seat; 2, spigot of water tank; 3, litter, with handles, drawn partly out, on small steel rollers sunk in floor of compartment; 4, litter, in position; 5, inside of door of compartment for litters; 6, stretchers carried outside; 7, loop for gun racks.)

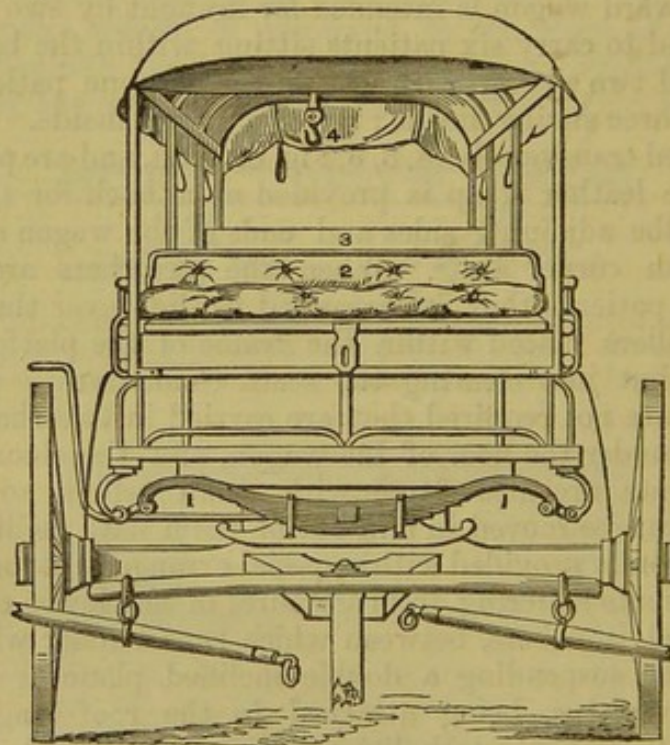


Fig. CXLVIII.—Front view of Howard's sick-transport wagon. (1, stout semi-elliptical spring; 2, complete back to driver's seat; 3, leather back to middle seats; 4, hook for support of fractured limbs.)

Alleged advantages of the Howard wagon.

The inventor of this wagon claims as one of its advantages in a military point of view that, besides the prescribed articles which may be carried in the driver's box, a large amount of medical supplies in case of necessity may be safely carried in the space between the platform on which the seats rest, and the floor of the wagon. With the necessary supplies stowed away thus, the proper care of the wounded would not be impeded by the

absence of the regular ambulance store-wagons; a casualty which has frequently happened during the first few days after great battles, and on almost every occasion after cavalry engagements, and which, from the nature and circumstances of such events, must frequently recur.

I am not acquainted with the exact weight of the Howard wagon,* but Inspector-General Dr. Muir, C.B., who saw some of them with the army of the Potomac†, informs me that they were, when complete, so heavy as to cause them, notwithstanding their ingenious arrangements, to be universally condemned. Dr. Muir inspected them in company with the chief medical director and many of the Potomac army surgeons. These officers informed him that the qualities of the Howard wagons had been thoroughly tested, and that an unanimous verdict had been pronounced against them, not only on account of their weight, but because they were less handy than the Wheeling wagons in ordinary use, and because also they were liable to get out of order owing to their complicated construction.

"*Rucker sick-transport wagon.*"—This wagon was constructed under the direction of Major-General Rucker, of the United States' Quartermaster's Department, at the Government repair shops, Washington, towards the close of the late war, and met with much approval. In the Surgeon-General's report, before quoted, it is stated that this conveyance had been recommended for adoption as the regulation sick-transport wagon of the United States' army. The Rucker wagon is adapted for the reception of patients either in a sitting or in a recumbent position. It is so planned, that four patients are capable of accommodation in the latter posture. Eight or ten sick soldiers can be carried in it seated. It resembles the Wheeling wagon described a few pages back in several respects; like it, when used for the carriage of patients sitting, two cushioned seats, with cushioned flaps dropped down in front, are arranged along the two sides of the interior of the conveyance. These seats are also made to act as litters. The manner of using them, however, when they are required for patients lying down is different from the plan adopted in the Wheeling wagon. Under the circumstances named, the seats are detached from their connexions with the sides of the vehicle, are folded flat, and are then laid upon the *floor* of the wagon. Here they are ready for use as litters or stretchers. Small wheels are permanently attached to them to facilitate their ingress and

Verdict regarding the Howard wagon in the United States.

The "Rucker" sick-transport wagon recommended for future adoption in the United States army.

Construction of the Rucker wagon.

Its lower tier of litters.

* A pattern of the Howard wagon, made of hickory, and well built, was at the Paris Exhibition of 1867, and its weight, including the stretchers which belonged to it, was judged to be about 11 cwt. The chief objections made to it, on trying it in the park, were, the difficulty of turning, no contrivance existing at the fore part of the wagon to facilitate this operation; the narrowness of the front seat for three persons; and the insufficient depth and confined space for the patients carried sitting in the interior. It was also found difficult to place a patient lying on one of the stretchers into the wagon owing to the height of the platform on which the stretcher had to be placed.

† Thirty of them are said to have been built for the use of this army. They were probably provided out of the funds of the Volunteer Sanitary Commission, as they do not appear in the list of transport officially provided by the United States' Government.

Result of trials of the Howard wagon at Paris.

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Its upper tier
of litters.

egress when patients are lying upon them. To accommodate the other two recumbent patients, the backs of the seats are made high, are only joined to the sides of the wagon by hinges at their upper margins, and are thus adapted for being raised upwards and inwards toward the middle of the carriage. On being elevated in the manner described, the two backs meet close together in the centre of the carriage, and are now ready to be supported by some iron props, which, being hinged to their under surfaces, can readily be lowered for the purpose. There are small openings in the floor for the reception of these props. In this way a platform partition is formed in the carriage, on which two stretchers can be laid. The stretchers for this purpose are carried in the wagon; they are slung from the roof, each stretcher being attached by one of its sides to the middle of the roof, and by its other side to the part where the spring of the arched roof commences. The upper stretchers are of very simple construction, are not provided with wheels like the lower pair, and have no special means provided for helping the bearers to get them upon the platform when patients are lying upon them. The distance between the surfaces of the litters on the floor and of those placed on the upper platform is a little over two feet; the space between the two platforms, that is, between the under surface of the upper platform and the upper surfaces of the two lower litters, twenty-one inches. This space is ventilated by four louvres which open on each side of the wagon. The whole arrangement will be best understood by reference to the cross-section sketches, copied from Surgeon-General Barnes' circular, of November, 1865, which are subjoined.

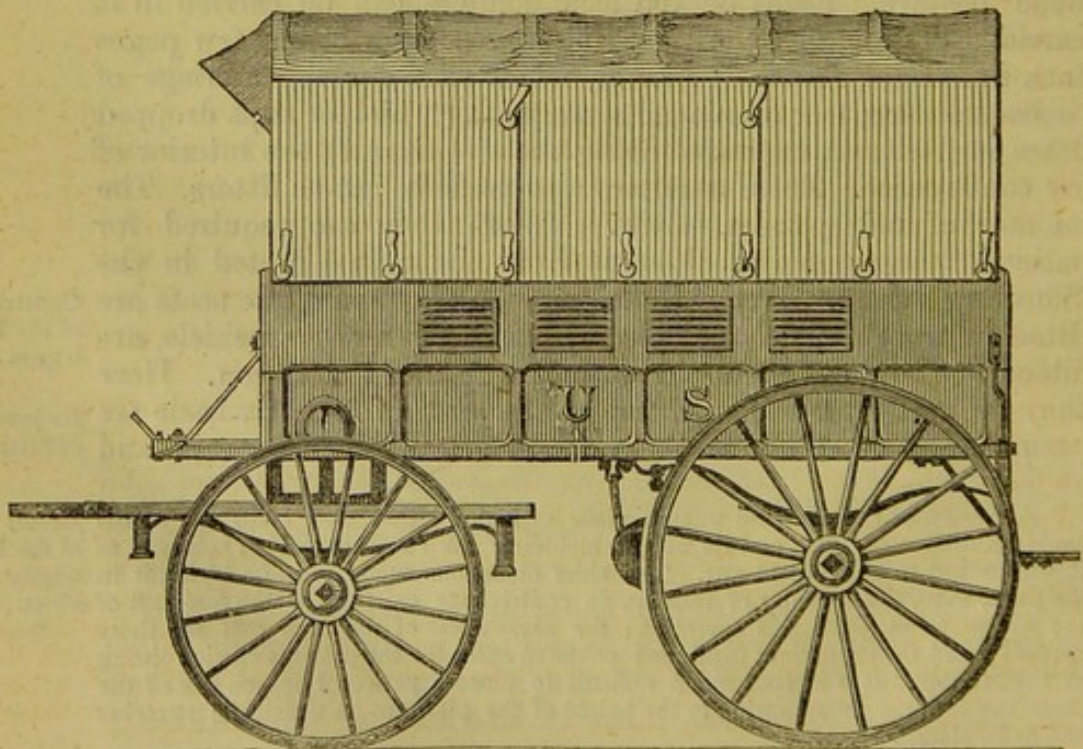


Fig. CXLIX.—Ambulance wagon, built at Washington, under the direction of Major-General Rucker, and recommended for adoption as the regulation sick-transport wagon of the United States army.

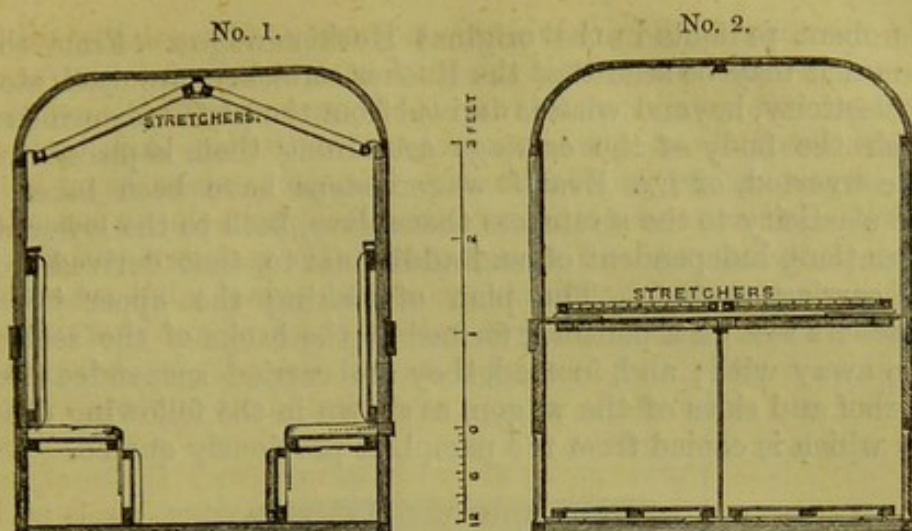


Fig. CL.—Cross sections of the Rucker wagon. No. 1, arranged for patients sitting. No. 2, arranged for patients recumbent, the seats being detached, lowered, and acting as stretchers, the backs of the seats being raised, and supporting two stretchers brought down from the roof.

The body of the wagon is similar in general construction to that of the Wheeling wagon, but is slightly longer and broader, being eight feet long by four feet broad. It is supported on platform springs; there is no inner system of springs within the carriage or attached to the stretchers. The wheels are unequal in size, but the fore wheels do not turn under the body of the wagon; they are of the same diameters as those of the Wheeling wagon. The water is carried in front, instead of at the rear of the vehicle. The weight is greater than that of the Wheeling wagon, being 1,120 lbs. As before-mentioned, there was not the opportunity of making any extended practical trials of this carriage, the war being nearly at its close when its use was first introduced.

Weight of the Rucker wagon.

The Rucker sick-transport wagon, modified by Dr. Evans of Paris.—This is a carriage to which one of the prizes was awarded by the International Committee (see page 307), on the occasion of the Paris Exposition of 1867. The particular vehicle which received the prize had been exhibited in the United States' Sanitary collection formed by Dr. Evans, as a pattern of the Rucker wagon, but it was materially altered in its internal fittings before being submitted to competition. The body, wheels, springs, and other external parts of the carriage were then unchanged, beyond the necessary renewal to repair the superficial defects which had resulted from use and its transport from America; but, as shown in a descriptive pamphlet published by Dr. Evans,* some of these parts also have subsequently undergone considerable alteration.

Dr. Evans' sick-transport wagon at the Paris exhibition.

A description has been already given of the plan adopted for forming and supporting the two tiers of stretchers employed for

Alterations of the Rucker wagon in Dr. Evans' pattern.

* "History and Description of an Ambulance Wagon constructed in accordance with Plans furnished by the Writer." By Thos. W. Evans, M.D., Paris, 1868.

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recumbent patients in the original Rucker wagon. From that account it may be seen that the Rucker stretchers are destitute of all elasticity, beyond what is derived from the platform springs on which the body of the carriage containing them is placed. In the converted, or Dr. Evans' wagon, steps have been taken to give elasticity to the stretchers themselves, both to the lower and upper tiers, independent of, and additional to, that derived from the carriage springs. The plan of making the upper tier of stretchers rest on a platform formed of the backs of the seats is done away with; and, instead, they are carried suspended from the roof and sides of the wagon, as shown in the following drawing, which is copied from the pamphlet previously quoted.

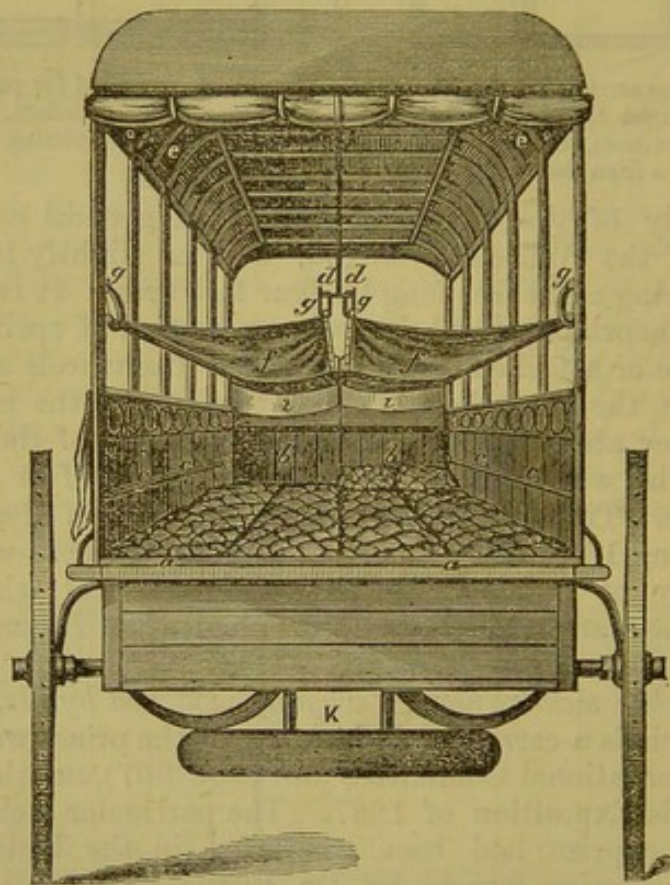


Fig. CLL.—Perspective view of the interior of the Evans' Sick Transport Wagon. *a a*, seats laid on the floor to form litters; *b*, head-rest elevated; *c c*, ledges for seats; *d d*, hooked rod hanging down from the roof; *f f*, upper tier of stretchers suspended; *g g g g*, india-rubber or leather rings; *i i*, leather back of front, or driver's seat; *k*, tail-board lowered.

A different method is adopted for giving elasticity to the lower two stretchers from that which is adopted in the upper tier. The mechanism by which this end is accomplished is simple and apparently very effective, without much liability of becoming deranged. The floor of the wagon is made double, and the stretchers are furnished with small iron wheels. Openings are made in those parts of the upper floor, on which the small stretcher-wheels would rest when the stretchers are pushed home, and the spaces thus left vacant are nearly filled up by convex

steel springs. These springs are bow-shaped; their ends play upon the lower of the two floors, while the most prominent portions of their convex aspects rise up into the openings in the upper floor, until they are nearly on a level with it. A grooved tramway on each side of the floor of the wagon conducts the corresponding stretcher to its place over the springs. When the wheels of the stretcher rest upon the springs they are prevented from going further forward by iron stops; and the stretcher is completely prevented from shifting backward by shutting the tail-board of the wagon.

Secondary
springs in the
floor of Dr.
Evans' wagon.

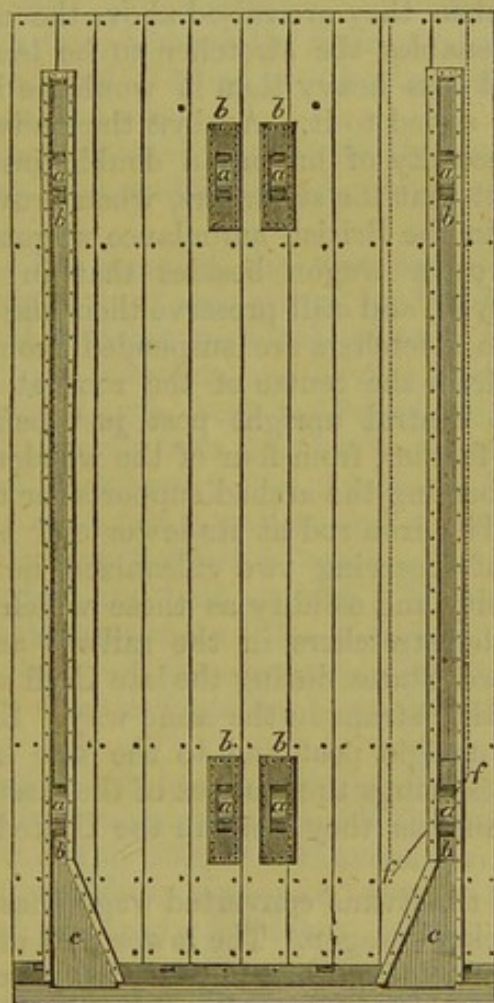


Fig. CLII.—Plan of the floor of the Evans' Sick-Transport Wagon. *a a*, springs; *b b*, iron plates; *c c*, grooved tramways.

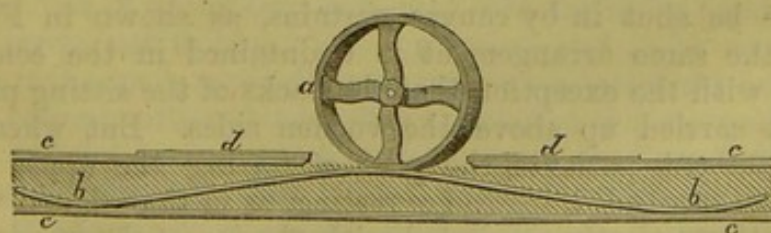


Fig. CLIII.—Sectional view of part of the floor of the Evans' Sick-Transport Wagon. *a*, litter-wheel; *b b*, one of the floor-springs; *c c*, section of upper and lower floor; *d d*, iron stops to litter-wheel.

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Effect of these
springs.

In consequence of the arrangements above described, a patient lying upon one of these stretchers is doubly protected in case the wagon receives a shock from suddenly meeting an obstacle to its progress; for the shock is first, to a certain extent, broken by the general springs of the vehicle, and, secondly, is further broken by the yielding of the springs intervening between the lower of the two floors and the stretcher on which the patient is placed. These bow springs take the place of, and answer the same purpose, as the india-rubber springs attached to the stretchers themselves in the British ambulance wagon, the arrangement of which, however, necessitates a second frame to the stretcher. The floor-spring plan is simpler; the springs from their position are less likely to get out of order than when they are raised above the upper floor; and the contrivance enables the stretcher to be less complicated in construction, and less heavy than it would be if a supplementary frame were added to it. Against these advantages must be balanced the necessity of having a double instead of a single floor, and the fact that the stretchers, when provided with their own springs, as in the British ambulance wagon, can be used if needed, in any other wagon besides that in which they are ordinarily employed, and still preserve their elasticity.

The upper tier
of stretchers
in Dr. Evans'
wagon.

The upper two stretchers are suspended from a jointed iron rod, depending from the centre of the roof at the rear of the vehicle; from a central upright post just behind the seat of the driver; and further, from four of the wooden side standards which assist in forming the arched supports for the canvas cover of the vehicle. The iron rod at its lower end is doubly hooked for the purpose of receiving two vulcanized india-rubber rings of the same density and solidity as those which were employed for suspending the stretchers in the railway ambulance trains used in the United States during the late Civil war. Dr. Evans has also used leather straps in the same way. Similar rings are attached to the upright post, and to the side standards of the wagon. Into these rings the handles of the stretchers are passed in the same manner as they were in the United States' railway ambulance cars.

Ventilation of
the Evans
wagon.

The interior of the Evans' converted wagon has greater aeration than General Rucker's wagon. The lower part of the sides of the original Rucker vehicle is enclosed by wooden panels with jalousied openings, and, for nearly a foot above, by the high backs of the seats employed in forming the upper platform; above, the spaces between the upright supports of the roof are open, but can at pleasure be shut in by canvas curtains, as shown in Fig. CLI. So far the same arrangement is maintained in the converted wagon, with the exception that the backs of the sitting patients are not carried up above the wooden sides. But when used for recumbent patients, the plan of having the upper tier of stretchers suspended, instead of resting, as in the original wagon, on a platform closely connected with the top of the wooden part of the side enclosure, permits the access of much more air to the lower stretchers. In the former case the lower stretchers are

completely covered above, and are also enclosed at the sides with the exception of the jalousied openings before named; in the converted wagon, when the canvas side-curtains are unbuttoned and rolled up to the roof, the upper part of this space is left quite open.

There is one serviceable appliance added to the converted wagon, which was not in the original one. This is the adoption of the Locati plan of having a small round piece of wood to serve as a seat for a conductor near the entrance at the back of the carriage. Two of these seats are added to the back of Dr. Evans' wagon. Instead of sliding within the body as they do in the Italian wagon, they are hinged and made to hang down when not required for use. When either is required to be sat upon, an iron rod is drawn from beneath the floor of the wagon, and this rod supports the piece of wood in a horizontal position and at once fits it for use as a seat.

Place for the attendant on the sick.

There is also an additional stretcher in Dr. Evans' wagon; it is one of the folding kind, and is carried outside on the side of the wagon.

The following are some of the measurements of the wagon, as well as its weight and cost, given by Dr. Evans:—Body of the wagon, 3 feet 3 inches from the ground; 8 feet $2\frac{1}{2}$ inches long; 3 feet $11\frac{1}{3}$ inches broad; and having a height in the centre of 5 feet. Interior length from tail-board to the driver's seat, 7 feet and $\frac{5}{8}$ inch; height from the floor to the rings for receiving the upper tier of stretchers, 2 feet 9 inches. The hind wheels have a diameter of 4 feet 5 inches, and a distance from each other from tire to tire of 4 feet 8 inches. The fore wheels have a diameter of 3 feet and half an inch. The width of the tires is $1\frac{1}{8}$ inch; the thickness of the felloe $2\frac{3}{4}$ inches. The fore-wheels turn under the body of the carriage. Weight of the wagon, about 1,300 lbs. Cost in Paris for a single wagon, about 2,000 francs (80*l.*)

Measurement of the Evans wagon.

Dr. Evans' wagon is light, airy, and evidently easy of draught on fair roads; it is economical as regards the number of patients carried; and is tolerably simple in construction. The springs of the lower tier of stretchers appear to be a decided improvement over the plan of the original Rucker wagon. The serviceable qualities of the upper tier of stretchers are very problematical, and thorough experimental trials require to be instituted before reliance can be placed upon them. Experience inclines to the belief that it is better not to attempt carrying in any vehicle a second tier of recumbent patients. On the other hand, if this should prove not to be a right conclusion, and it be considered wise to make such a provision to meet an occasional emergency, then it seems questionable whether the plan of the original Rucker wagon will not be found to be the most safe and substantial for effecting the purpose. The lateral shocks to which the patients would be subjected when the Rucker wagon happened to be traversing uneven roads would be less than when they were lying in suspended litters liable to swing and strike against the

Observations on the Evans wagon.

CHAP. V.

Accommoda-
tion of the
Swiss army
sick-transport
wagon.

Construction
of the Swiss
sick-transport
wagon.

The body of
the wagon.

side posts of the vehicle. How far, again, the wagon constructed according to Dr. Evans' description, with its comparatively light frame, light and short fore wheels, would stand the shocks and rough usage inseparable from field service, is a matter which only experience can determine. Certainly, if its present capacity and design were maintained, and it had to be fitted for package and transportation on board ship, and for general use in the British service, it would have to be made more substantial in some of its parts, in order to give a reasonable prospect of its preserving its efficacy during the course of a campaign.

Sick-transport wagon employed in the Swiss army.—One of these wagons was exhibited in the Park of the Paris Exposition of 1867. It chiefly attracted notice on account of a very ingenious, though rather complicated, arrangement, by means of which the part of the wagon on which the sick were to be carried could be prolonged and again shortened at pleasure. Owing to this contrivance, the vehicle could be made to accommodate either two or three recumbent patients with six others seated; or, secondly, four or six wounded men recumbent, all being on the same level; or, thirdly, twelve men seated.

The Swiss ambulance wagon is constructed on the tray principle with low sides. The bottom of the tray, or floor is ten feet long, exterior measurement, by four feet broad. Beneath the floor and occupying its whole width are two closed receptacles, or cases, one having the opening into it behind, the other in front. The hinder case is seven feet in length, the case in front two feet in length, the depth of both being fourteen inches. A space is left between the two cases which is one foot in width at the bottom, and in this space the fore wheels, which are shorter than the hind wheels, turn. The fore wheels are two feet seven inches in diameter; the hind wheels, three feet seven inches in diameter. The body of the vehicle is supported upon six strong semi-elliptical steel springs, three in front and three behind. Two of the springs are placed longitudinally, and the third transversely at each end. The wagon is drawn by two horses, on one of which the driver rides.

Each side of that part of the body of the carriage within which the sick are carried is divided into three sections, a short section at each end, a long section in the middle. The end sections are permanently fixed to the frame of the wagon. The middle section, which is slightly more than six feet in length, is removable; it can be readily lifted out of the sockets which connect it with the frame, so as fully to expose the middle part of the interior of the carriage, and can as easily be replaced and secured in them. Recumbent patients are placed in the wagon through the side opening which is left after the middle section is removed. To facilitate the admission of such patients, folding iron steps are attached to each side of the vehicle, and a considerable space is left between the fore and hind wheels. The distance between the centre of the nave of the fore wheel and that of the hind wheel is seven feet eight inches. The end sections are padded inside.

Between them, both at the front and back of the vehicle, is a wooden back-support, covered with a thickly padded leather cushion. This back-support is attached to the sides of the vehicle by two iron rods, one on each side; and as the end of the rod connected with the wagon is made to turn on a pivot, the whole cushioned back can be made to revolve also, until, if necessary, it is brought on a level with the floor of the wagon.

When the back-supports are left upright between the end sections before spoken of, the front and back of the vehicle is adjusted to receive patients in a sitting position. There are foot-steps to assist the patients to mount, and a broad projecting board to support the feet when they are seated, at each end of the wagon. Besides the two cushioned back-supports just mentioned, the wagon is provided with five thickly padded oblong cushions of equal size, which, when all are placed on the floor of the wagon, completely cover it, and act instead of stretchers. The middle one of these cushions is removable, and is fixed to a plank of wood which forms a bottom to it of corresponding size. The part of the floor to which it belongs is left open; when the cushion is in its place this opening is filled up. This cushion can be carried, when required, in the hinder of the two receptacles below the body of the wagon. There are two other cushions of the same width as the wagon, and each made in shape like a prism; these act as pillows for the patients carried lying down. A waterproof canvas tilt covers the wagon. It is supported on a frame, composed of iron hoops and bars, so jointed that it can be folded up at will, and, together with the tilt, placed in the receptacles below the floor of the vehicle. The adaptations by which the vehicle is enabled to accomplish the several kinds of transport, named at the commencement of this description, are the following:—

The Swiss army sick-transport wagon fitted with cushions in place of stretchers.

When the wagon is required for two or three recumbent patients and six sitting, the central side section is taken out, the middle cushion is inserted so as to fill up the vacancy in the floor, and the recumbent patients being placed on the cushioned couch thus formed with one of the pillows against the rear back-support for their heads, the side is again closed. Three sitting patients take their seats on the short section in front, and three on the section behind.

Adjustment of the Swiss wagon for two recumbent and six sitting patients.

When it is required for six patients all lying down, in addition to completing the cover of the floor by the insertion of the middle cushion, the back-support in front is caused to revolve forward until the cushion which covers it is brought to a level with the floor cushions, and the same thing is done with the back-support in rear, only in an opposite direction. Fastenings are provided for fixing them in their new positions. The floor by these means is extended both in front and in rear by the depths of the two reversed back-supports, and the whole of this prolonged floor is covered by padded cushions on the same level. The front and rear footboards for sitting patients are capable of being withdrawn from their places, and by means of hooks and bolts can be fixed to the parts of the back-supports which now

Adjustment for six recumbent patients.

CHAP. V.

Adjustment
for twelve
patients, all
seated.

Observations
on the Swiss
army sick-
transport
wagon at
Paris.

Peculiar
features of
Locati's
Italian sick-
transport
wagon.

form the two ends of the floor of the wagon. They add to a slight extent still further to the length of the floor, but serve principally as supports and for closing up the two ends of the wagon. The wagon is now so lengthened that if the two triangular pillows are placed back to back in the middle of the vehicle, two or three men can be placed on one half of the floor facing the horses, and two or three others on the other half facing the rear of the wagon.

When it is to be adjusted for carrying twelve patients seated, the side is taken out as before, the central cushion with its plank is removed and placed in the case below the rear of the wagon; one pillow is placed upright behind the front back-support, the other pillow similarly placed behind the rear back-support. There are now four transverse seats in the wagon, two in the middle section, with an opening or well in the floor for receiving the feet of the patients sitting upon them; two at the two ends; and each capable of accommodating three persons seated close together. Six patients are placed in the central compartment by way of the side steps, the side support being replaced and the steps folded up as soon as they are in their places. The other six patients are assisted into their places at the two ends, as before explained.

The wagon at Paris was very solidly constructed and appeared to be very heavy. Its particular weight was not stated; its bulk, however, and the lowness of the wheels, led to the belief that the draught would be far too great for two horses when it was fully loaded if the roads were not level and in good order. It was drawn by two horses over the smooth roads of the Exhibition park with twelve persons seated in it, and was then moved and turned without difficulty. The motion of the springs was also easy, but the number of persons carried, three on each seat, caused more inconvenience to the sitters, chiefly owing to the sloping direction of the sides of the vehicle, than could have been borne by men with such wounds as soldiers carried sitting are usually suffering from. Two men could, however, sit on each seat with comfort. The substitution of cushions for the usual stretchers would lead to the necessity of a wounded man being lifted off a stretcher should he be brought on one to the wagon, as it would also necessitate his transfer to another stretcher on arrival at the hospital into which he was to be admitted, changes which should always, if possible, be avoided.

Locati's vettura d'ambulanza or voiture-hôpital.—A pattern of this sick-transport wagon was exhibited at the Paris Exhibition by the Florentine Committee for Aid to Wounded in Time of War, to whom it belonged. The particular vehicle exhibited was one which had been used in the campaign of 1866 in the Tyrol. It was designed and constructed by A. Locati, coach builder, at Turin, under the general direction of Dr. Bertani, Médecin-en-chef of the volunteers in Italy. The carriage presents a great number of very novel and peculiar features. Its chief peculiarities are: (a), the mode in which the recumbent patients are moved in and out of the vehicle *at its sides* instead of, as

usual, *at the back*; (b), the number of recumbent patients (five) it is arranged for carrying; (c), the plan of ventilation; and (d), the variety of hospital purposes to which the carriage is made subservient, everything necessary for the surgical and medical treatment of the patients, for cooking purposes, and for their dietary being carried with it. It is not merely an ambulance vehicle for the transport of sick and wounded, but is an ambulance or moving field hospital itself, with its sick transport and store transport, and attendants, all complete; capable, therefore, of being rendered independent of aid from any other quarter for many days together, and consequently fitted for the removal of patients from a field of action to places a long distance off.

The Locati wagon is a four-wheeled vehicle of the omnibus kind, for two-horse draught, and is divided into an interior and a front coupé. The division is effected by a wooden partition. There are sliding doors in the partition, so that a communication can be readily established between the two parts of the vehicle when necessary. The length of the carriage, exclusive of the coupé, is 2 metres, or nearly 7 feet; its width 1 m. 20, or nearly 4 feet. The body is suspended upon six springs, four longitudinal, two transverse, all with double joints to break the shocks of concussions as far as practicable. It is driven from a box, the driver's seat being separate and advanced in front of the coupé. Behind, near the door at the back of the vehicle, is a wooden slab made to slide in and out of a grooved recess under the floor at pleasure; this serves as a seat for a hospital attendant. Below it there is a hinged footstep, which can be folded up out of the way or lowered to act as a support for the feet of the attendant just mentioned, or to assist the entrance of patients into the vehicle. The coupé in front, which is well protected by coverings above and an apron in front, can carry three persons sitting; the interior, five persons recumbent, two on each side and one at the bottom, or two only recumbent on one side and five seated on the other; or else ten seated, five on each side, besides the driver and the attendant. It is said that these wagons with a load of ten patients were proved to be capable of being conveniently drawn by two horses only, so long as they were travelling on main roads. The drawings on the next page represent the external appearance of the carriage and some of the appliances attached to it.

Construction
of Locati's
sick-transport
wagon.

The manner in which patients lying down are got into the wagon is the following. The two sides of the interior are each enclosed by four folding doors. The two doors on each side of the central opening are hinged together, and these again are connected by hinges with the upright posts of the frame of the body of the vehicle at each end. Thus the two doors in the middle on being opened are capable of being folded back on the adjoining doors, and, when again the double door thus formed is turned back, the whole interior of the vehicle is exposed to view. On each side of the interior there are two frames, one above the other, for the reception of litters and mattresses. They are so

Mechanism by
which recum-
bent patients
are raised into
Locati's
sick-transport
wagon.

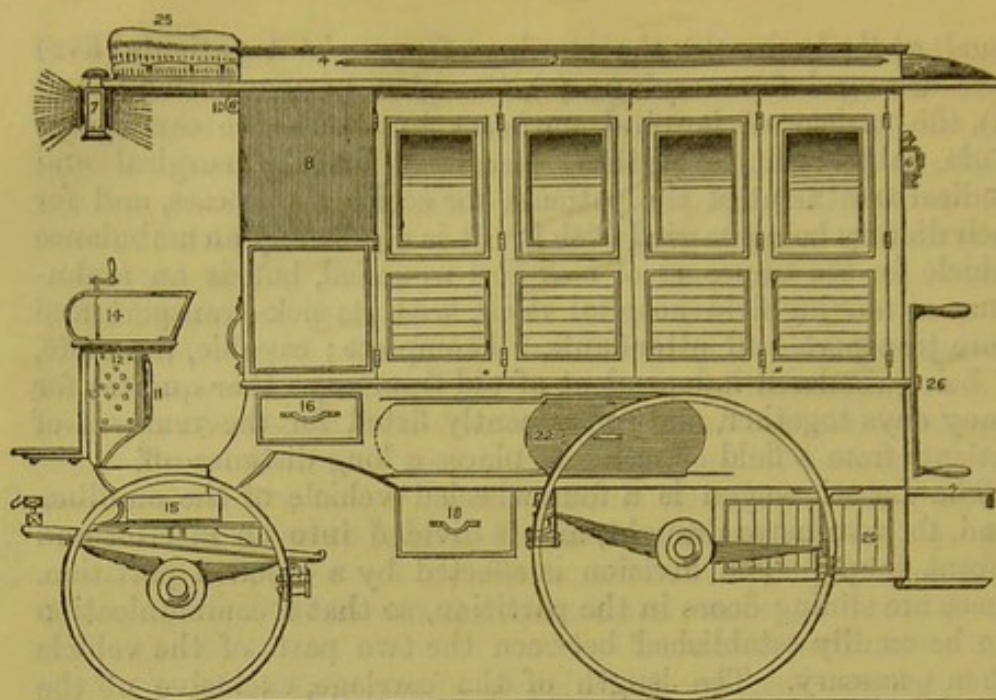


Fig. CLIV.—Side view of Locati's Ambulance Wagon. 1, double imperial; 2, lateral screen on roller; 3, screen behind; 4, hospital attendant's sliding seat; 5, footstep; 6, hand-lantern, removable; 7, front lantern; 8, wooden sides of coupé; 9, break; 10, 11, coupé cover and apron; 12, partitioned case for various objects; 13, wooden screen to keep off mud; 14, driver's seat; 15, chest for tools; 16, medicine chest; 17, water-tank and ice-box; 18, drawer for surgical materials; 19, footstep to reach the roof; 20, cage for forage; 21, small door in main door; 22, doors to openings for patient's kits; 23, cover of roof; 24, entrance door to back of carriage; 25, place for horse-clothing; 26, lever to lower and raise upper litter frame. These explanations also refer to the corresponding numbers on the three illustrations of this wagon which follow.

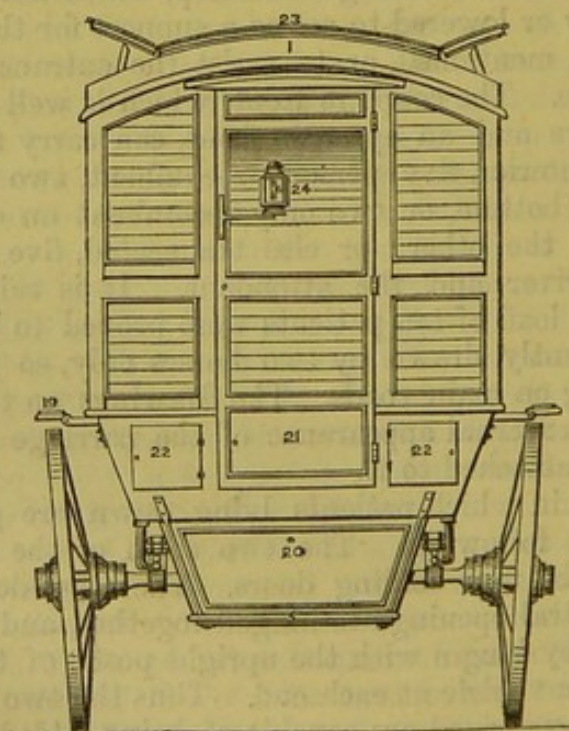


Fig. CLV.—End view of Locati's Ambulance Wagon.

placed that when the litters and mattresses are upon them they have the appearance of the upper and lower berths in a cabin upon board ship. There is a peculiar mechanical contrivance for

placing patients upon the upper mattresses. At the back of the vehicle on each side of the entrance door are two rather long iron levers with double handles; on turning either of these levers in one direction the corresponding upper litter, with the frame on which it rests, is lowered out of the side of the vehicle until it is brought to a level with the lower litter; a patient being then laid upon it, the litter and patient are raised into their place in the interior by turning the lever in the opposite direction. The two patients for the lower tier of mattresses are easily laid on them from the outside when the side folding doors are fully opened. The litter for the fifth patient is laid on the floor of the vehicle in the centre, between and below the two tiers already mentioned. This litter is put in and out through the door at the back of the vehicle. The particulars just described are shown in the following illustrations:—

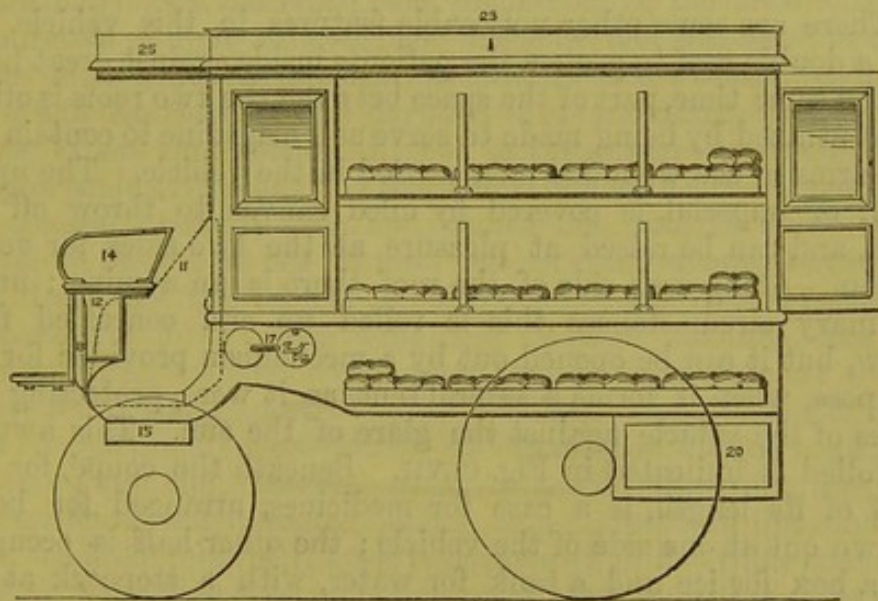


Fig. CLVI.—Side view of the interior of Locati's Ambulance Wagon.

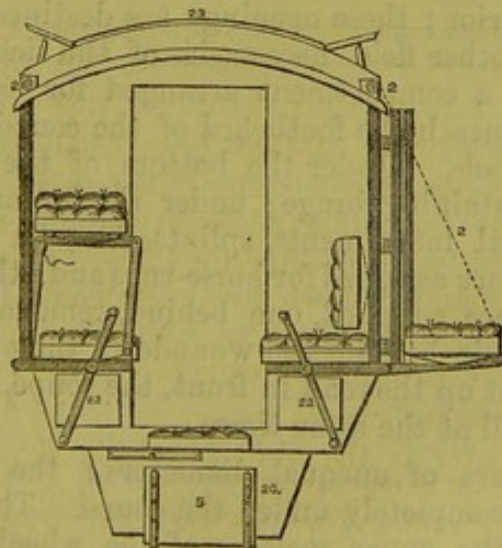


Fig. CLVII.—End view of the interior of Locati's Ambulance Wagon. In this view both litters on one side are in position; in the other, the upper litter has been lowered to the outside, ready to receive a patient.

CHAP. V.

Construction
of the litters
in Locati's
wagon.

The litters used in this wagon are made so as to answer as hand-stretchers for the removal of patients, or, if need be, as hospital beds. Each is formed of an oak frame, with cross-bars of thin steel placed at intervals of 0.10 m. from each other to sustain the mattress, light folding iron handles at the four corners, and with rather high wooden feet, which are made to fold up beneath the stretcher. Two semicircular hoops of thin steel are attached to the sides of these stretchers, and arch over it, so as to guard a patient from falling off; when not required, they can be folded down. The advantage of a certain amount of elasticity is afforded to a patient lying on the stretcher by the steel bands on which the mattress rests.

The upper part of the coupé seat can also be taken off and used as a stretcher. It is so jointed as to be capable of carrying a patient in a recumbent, semi-recumbent, or sitting position.

The double
roof of
Locati's
wagon.

There are some other noticeable features in this vehicle. It has a double roof to protect the patients inside against great heat; at the same time, part of the space between the two roofs is otherwise utilized by being made to serve as a magazine to contain the fire-arms of the wounded men carried in the vehicle. The upper roof, or imperial, is covered by oiled canvas to throw off the rain, and can be raised at pleasure at the two sides for ventilation. Along each side of the roof there is an awning; under ordinary circumstances this is rolled up and concealed from view, but it can be opened out by a mechanism provided for the purpose, when it forms a lateral tent, as it were, protecting the sides of the vehicle against the glare of the sun. This awning unrolled is indicated in Fig. CLVII. Beneath the coupé, for one half of its length, is a case for medicines, arranged for being drawn out at one side of the vehicle; the other half is occupied by a box for ice and a tank for water, with a stopcock at the other side of the vehicle. At the back of the vehicle are two doors which open into vacant spaces beneath the lower litters or seats of the interior; these openings are destined to contain the knapsacks and other field necessities of the sick. Beneath the driver's seat is a compartment arranged for carrying cases of provisions. Beneath the footboard of the coupé is a case for a few necessary tools. Under the bottom of the vehicle, behind, is a cage for containing forage; under the bottom, in front, is a chest for surgical instruments, splints, &c.; on the roof above the coupé is a place assigned for horse-rugs and other such articles. Two lanterns are supplied, one behind, removable, for the use of the attendant in helping the wounded; the other, in front, so placed as to light up the road in front, the coupé, and the interior of the vehicle, all at the same time.

The fittings in
Locati's
wagon.

The wheels are of unequal diameters; the fore-wheels are made to turn completely under the coupé. The break is made to press upon the upper surfaces of the wheels, and is applied by turning a handle placed conveniently near the seat of the driver.

The price of the Locati ambulance wagon complete, at Turin, is 3,475 francs, or 139*l*.

CHAP. V.

These ambulance vehicles, according to Dr. Appia, who assisted in using them in July 1866, during the operations of the Garibaldians against the Austrians in the Tyrol, gave much satisfaction as conveyances for the wounded. "Not being allowed to go with much speed," he writes, "the carriage did not give rise to the troublesome rocking movement which the increase of load at the upper part might lead one to fear it would." * M. Appia also mentions that he sent away several carriage loads in these vehicles, after the battle of Bezzecca, to Storo, and that even the wounded who subsequently travelled the distance from Storo to Brescia in them, a journey of twenty-one hours, declared themselves well satisfied with this new form of carriage.

Experience of Locati's sick-transport wagons in the Tyrol.

Voiture simplifiée d'ambulance Locati.—The "vettura d'ambulanza" just described, was examined by the International Committee at Paris in 1867, and while it was admitted to have many meritorious features, it was held to be too complicated and too costly for the ordinary purposes of an ambulance vehicle. M. Locati then constructed another sick-transport carriage of a simpler kind, and sent it to the Exhibition under the above title. In general external form and dimensions, and in many of its details, it resembled the original vettura d'ambulanza, but it was not fitted for the variety of purposes which that wagon was prepared to fulfil. The simplified carriage was not, like the former, a hospital complete in itself, but was built almost exclusively for sick-transport purposes. Thus a large number of cases and compartments were got rid of. It carried with it a surgical canteen, but the contents were rather intended for the first necessities of the wounded before being placed in the carriage, than for their treatment after being placed in it. The experience of the circumstances of campaigning as they are met with in such a climate as that of Italy in a summer campaign, evidently still dictated many of the leading features of this carriage, such as the double roof, side-awnings, &c., as the same circumstances had done in nearly all the arrangements of the former carriage. It was only made for four recumbent patients, and these were placed directly in at the sides of the vehicle. The mechanical appliance for lowering the upper tier of stretchers, which has been described in the account of Locati's original carriage, was not provided in this vehicle; but, instead, the places for the upper stretchers were fixed at a rather lower level, and small wheels were fitted to the framed supports to facilitate the entrance and passage over them of the stretchers.

Alterations made in Locati's simplified sick-transport wagon.

Baron Mundy's, or the first-prize ambulance wagon at the Paris Exhibition of 1867.—This is the vehicle which gained the prize of a thousand francs offered at the Paris Exhibition, for the best ambulance wagon, possessing certain stated qualities.

Baron Mundy's sick-transport wagon.

* "Les Blessés de la Bataille de Bezzecca dans la Vallée de Tiarno" (Tyrol) "21 Juillet 1866. Par Louis Appia, docteur, &c. &c., Genève, 1866," p. 39.

CHAP. V.

Its amount of
accommoda-
tion.

Construction
of Bn. Mundy's
wagon.

It was made by M. Locati, the builder of the two carriages previously described, but was constructed in accordance with directions laid down by Baron Mundy, Médecin-Major of the Austrian army. Like the simplified Locati carriage just described, this vehicle resembles in general appearance, in its side-openings, and still more closely in its external proportions, the Locati hospital wagon used by the Italian volunteers during the last campaign in the Tyrol. But the resemblance here ceases. The internal fittings, appliances, and amount of accommodation for which it is designed, differ greatly from those of the "voiture-hôpital," sent by the Florentine Committee to the Exhibition. The prize wagon, which for brevity may be called Baron Mundy's wagon, instead of five recumbent patients, is arranged to carry only two recumbent patients. In addition, it is capable of conveying three or four sitting; or it can carry eight or ten sitting, if none are carried lying down. As the adaptation is for only two patients in a recumbent posture, the internal construction is enabled to be simpler, and the ventilation more thorough. Only a portion of the side of the carriage is enclosed by wood, namely a space about seventeen inches in depth; and of this, fourteen inches can be opened at pleasure, the panels, by which it is enclosed, being hinged, so as to be capable of being let down when necessary. In the drawing which follows, one half of the wooden side is lowered, so that the position of the stretcher may be visible.

Baron Mundy's wagon, like the rest of Locati's carriages, has an open coupé in front, and an interior behind. The roof, however, is single; it is only formed of thick sailcloth canvas. The same material falls down to shade and to protect the two partially open sides of the interior above the wooden panels

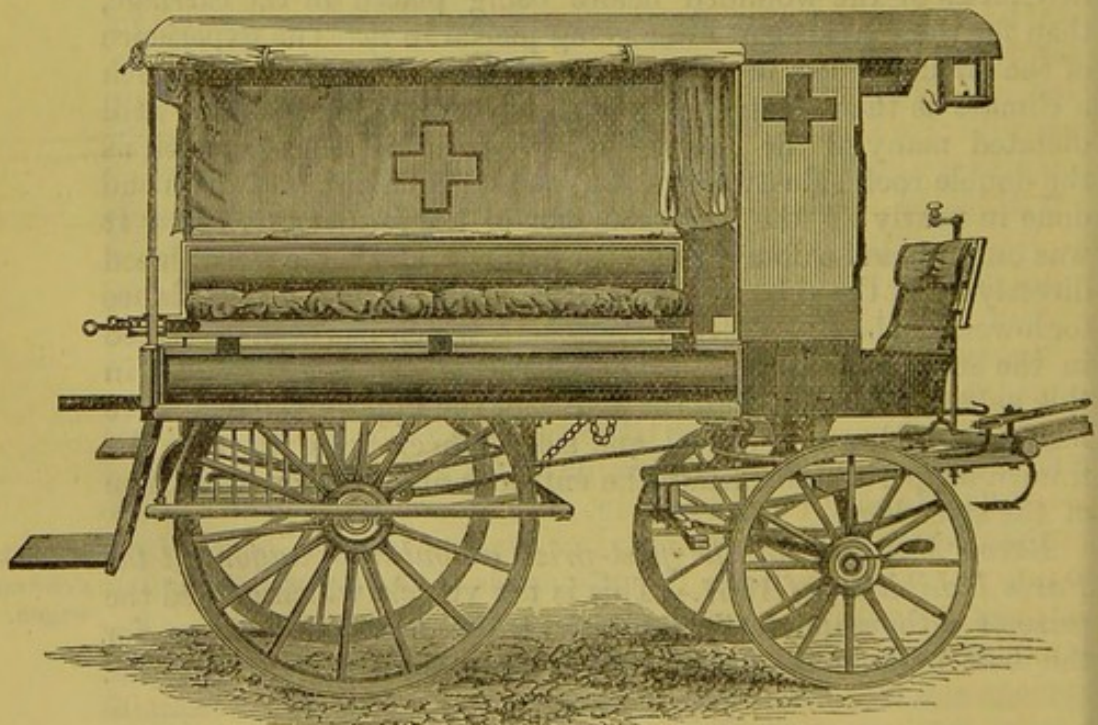


Fig. CLVIII.--Side view of Baron Mundy's Sick-transport Wagon.

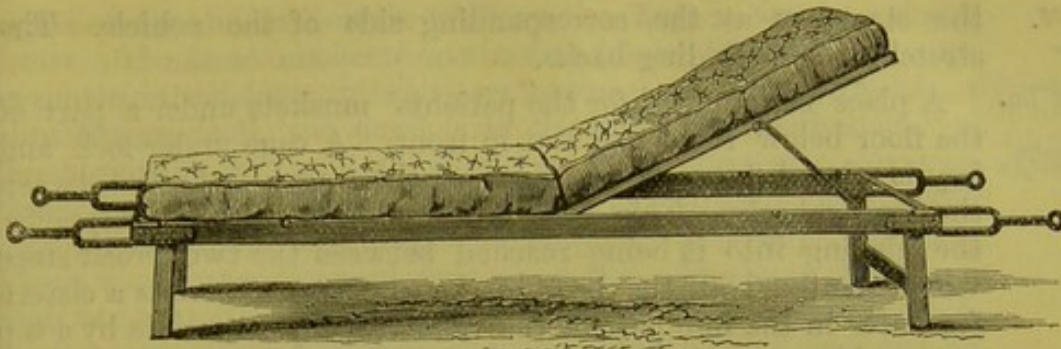


Fig. CLIX.—View of one of the stretchers removed from Baron Mundy's Sick-transport Wagon.

before mentioned ; it is used as a curtain, sliding along a rod, to separate the interior from the coupé ; it also closes the back part of the carriage. A considerable diminution in weight is obtained by this arrangement. The canvas behind is divided into three parts, one corresponding with the middle entrance at the back of the carriage, the other two with the end openings for the admission of the stretchers on each side. When the sail-cloth curtains at the side are rolled and fastened up near the eaves of the roof, and the wooden panels are fully lowered ; when the canvas at the end is also either rolled up or thrown over the roof ; when the partition curtain which separates the interior from the coupé is withdrawn ; then the whole interior is open to the air, with the sole exception of the roof which covers it. The front wheels are small enough to turn under the fore part of the body of the carriage. The carriage rests on platform springs. The transverse seat in front is capable of accommodating three persons sitting with great ease ; on occasion it could readily carry four sitters. The handle of the break is placed at this part of the carriage ; it acts upon the two hind wheels. The frames on which the two stretchers for the recumbent patients are placed are separated from the floor of the carriage behind by a space of seven inches. Within this space are two simple bow springs, the extreme height of each of which is three inches. The rear ends of the two stretcher frames directly rest on these springs ; the remaining four inches of the space above-mentioned are occupied by blocks of wood, on which the springs move when they are in action. The fore parts of the two stretcher frames are supported upon two corresponding bow springs ; but at this part of the vehicle the floor itself is raised four inches, so that no blocks are required in this situation. The object of raising the floor at this end is to give more space to the compartments beneath. The stretchers can be placed into the interior either at the back of the carriage or at the sides. They glide upon two wooden rollers ; these rollers are within and slightly above the level of the framework which is destined to carry the stretchers. Outside each hind wheel, and of course completely detached from it, is a foot rail, on which a person can stand, and from which he can readily assist a patient lying upon

CHAP. V.

Fittings of Bn.
Mundy's
sick-transport
wagon.

the stretcher at the corresponding side of the vehicle. The stretchers have folding backs.

A place is provided for the patients' muskets under a part of the floor below the coupé seat in front. A cage under lock and key is placed beneath the floor of the wagon behind, between the hind wheels. This case is intended to receive knapsacks, the opening into it being reached between the two broad steps which are fixed at the back of the carriage. There is a cistern for water in the fore part of the vehicle, easily accessible by a tap at one side. On the opposite side a door, under lock and key, leads to a compartment containing surgical dressings. There are also two barrels for wine and other medical comforts in front. The taps of these barrels are placed immediately under the coupé seat, and are protected by a sliding door under lock and key.

Measurement
of Bn. Mundy's
wagon.

The dimensions of the principal parts of the carriage, ascertained by measurement of the pattern at the Exhibition, are as follows:—Length of carriage, interior measurement, exclusive of coupé, 6 feet 6 inches; outside measurement, 6 feet 7½ inches; width of carriage, interior measurement at level of stretchers, 4 feet 10 inches; outside measurement, 5 feet; width of floor of carriage, inside measurement, 4 feet 5 inches; height of carriage from centre of floor to middle of roof 4 feet 6 inches; from floor to spring of arch 3 feet 4 inches. The full length of the carriage from end to end, including the coupé, was 9 feet. The diameter of the fore wheels was 2 feet 9 inches; that of the hind wheels 3 feet 10 inches.

The width of each stretcher bed was 2 feet 2 inches, leaving a space only of 6 inches between them, available for the legs of patients, in case of their being used by men in a sitting position. This interval of space would be altogether too narrow to allow any one to pass along for the purpose of attending upon patients lying upon the stretchers; but the arrangements of the carriage already explained evidently design that any such attention shall be given from the outside.

Neuss's Prussian ambulance wagon.—This wagon, designed for draught by two horses, was constructed for the brotherhood of the Knights of St. John, by Messrs. Neuss, of Berlin, the same carriage builders who constructed the two-wheeled hand-litter for them, described in a previous chapter. It was first used by this brotherhood in the war between Prussia and Denmark in 1864, and afterwards in the campaign of 1866. It was built, with some modifications, on the general principles and plan of what were held to be the best kind of German sick-transport wagons, viz., those made to accommodate two badly wounded men on stretchers in the body of the wagon, and a certain number less severely hurt sitting in a coupé partitioned off from the interior and formed by the transverse seat usually occupied by the driver in front. The patients sitting on the front seat were protected by a folding hood, and the horses, when the seat was thus occupied, were conducted by the driver postilion fashion.

The weight of the wagon built by the Messrs. Neuss was only 6 cwt. The iron axle between the two hinder wheels was bent, as shown in the drawing at (*a*), and upon it and the fore-axle, a connecting pole (*b*) was fixed. By this arrangement the body of the carriage is enabled to be placed at a very moderate elevation above the ground. On the hinder axle two springs were fixed longitudinally, on the fore axle one spring transversely. The fore-wheels were low and turned under the coupé. The body of the carriage had very light open sides, the upper part having only waterproof canvas curtains capable of being rolled up and fastened by straps. The hood over the seat in front was made of the same material, and the part (*f*) marked with the Maltese cross was enclosed also by waterproof canvas. Within this part of the wagon was a compartment for the reception of the men's knapsacks and for a supply of restoratives and surgical dressings. The interior of the wagon was separated into two longitudinal divisions by a partition reaching from the floor half way up to the roof. In this partition, and also at corresponding heights on the sides of the wagon, ledges (*h, h, g*, in the drawing) were fixed in order that two folding stretchers, each capable of supporting a patient in a semi-recumbent or recumbent posture, might be slid along them into the wagon.

Construction of Neuss's sick-transport wagon.

The stretchers used in these wagons were specially constructed for them and have been described elsewhere (see page 156). Their peculiar feature, as already mentioned, was the arrangement of the canvas bottom and folding backs, by means of which the patients could be conveyed with full support, either in a sitting, semi-recumbent, or entirely recumbent posture.

Professor Gurlt in his "Militär-chirurgische Fragmente" speaks, from personal observation and experience, of the lightness, ease of

Dr. Gurlt's favourable opinion of Neuss's wagon.

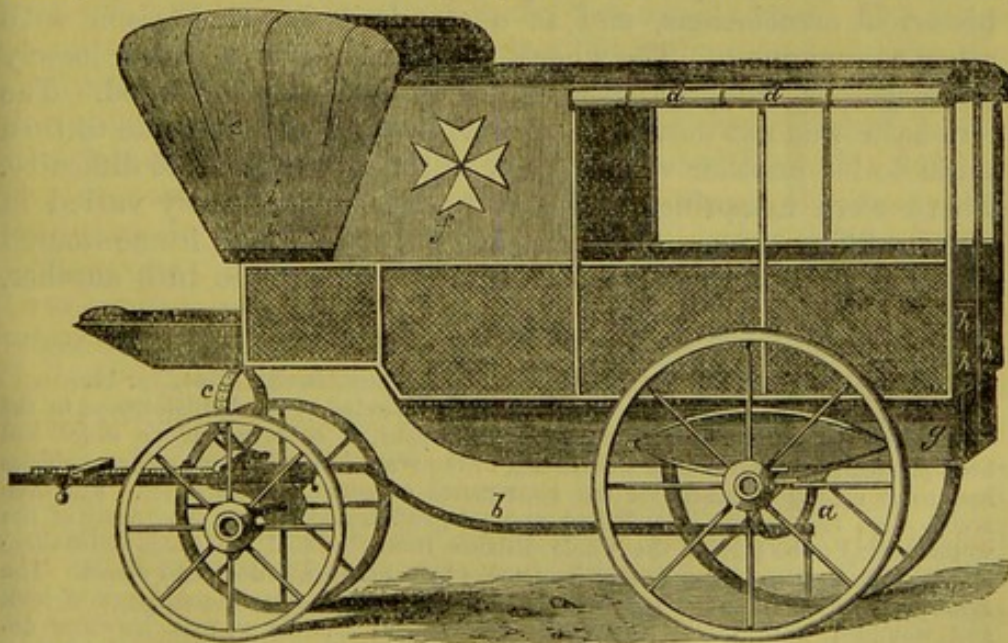


Fig. CLX.—Neuss's Prussian Ambulance Wagon. *a*, curved axle; *b*, pole; *c*, transverse spring; *d*, side curtain; *e*, folding hood; *f*, compartment for stores, &c.; *g, h*, ledges for stretchers; *i i*, position of coupé seat.

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Neuss's sick-transport wagon for a single patient.

motion, and solidity, characterizing these vehicles, as well as of the advantages afforded to the wounded from the varied postures which they were able to be placed in, owing to the peculiar construction of the stretchers.* The drawing of the wagon is taken from the same source.

Voiture d'ambulance à quatre roues, appt. au Quartier Général de sa Majesté le Roi de Prusse.—A carriage by the same maker and constructed on the same principles was exhibited at the Paris Exposition of 1867 by the Prussian National Committee for Aid to Wounded in Time of War. This carriage had been attached to the Head-quarters of the King of Prussia during the war of 1866 in Germany. It was arranged for the conveyance of only one patient in the interior, the place of the two stretchers described in the preceeding carriage being occupied only by one bed. The coupé in front was intended for a driver and for attendants. The materials of the carriage and all its fittings were of a very superior quality, the object kept in view being to provide every convenience that might be required for the wants of a single patient. The bed, which was covered with morocco leather, could be converted into an arm-chair, one end being capable of being raised to form the back, the other of being lowered to support the legs. The lowness of the body of the carriage obtained by the bending of the axle between the hind-wheels was one of the leading features of its mechanical construction, as it was in the other of Neuss' wagons previously described.

The araba an example of the most primitive form of wagons.

The Araba.—The araba, or Turkish agricultural wagon, which was largely employed for the conveyance of sick of the British army in Bulgaria and in the Crimea,† during the Russian war, may be taken as an example of the rudest form of a four-wheeled sick-transport conveyance. It is only noticed for its historical associations, and as a standard for comparison with other conveyances. The wheels were without tires, rather loosely put together, and, like the axles, formed only of wood. The fore-axle was not moveable, so that it could not be made to turn aside to let another vehicle pass without the greatest difficulty. There were no springs. The body, which constantly varied in size in different examples, consisted only of a rough frame secured together by a simple system of inserting one piece into another,

* "Militär chirurgische Fragmente, von Dr. E. Gurlt, Berlin, 1864," p. 11.

† The only available wagons for carrying the wounded of the British troops to the shore, after the battle of the Alma, were the arabas, or country wagons, which had been pressed into service after the landing of the army in the Crimea. These vehicles had been chiefly obtained for the conveyance of commissariat stores. But even arabas were not present in sufficient numbers, and hence it was that many of the wounded had to be carried the whole distance from the field of action, about three miles, to the boats on stretchers or hammocks by bandsmen, sailors, and others. The Arabas continued to be the only wheeled vehicles available for the carriage of sick and wounded, until the arrival of Director-General Smith's wagons, hereafter described, from Varna. The commissariat arabas were still largely used, however, even after the arrival of the ambulance wagons, owing to the limited number of the latter, viz., two to each division of the army. Many of the wounded after the battle of Inkerman were removed from the front to Balaklava in arabas.

or of union by wooden pegs. Two or three planks, sometimes laid loosely, sometimes pegged to the bottom of the frame, formed the floor of the vehicle. It was drawn by two bullocks;* was necessarily very slow in its movement; and was constantly accompanied by a creaking noise, as the pieces of wood of which the wheels and other parts were composed rubbed against each other. When used for conveying sick, the only means adopted to obviate its inconveniences, was a supply of straw or mattresses on the floor to form a bed, and to lessen the effects of jolting. Two, or sometimes three, patients could be placed in an araba in a recumbent position; eight or nine could be accommodated sitting.

The araba bears a close analogy with the hackery of India previously described, and, as in it, so also in the araba, only one quality can be advanced in its favour. It is this, that in a partially civilized country, with long distances intervening between the places where skilled workmen can be obtained, great difficulty would be experienced in remedying the effects of an accident to a carriage of complicated construction; while, under similar circumstances, in case of any part of an araba becoming broken or lost, means of restoring the damage can be always attained wherever wood or a tree is available. The wood being provided, the skill of the driver, with the aid of the few tools which he always carries with him, quite suffices to effect the necessary repair. The hackeries in India are sometimes four-wheeled, but no further allusion to them is necessary, as their construction is carried out on precisely the same plan as the two-wheeled hackeries already described.†

The araba resembles the Indian hackery.

Four-wheeled hackeries of India.

Macpherson's Indian sick-transport wagon.—This wagon was constructed in the year 1858, under the direction of Inspector-General Macpherson, of the Madras medical service, who designed the cart previously described under the same name. The experience of this officer was not confined to India; he had been the Principal Medical Officer of the Turkish Contingent and other forces under the command of General Sir Robert Vivian during the Crimean war, and, in that capacity, it had been his duty to organise the ambulance equipment for that army. Circumstances had thus led him to give attention to the subject of sick-transport conveyances, and their construction. Dr. Macpherson's wagon was on the omnibus plan, was supported on four double elliptic steel springs, and was intended for draught by two bullocks or horses. It was constructed to carry eight patients within the body of the vehicle, and two sitting on each side of the driver in front. Space was provided for carrying the arms and accoutrements of these ten men. The driver's box was separated from the interior by a slight open frame fitted with curtains that could be raised and fixed near the roof if desired. The weight of the whole conveyance, as made at Madras, was 15 cwt.; the cost 600 rupees (60*l.*). Two stretchers with hoods were carried with

Construction and fittings of Macpherson's Indian wagon.

* The arabas in the Crimea were occasionally drawn by camels.

† See page 361.

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Double floor of
Macpherson's
Indian wagon.

the wagon, one being fixed to each side of the body of the conveyance. The upper half of the body was open, with the exception of the upright posts employed to support the roof; but the open part was protected on each side by a framed canvas blind, hinged to the sides of the roof, so that it could be raised, or lowered, and fixed in either position at pleasure. Overhead, the wagon was covered by a canvas tilt, and this was prolonged in front so as to form a hood over the transverse seat in front. A free circulation of air, and, at the same time, protection against the glare of the sun, were afforded by these means to all the persons carried on the vehicle. All the wheels were of equal diameters. The longitudinal seats in the interior were made of open cane-work, as were also the backs for the patients to lean against. The front borders of both seats were grooved, and in this way were prepared for receiving two canework frames, which were carried with the wagon, of proper size for fitting into and resting upon the grooves. When the frames were laid in their places, they and the seats formed a continuous platform on which two patients lying upon mattresses or stretchers might be readily placed. Under the seats were racks for the men's muskets. Beneath the upper floor was a second floor divided into two wells, one rather deeper than the other, with moveable lids, arranged for the reception of various articles. The two wells were separated only by a narrow space, in which the axle of the hind wheels was received; with this exception the lower floor, or the two wells into which it was divided, corresponded in size with the size of the upper floor. The under part of the driver's seat was hollowed out at the sides to facilitate the turning of the fore wheels.

The following illustration is taken from the model of this conveyance in the Museum of Military Surgery, at Netley.*

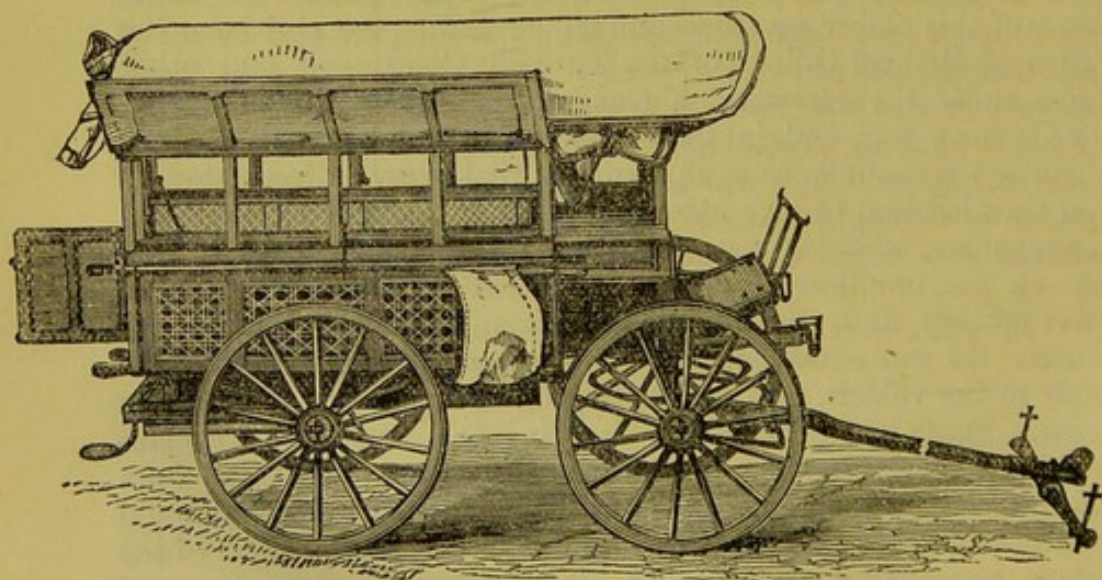


Fig. CLXI.—Inspector-General Macpherson's Indian Wagon.

* Spec. No. 1331.

The officer commanding the 1st Battalion Madras Artillery, St. Thomas's Mount, who made a report, already referred to,* respecting the cart of Dr. Macpherson's invention, was also ordered to make a trial of this wagon. On the 11th of July 1859, this officer stated with regard to the wagon, that he had sent it out filled with men, some of whom were sick, over the roughest ground in the neighbourhood for three days under non-commissioned officers, and that he had himself accompanied it on the fourth day. "The four-wheeled ambulance wagon," he reported, "runs very light and easy; wonderfully so, considering the load it carries. The one pair of bullocks took it over difficult ground with as much ease as the two-wheeled; but both require more cattle. The drivers were all very bad, *i. e.*, not one of them seemed to have the remotest idea of the best way of crossing a ravine or ditch, but did all they could (ignorantly I believe) to break the springs, and to give the greatest possible inconvenience and discomfort to the inmates. Yet, notwithstanding these disadvantages, the men generally express a favourable opinion of these ambulance vehicles."† Notwithstanding the general satisfactory character of this report, neither Macpherson's sick-transport wagon nor the cart invented by him have come into general use in India. I am not aware of any circumstances having subsequently occurred to cause them to lose the favourable opinion which was held regarding them on the occasion of the trials to which they were subjected when they were first introduced to notice.

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Result of trials
of Macpher-
son's sick-
transport
wagon at
Madras.

Currie's Indian sick-transport wagon.—This wagon was constructed in the year 1864 after designs furnished by Captain Currie, R. A., agent for gun carriages in Bengal. It was intended to replace the ordinary country carts, and, partially, the use of dhoolies, for sick-transport purposes in Bengal. It appears from a report by the Sanitary Commission for Bengal‡ that these wagons had stood the test of repeated trials, both with horses and bullocks, not only on roads but over all descriptions of rough ground, and that it seemed to be shown they could be taken wherever a gun could be taken. The Commission therefore reported that in their opinion a supply of these wagons in addition to the full complement of dhoolies, not as substitutes for them, would be advantageous on field service; while, on the ordinary line of march, one half of the sick could, under all circumstances, be safely and advantageously carried in them instead of in dhoolies. Two of

Captain
Currie's sick-
transport
wagon.

* See page 365.

† Report from the Officer Commanding 1st battalion Madras Artillery, St. Thomas's Mount, 11th July 1859, No. 379.

‡ Printed Report No. 59, from the Officiating President of the Sanitary Commission for Bengal, to the Secretary to the Government of India, Military Department, dated Calcutta, 30th January 1865, relative to the substitution of wheeled ambulance conveyances for dhoolies.

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Reports on
Currie's sick-
transport
wagons used
with regiments
on march in
India.

Trials of sick-
transport
wagons under
different cir-
cumstances
compared.

them were also recommended to be issued to every full regiment of infantry and cavalry in cantonments for conveying sick to hospital, as well as for taking out from hospital for an airing those convalescents who might not be able to bear the motion of an elephant. Each of Captain Currie's wagons, the Commission believed, would carry three men in a recumbent position, or from eight to ten sitting.

The construction of twenty of these ambulance wagons was subsequently authorized, and they were directed, as soon as finished, to be subjected to trial on the line of march by regiments moving in relief through the country. The reports of these trials proved unfavourable. The principal objection made to the vehicles was their weight, cumbrousness, and consequent slowness of movement. Even when the march took place over good roads it was said that their weight caused them to be of doubtful utility, while over bad and broken ground in places where no good roads existed, they proved a complete failure so far as the sick-transport service was concerned. It appears at first strange that these reports should have differed so materially from the report of the Sanitary Commission, whose recommendation was only given after repeated trials; but similar discrepancies, as was mentioned before when describing Colonel Clerk's ordnance hospital cart, have constantly happened in corresponding cases. The fact is that the former trials, even though they were frequently repeated, constituted a very incomplete test when compared with the long continued trials to which the vehicles were subsequently subjected during sustained marches, day after day, for a long period together, over all descriptions of ground, in all kinds of weather, without experienced supervision, and with drivers and draught animals of very different capacities. The latter is the only real practical mode of testing the qualities and value of any such vehicle, especially one intended to be used in time of war; for it is the only one which approximates to the circumstances under which the vehicles would be used on active service. This is the latest form of Indian wagon, I believe, which has been subjected to trial, and in consequence of its failure an ambulance wagon of an approved pattern for India is still a desideratum.

As will be seen from the illustrations which follow, Captain Currie's conveyance was constructed on the gun-carriage principle. I have been informed that the weight of the wagon complete was very high, viz., 25 cwt. The fore wheels are smaller than the hind wheels, and a space between the interior and coupé is left to facilitate turning. The body, which appears rather high for the ready insertion of recumbent patients, is supported on elliptical steel springs in front and on semi-elliptical springs behind. The sides are open and support a roof. The drawings are taken from lithographic illustrations accompanying the report from the Sanitary Commission already quoted.

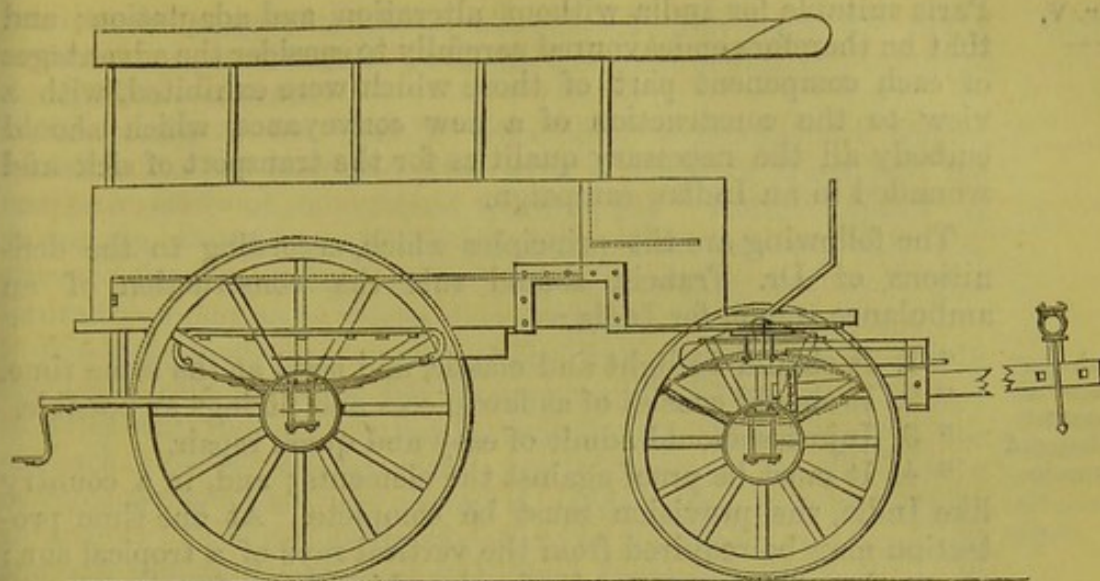


Fig. CLXII.—Side view of Captain Currie's Indian Ambulance Wagon.

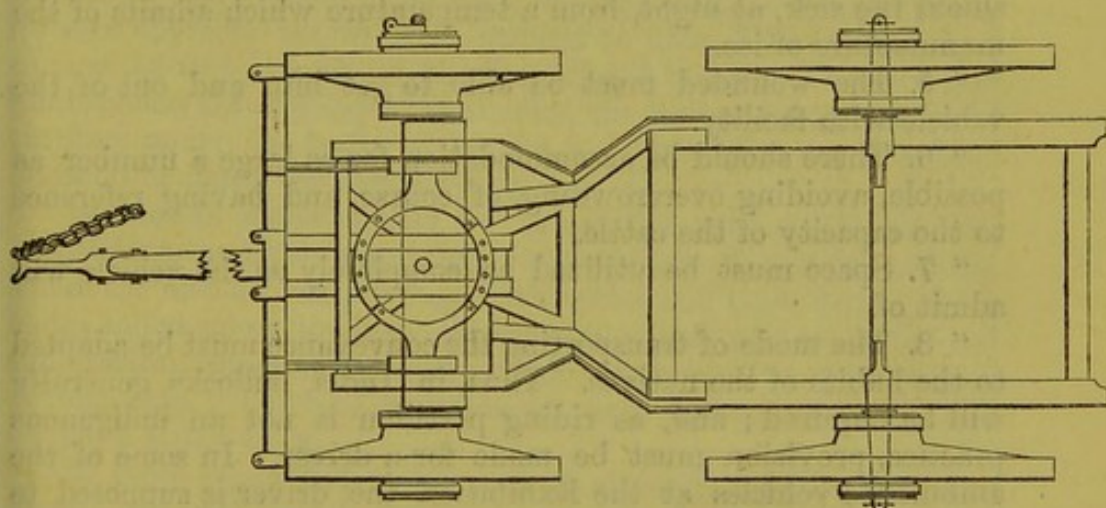


Fig. CLXIII.—Plan of Capt. Currie's Indian Ambulance Wagon.

Dr. Francis' proposed ambulance wagon for India.—This wagon, proposed for use in India, has been designed and modelled by Surgeon-Major C. R. Francis, of H.M.'s Bengal army. This officer made the hospital equipments at the 1867 Universal Exposition of Paris a subject of special study, with a view particularly to ascertaining their suitableness for ambulance service in India. The result of these observations Dr. Francis published in a quarto pamphlet, illustrated by drawings of several of the articles which had particularly attracted his notice.*

With regard to sick-transport carriages, Dr. Francis mentions that he could not find any single one in the collection at

Origin of Dr. Francis' proposed ambulance wagon for India.

* "An inquiry into the suitableness of certain Articles of Hospital Equipment for India. By Surgeon-Major C. R. Francis, M.B., Her Majesty's Indian Army, Bengal. Rochester: W. T. Wildish, 1867."

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Paris suitable for India without alteration and adaptation; and that he therefore endeavoured carefully to consider the advantages of each component part of those which were exhibited, with a view to the construction of a new conveyance which should embody all the necessary qualities for the transport of sick and wounded in an Indian campaign.

The following are the principles which, according to the definitions of Dr. Francis, should rule the construction of an ambulance wagon for India:—

Essential
qualities of a
sick-transport
wagon designed
for service in
India.

“ 1. It should be light and elastic, and solid at the same time.

“ 2. It should consist of as few pieces and fittings as possible.

“ 3. Injuries should admit of easy and quick repair.

“ 4. It must be proof against the elements; and, in a country like India, the provision must be complete. At one time protection may be required from the vertical rays of a tropical sun; at another from a torrent of rain which, in a few hours, will cover the ground to an extent of four or five inches; and, in the cold weather, in the upper provinces, it may be necessary to shield the sick, at night, from a temperature which admits of the manufacture of ice.

“ 5. The wounded must be able to get into and out of the vehicle with facility.

“ 6. There should be accommodation for as large a number as possible, avoiding overcrowding, of course, and having reference to the capacity of the cattle.

“ 7. Space must be utilized as completely as the vehicle will admit of.

“ 8. The mode of transporting the conveyance must be adapted to the habits of the natives. Thus, in India, bullocks generally will be required; and, as riding postilion is not an indigenous practice, provision must be made for a driver. In some of the ambulance vehicles at the Exhibition the driver is supposed to sit amongst the sick on the front seat; but, as this arrangement would be manifestly objectionable in India, and for other reasons, I have provided him with a separate seat, as in the original ambulance wagon, sent by Locati, of Turin, to the Exhibition—the wagon which was characterised by the ‘*Société de Secours aux Blessés*’ as a ‘*type modèle*.’

“ 9. The vehicle should be well supplied with good water, with medical comforts, and with the means of sustaining life for a limited period.

“ 10. It should carry a medical subordinate.”

Only sitting
patients to be
carried in
wheeled
vehicles in
India.

In designing his ambulance wagon, Dr. Francis also starts on the principle that men badly wounded, and therefore requiring a recumbent position, should continue to be conveyed in dhoolies (for which number, it is presumed, a sufficient proportion of dhooly bearers may still be obtained); while those able to sustain a sitting position should be conveyed in wheeled conveyances. This is an arrangement which appears to be advocated by not a few

who have thought much on the subject; and there are many arguments in its favour, so far as the transport of sick and wounded in India is concerned.

The model of Dr. Francis' ambulance sick-transport wagon, which is on the omnibus plan with a coupé in front, and not unlike in many of its external features the "*voiture hôpital*" of Locati, is, therefore, on the principle above named, only constructed for the carriage of patients in a sitting position. This limitation enables the mechanical details to be very simple.

The seats inside are arranged for five patients on each side, the coupé seat in front for four patients. There are also two shifting seats behind, similar to those in the Locati wagon, one on each side of the entrance; one of these is intended for a medical subordinate, the other, if needed, for a soldier slightly wounded. Thus the accommodation is for fifteen patients and one attendant; there is also the seat for the driver, making 17 persons in all to be carried.

Construction
and measure-
ment of Dr.
Francis'
proposed
ambulance
wagon.

The dimensions are as follows:—Length of body, 10 feet; width, $5\frac{1}{2}$ feet; length from back of coupé seat to the extremity forward, $3\frac{1}{4}$ feet; height from ground to floor, 3 feet; from floor to roof, $5\frac{3}{4}$ feet; depth of the imperial, 9 inches. The fore and hind wheels are of unequal diameters, the former being small and turning under the body, which for a certain distance has been lessened in depth for this purpose.

The roof is made double, for protection against the sun, for ventilation, and for admitting the stowage of certain articles. There are also canvas awnings at the sides and back, arranged for being rolled up or lowered at pleasure, which act as additional sun-shades; these curtains are made waterproof as a protection against rain. The roof is prolonged over the coupé, and is also screened at the sides.

The space below the coupé seat is divided into two compartments, one half containing an iron tank for water, capable of being removed to be cleaned, with its iron stop-cock projecting at the side of the vehicle; the other half occupied by a drawer containing medical comforts. The seats of the interior are also made into lockers for the stowage of sundry articles.

The sides of the vehicle are formed of wooden panels, with glazed windows; these panels can be opened at the middle, and folded backward, so as fully to expose a great portion of the interior. A double step is placed at the side of the vehicle in this situation. The transverse seat of the coupé is only divided from the longitudinal seats in the interior by a bar, which forms a support for the backs of the patients in front, and is removable at pleasure, so that the communication between all the seats is easy, and there is no interruption to free ventilation. The regular entrance is by two folding doors at the back of the vehicle. A double step leads to this entrance.

The general design of Dr. Francis' wagon is illustrated in the following Drawing.

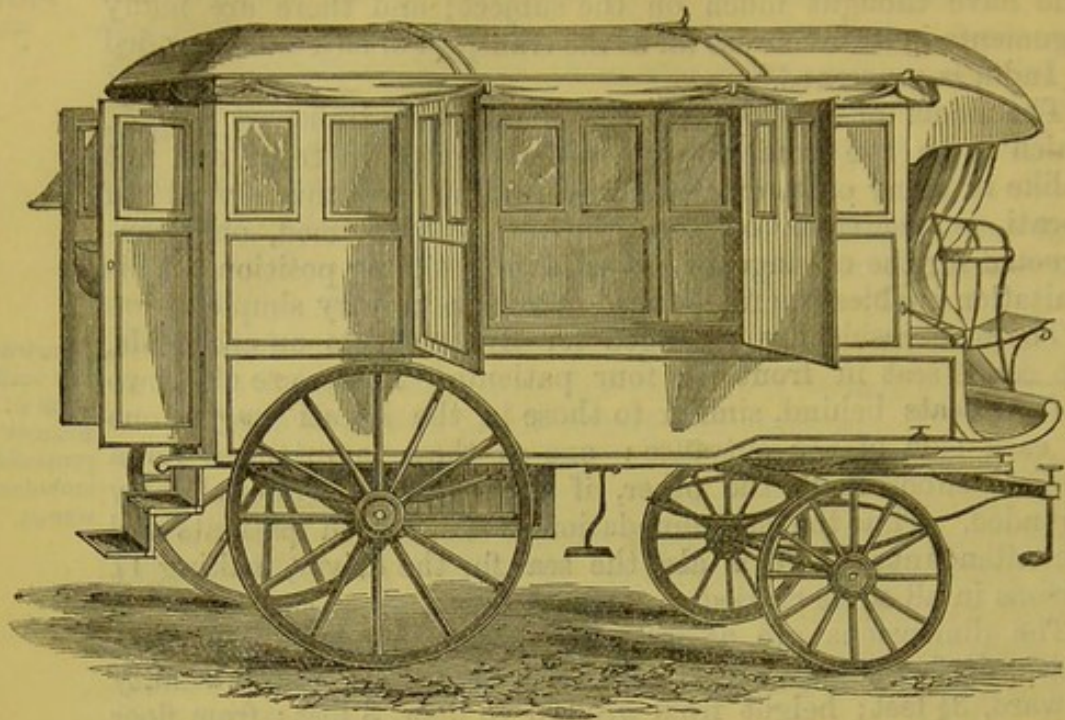


Fig. CLXIV.—Sick-transport Wagon, proposed by Surgeon-Major Francis, for use in India.

Observations
on the proposed
ambulance
wagon of
Dr. Francis.

I had the opportunity of examining the model of the carriage under description. The necessary qualities of ease of motion, protection against extremes of temperatures, whether heat or cold, of aeration, facility of ingress or egress, means of attention to patients, provision for their wants as regards water, surgical and medical materials, stowage of arms and accoutrements, ease of turning in narrow roads, &c. seemed to be well provided for in it.

Objections may be raised to the employment of glazed windows in a vehicle intended for use in the field. The reply of Dr. Francis is that he has contrived his wagon as much for a moving hospital as for a transport vehicle for the field, for the accommodation of patients who are required to be removed long distances for periods extending over many days together, a necessity which constantly arises in India, and that open or canvas sides would afford insufficient protection for sick or wounded men at night in many parts of the country during the cool season. It is not possible to estimate with any exactness from a model what will be the weight of a full sized vehicle constructed on the same design; and, after all, the practical value of a sick-transport conveyance must to a great extent be determined by its possessing qualities of lightness combined with sufficiency of strength, as well as proper kind and amount of accommodation. Dr. Francis estimates the weight at about 1,800 lbs, the wagon being built of native wood. This weight, with the additional weight when loaded, would certainly prove too great for the power of draught for which the vehicle has been designed, two

bullocks, even at the rate of two or three miles per hour. The lowness of the fore wheels would also greatly militate against its passage over such roads as are met with in some parts of India. Various methods of rendering the wagon lighter, and of adding to the leverage of the fore wheels without destroying the leading principles on which the vehicle has been designed, will probably suggest themselves if the construction of a full sized pattern be approved to be subjected to the direction of a committee in India. With the exception of the particular points just named, the plan seems to combine the chief qualities requisite for a good ambulance conveyance for patients who are to be moved in a sitting position in India. The conveyance has not been designed for transmission on board ship as British ambulance conveyances have to be, but for India this quality of portability is not essential, any more than it is for carriages intended to be used on the continent of Europe.

Spring wagon in use during the Peninsular war.—I am not aware that any record exists of the construction of these wagons, but a great amount of concurrent testimony confirms the fact of great inconveniences having been experienced from their cumbersome size and weight. They were drawn by four horses. Each wagon was calculated to carry seven or eight men sitting, but would only accommodate two men requiring a recumbent posture. There was a strict prohibition against these vehicles carrying stores, or anything but the sick men, their kits, and fire-arms.

Weight and limited accommodation of the Peninsular spring wagon.

British ambulance wagon (Regulation pattern).—This conveyance is styled in the Army Medical Regulations "ambulance car,"* in the Military Store Department and in the Military Train it is entitled "ambulance wagon." The ambulance wagons now in charge of the Military Train are in all respects the same as the cars referred to in the Medical Regulations as forming part of the field hospital equipment of battalions, brigades, and divisions in time of war.

The unfavourable reports received from the Crimea concerning the wagons and carts sent out to that country with the Hospital Conveyance Corps in the year 1854 have been already referred to elsewhere. It has also been mentioned that in the month of April 1855, Lord Panmure, who was then Secretary of State for War, directed a committee† to consider and report upon the merits of certain ambulance conveyances which were proposed to be adopted as substitutes for those which had then turned out to be failures. This committee having met at the Royal Carriage Department, Woolwich, inspected among other conveyances submitted to them, two hospital wagons for carrying eight

History of the present pattern British sick transport wagon.

* Med. Regs. p. 76.

† The constitution of this committee has been referred to at page 154.

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Pattern with
india-rubber
springs first
adopted.

wounded men each, viz., six sitting and two recumbent, and only differing from each other in the springs and mode of suspension. One of the wagons was supported on steel springs. This vehicle weighed 12 cwt., being nearly 10 cwt. lighter than the wagons which had been sent with the hospital conveyance corps to the Crimea; the other wagon was fitted with Fuller's india-rubber springs, and weighed only 11 cwt. each, or nearly 11 cwt. lighter than the original Crimean wagons.

The kind of wagons which was fitted with Fuller's india-rubber springs was chiefly recommended. "Although these wagons may not prove so easy for badly wounded men," the Committee remarked in their report, dated May 7th 1855, "as those on steel springs, still considering the stretchers are also on india-rubber springs, the Committee consider them to be suitable for the majority of cases, and also to possess the advantage of accommodating a good many men; and having further ascertained that no four-wheeled vehicles of a lighter description can be constructed without a material sacrifice of strength absolutely necessary to enable them to withstand the wear and tear of field service, the Committee approve of these wagons." The form and construction of the india-rubber spring known by the name of "Fuller's spring," which for some years after the Crimean war was the kind of spring employed in the sick-transport vehicles constructed at Woolwich, is shown in the subjoined sketch.

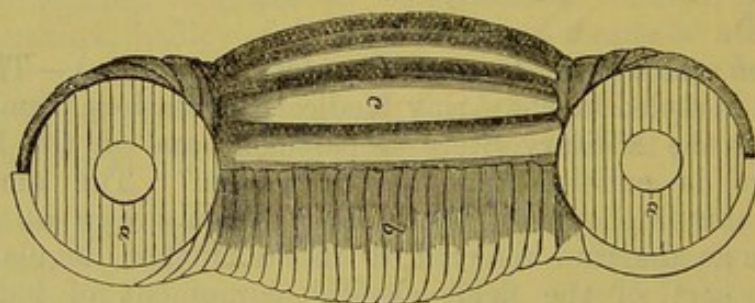


Fig. CLXV.—Fuller's india-rubber spring. *a a*, metal rings; *b*, leather casing; *c c c*, india-rubber strands, half the leather casing having been removed to expose them to view.

The fore wheels were at that time smaller than the hind wheels, and the Committee recommended as an improvement in regard to lightness of draught and facility of movement that higher fore wheels should be substituted for them. This was afterwards done, and an appliance, known by the name of Jacob's lock, was added to lessen the inconveniences resulting from the use of the high fore wheels in turning the wagon.

The plan of this ambulance wagon, with the fore wheels made of the same diameter as the hind wheels, is shown in the drawings which follow. They are copied from the illustrations appended to War Office Circular, No. 856, "on the Staff and Equipment for Regimental Field Hospitals."

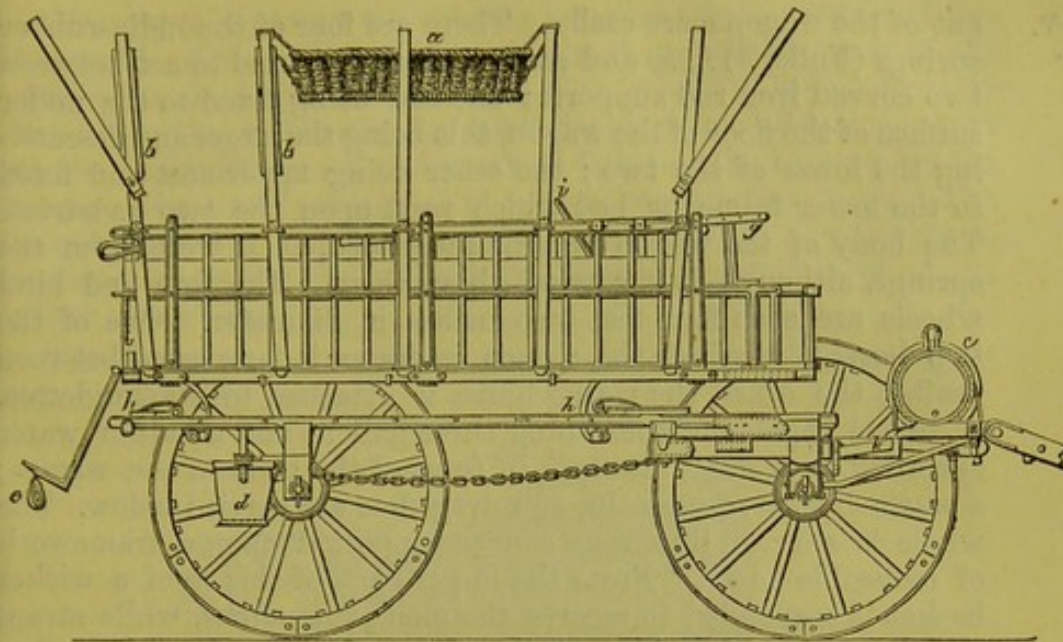


Fig. CLXVI.—Side elevation of British Ambulance Wagon (Regulation pattern). *a*, basket for knapsacks; *b*, straps for fire-arms; *c*, water barrel; *d*, water bucket; *e*, leather apron; *f*, grease tin; *g*, ladder; *h*, india-rubber suspension springs; *i*, seat with back; *k*, swingle-tree.

HALF PLAN TOP

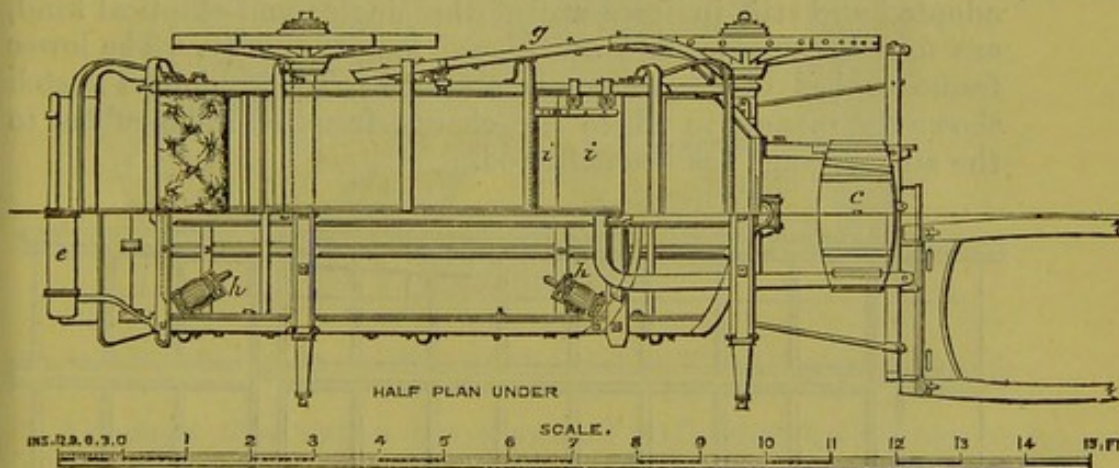


Fig. CLXVII.—Plan of British Ambulance Wagon (Regulation pattern). (The explanations with Fig. CLXVI, apply equally to the letters marked upon this figure.)

An examination of the drawings will show that the wagon is a modification of the tray-form of carriage. It is built without separate compartments for the recumbent and sitting patients. The two men carried recumbent lie upon moveable stretchers specially designed for the carriage, and occupy the central portion of the floor of the wagon; three of the men carried sitting occupy a transverse seat in front, the three others occupy a similar seat in rear. The driver conducts the vehicle postilion fashion. The stretchers, as already mentioned elsewhere,* are fitted with special springs and also with rollers to enable them to be moved in and

Construction and fittings of the British sick transport wagon.

* See page 153.

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out of the wagon more easily. There are four of the india-rubber springs (Fuller's) *h, h*, and each of these is caused to act between two curved iron rod supports; one rod being fixed to the under surface of the floor of the wagon, this being the larger and descending the lower of the two; the other being uppermost and fixed to the lower frame or bed which rests upon the two axletrees. The body of the wagon is thus suspended, as it were, from the springs, although it is carried above them. The fore and hind wheels are each four feet two inches in diameter. One of the two horses by which the wagon is drawn is harnessed between shafts; the other, the riding horse, is attached to a swingletree. A barrel capable of containing three gallons and a half of water is corded on a small platform in front of the body of the wagon; a water-bucket, grease tin, and drag-shoe are carried below. The whole is covered by strong canvas supported upon a framework of moveable hoops. From the upper part of this roof a wicker basket is suspended to receive the men's knapsacks, while straps are attached to the sides of the wagon for carrying their fire-arms.

The india-rubber springs ordered to be discontinued in 1866.

In February 1866, in consequence of the india-rubber springs having proved defective, principally as regards durability, steel springs were approved to be substituted. The springs then adopted and still in force are of the single semi-elliptical kind, are four in number, and are placed longitudinally. The lower frame or bed of the wagon is retained. The subjoined sketch shows the manner in which the change from the india-rubber to the steel springs has been effected.

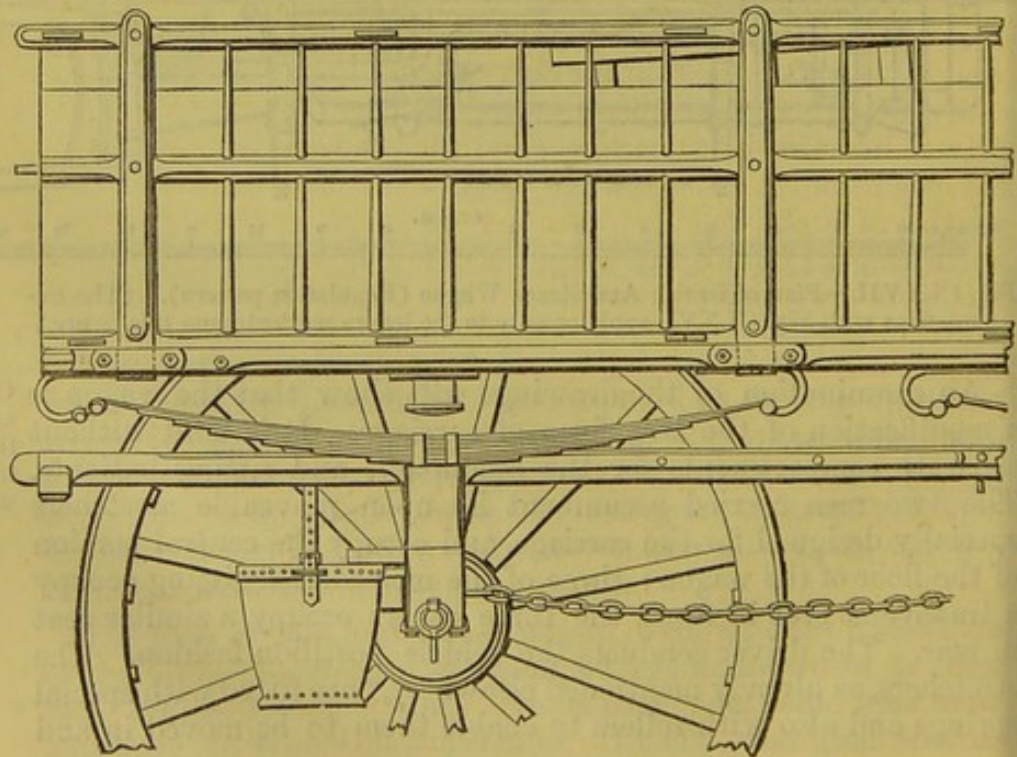


Fig. CLXVIII.—Sketch, showing the plan on which steel springs have been substituted for the india-rubber springs of the British Regulation pattern ambulance wagon.

The space between the wheels, measured from outside of tire to outside of tire, or in other words, the width of track of the wagon, is five feet five inches. The wheels are moderately dished, so that a line and plummet dropped from the upper part of the circumference of either wheel falls four inches outside the track. The nave projects six inches beyond the track. The wagon, therefore, requires a clear space of six feet five inches to enable it to pass along without touching an upright obstacle on either side of it.

The drawing which follows gives a general view of the wagon, fitted and ready for use.

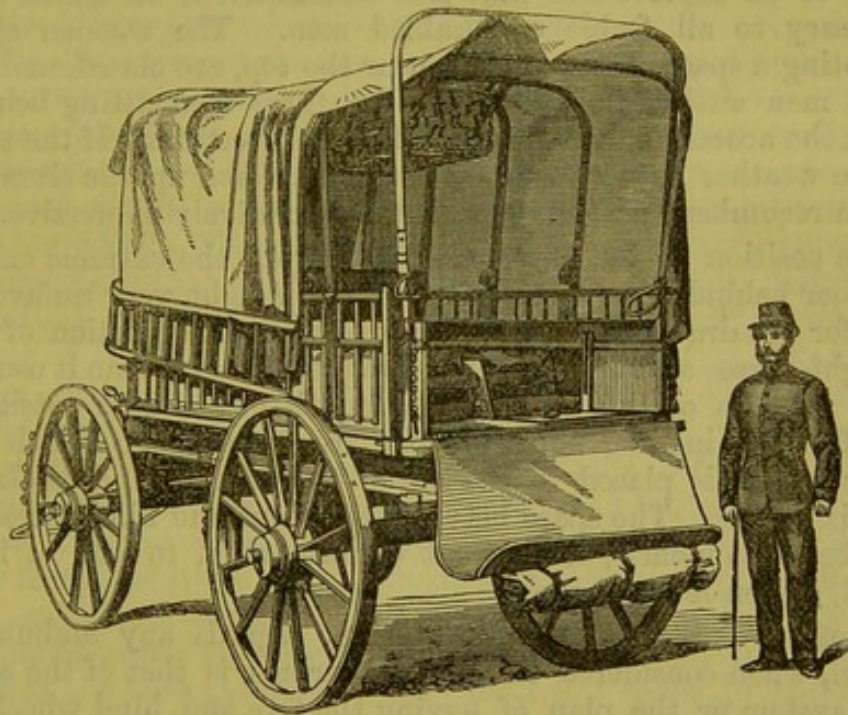


Fig. CLXIX.—Perspective view of the British Ambulance Wagon (Regulation pattern).

Although this wagon has answered well enough the tests to which it has been subjected in England, it has not proved successful when it has been employed on service abroad. It has been sent to India, to the Cape of Good Hope, and to New Zealand, and it has not been found to answer in any of these countries. Either its weight has been found to be too great for the means of draught at command, or it has been found not to be suited to some peculiar features in the surface of the country over which it had to pass. In India, its very solidity and massiveness appeared to be the cause of parts yielding and breaking under the shocks met with in travelling. The extreme dryness to which the wood had been brought by the heat of the climate, may have also had a share in its failure. At the Cape of Good Hope, the wagons broke down under the violent concussions they were subjected to in going down the precipitous cart-tracks, and over the rocky drifts which constitute marked features

Failure of the British sick-transport wagon on being sent to India and certain colonies.

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of certain parts of that colony. At New Zealand, where they were sent to be employed on the occasion of the late war, Inspector-General Mouat, who was the Principal Medical Officer there at the time, has since informed me, that their weight and the absence of roads prevented even attempts from being made to take them into the field with the troops.

Deficient
aeration of the
interior of the
wagon.

But independently of the weight of these vehicles, which has been the chief quality reported as destructive to their usefulness when on service abroad, there are several features in their construction to which objection may justly be taken. When the wagon is loaded, the position of the recumbent patients causes them to be deprived of that free circulation of air which is so necessary to all feeble or disabled men. The wooden sides, excepting a space of four inches near the top, are closed, and the three men sitting in front, and the three men sitting behind, block the access of air from each of these directions. If the state of the weather cause the wagon to be covered up, the situation of the recumbent patients is rendered excessively oppressive.

Distribution of
weight capable
of improve-
ment.

The position of the three men sitting on the extreme end of the floor behind, places this part of the weight very unfavourably for the draught. The distance between the position of the draught-horses and the rear of the wagon, is longer than it usually is in vehicles of this class. The length of the floor outside is nine feet six inches; but from the front frame on which the water barrel is placed to the end of the floor, behind, is eleven feet six inches. The space between the front and hind wheels is two feet nine inches; from front of fore wheel to rear of hind wheel, eleven feet one inch.

Introduction of
the equi-rotal
system in sick-
transport
wagons.

Another questionable advantage as regards any ambulance wagon, when considered in all its bearings, is that of the equi-rotal system or the plan of having the fore and hind wheels of equal diameters. This system, as already mentioned, was first applied to sick-transport wagons after the failure of the wagons (Director-General Dr. Smith's, described hereafter) sent out to the Crimea with the Hospital Conveyance Corps. The last-named wagons were built with wheels of unequal size, and the difficulty that had been met with in driving them over the bad roads of the Crimea was supposed to have been partly attributable to the lowness of the fore wheels. How far this was a source of difficulty is problematical, as the badness of the roads did not arise from irregularities to be got over so much as from depth of mud to be got through; and it is in going over solid obstacles that the advantage of the extra leverage of a high wheel, as compared with that of a low wheel, is chiefly experienced.

Reasons for
introduction.

There were other motives for increasing the size of the fore wheels to the same diameter as that of the hind wheels. The system of having all the wheels of equal diameter, and that diameter being as moderate as it is with the Regulation wheels viz., 4 ft. 2 in., enables the floor and sides of the wagon to be

kept comparatively low, a point of importance as regards putting patients in and taking them out of the conveyance easily. The height above the level of the ground of the interior surface of the floor is 3 ft. 9 in. When the fore wheels are arranged for turning under the wagon, and the hind wheels are higher than the regulation wagon height, the floor of the wagon is also usually raised proportionally higher. Then there are the military advantages of the equi-rotal system: that it facilitates the manufacture of wheels, wheels of one pattern only being required; that spare wheels of only one description need be taken on service; and that it is easier and requires less time, therefore, all wheels being interchangeable, to replace one that may become accidentally disabled, whatever vehicle it may belong to.

The advantages of the equi-rotal system for a sick-transport carriage then are, that the body of the vehicle can be kept lower, that the fore wheels can over-ride obstacles in the road more easily than lower wheels, and that, in case of breakage of any one wheel, the mischief can be more readily repaired by the substitution of another wheel. The disadvantages are, however, very important, so important that they appear to outweigh the advantages just described. The most serious are, that it materially lessens the power of turning the vehicle, and that it gives it a tendency under certain circumstances, such as meeting an obstacle in the act of turning, to upset. The high fore wheels in turning are stopped at the side of the wagon; the wagon cannot be turned shorter than with the fore wheels forming an angle of 45° with its sides. This involves the necessity of a road being at least twenty-four feet in width to enable a vehicle of the length of the Regulation ambulance wagon to turn round in case of need. Moreover, if turned carelessly, or sharply, and an impediment were met with at the time the wheels were locked, it seems probable that such an accident as the whole vehicle being overturned might readily occur. With the fore wheels turning under the body of the vehicle there is no risk of such an accident occurring. This is a very important matter as regards a vehicle intended to carry sick or wounded men.

Alleged advantages of the system.

Objections to the equi-rotal system.

Some of these objections have been commented upon in the published report of the committee on the Transport and Supply Departments.*

The latest patterns of this wagon each weigh rather more than 12 cwt., viz., 1,374 lbs. This includes the cover, the two spring stretchers, and the basket to carry the men's knapsacks. It does

Weight of the latest patterns of the British sick-transport wagon.

* (Report, p. 27, par. 83.) The ambulance wagon under description is referred to in the following terms:—"The Committee are of opinion that the length (for the carriage of eight men, two recumbent and six sitting) is objectionable, and that the weight of three men seated behind is against the principle of easy draught. The Committee do not approve of the conveyance of men so seriously wounded as to require a recumbent position in the same carriage with men who are able to sit upright. The difficulty of turning the ambulance wagon, which is on the equi-rotal principle, is also a practical disadvantage."

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not include the 14 stretchers, the water barrel, and the operating table, which are to be carried in the wagon when on field service. The weight of these articles is as follows:—14 stretchers at 13 lbs. each, 217 lbs.; empty water barrel, with rope, 26 lbs. 4 oz.; operating table, 97 lbs.; total, 340 lbs. 4 oz. This increases the weight of the wagon to 1,714½ lbs. When estimating the weight for draught, the weight of the harness (a double set being 217 lbs.), the rider or driver and his kit, the load of eight patients, with their knapsacks, arms, and accoutrements, must be taken into account. The weight of the stretchers might be omitted, as they would probably be employed elsewhere when the wagon was in use for carrying sick or wounded.

Although two mules only are appropriated to this sick-transport wagon in the Regulations for Field Hospitals in the Medical Regulations, four draught animals are assigned to it in the list of equipment authorized for the Military Train by the War Office Circular, No. 947, of the 13th March 1866. Every ambulance sick-transport wagon, therefore, on service with the Military Train has four horses available for its draught in case of need, although, under ordinary circumstances on home service, for short distances, and over good roads, only two horses are commonly used. When paraded in marching order the wagon is always horsed by four horses.

The Government cost of the wagon is 63*l.* 10*s.* If to this sum be added the cost of the water barrel, bucket, operating table, and 14 field stretchers which are carried on it when equipped for field service, the price is raised to 78*l.* 9*s.* 2*d.*

New Zealand sick-transport wagon.—This was a spring conveyance introduced in 1860, during the last war in New Zealand, to take the place of the Regulation pattern ambulance wagon, which, as lately mentioned, had been found to be too cumbrous for the primitive roads opened up by the troops during the military operations in that country. It was made on the principle of an American wagon; so light that a few men would readily suffice to get it out of any difficulty it might meet with in its progress. It was capable of accommodating two men lying down, and several sitting. This wagon has been reported by Inspector-General Mouat, C.B., by whom it was introduced, to have answered admirably as a conveyance for the sick and wounded on the particular service in which it was employed, and it has been supposed by some that it might be adopted with advantage as the Regulation wagon of the British army for carrying sick and wounded in time of war.

One of these wagons, which had been built at Auckland, was sent to Netley for trial, more especially to ascertain its fitness for use as a military sick-transport carriage for general service. The trials were made under my observation, and the following account embodies the results of them. At first starting it was found that the Regulation Military Train harness was not suitable for being used with the New Zealand wagon. Some

Cost of the
British sick-
transport
wagon.

History of the
New Zealand
sick-transport
wagon.

Trials of this
wagon at
Netley, as to
its fitness for
general service.

civilian cart harness was therefore obtained, and one of the military train horses was attached by it to the vehicle.

Before, however, mentioning the results of the trials made with the wagon, it is necessary to describe its form and construction. At the first glance the body of the vehicle is seen to consist of a simple light tray mounted upon four elliptical springs. These springs are all placed at right angles to the axles upon which they rest.

Construction
and fittings of
the New
Zealand wagon.

All the fittings and appliances of the vehicle are of the simplest character. The wheels are narrow, as in most American vehicles, and are not on the equi-rotal principle. Two plain, cushioned seats with backs are made to rest upon the sides of the tray which forms the body of the wagon. They are simply laid on the tray, so that they can be taken off or shifted along the sides at pleasure. The seat in front is single, and is calculated to accommodate three persons, including the driver; the seat behind is double, having a back between the seats common to both. This last seat is calculated to accommodate six persons, three sitting on each side. The handle of a double break acting upon the two hind wheels is placed in front near the driver's seat.

The floor of the wagon is level, and affords space enough for two stretchers or two patients to be placed upon it at full length. But should the floor be used for two recumbent patients, the back seat could not be used for patients sitting, for the legs of the latter would be resting upon the patients lying upon the floor.

The wagon is therefore fitted for carrying nine persons sitting, including the driver; or three persons sitting, including the driver, as well as two recumbent.

A water barrel is slung beneath the floor of the wagon. Hoops are arched over the whole vehicle. These support a varnished canvas cover, which is divided down the middle at each end to afford openings for ingress and egress. The cover is secured by straps and buckles to iron staples fixed on the outside of the body of the cart. The wagon is designed for draught either by one horse or by two horses; in the latter case the horses must be driven tandem fashion.

The following are measurements of particular parts of the wagon:—Extreme length, including the shafts, 16 ft. 10 in.; extreme breadth, 6 ft. 6 in.; height, from ground to top of cover, 8 ft. 3 in.; outside length of tray including the foot-board, 8 ft. 3 in.; outside breadth of tray, 4 ft. 10 in.; outside depth of tray, 1 ft. 3 in.; inside measurement of tray 7 ft. 1 in., by 3 ft. 8 in., by 1 ft. The height from the floor of the tray inside, to the centre of the cover, is 4 ft. 10 in. The hoops, three in number, are 3 ft. 2 in. apart. The diameter of the fore wheels is 43 inches, that of the hind wheels, is 52 inches. The drawings which follow sufficiently illustrate the general appearance and construction of the wagon just described.

Measurements
of the New
Zealand wagon.

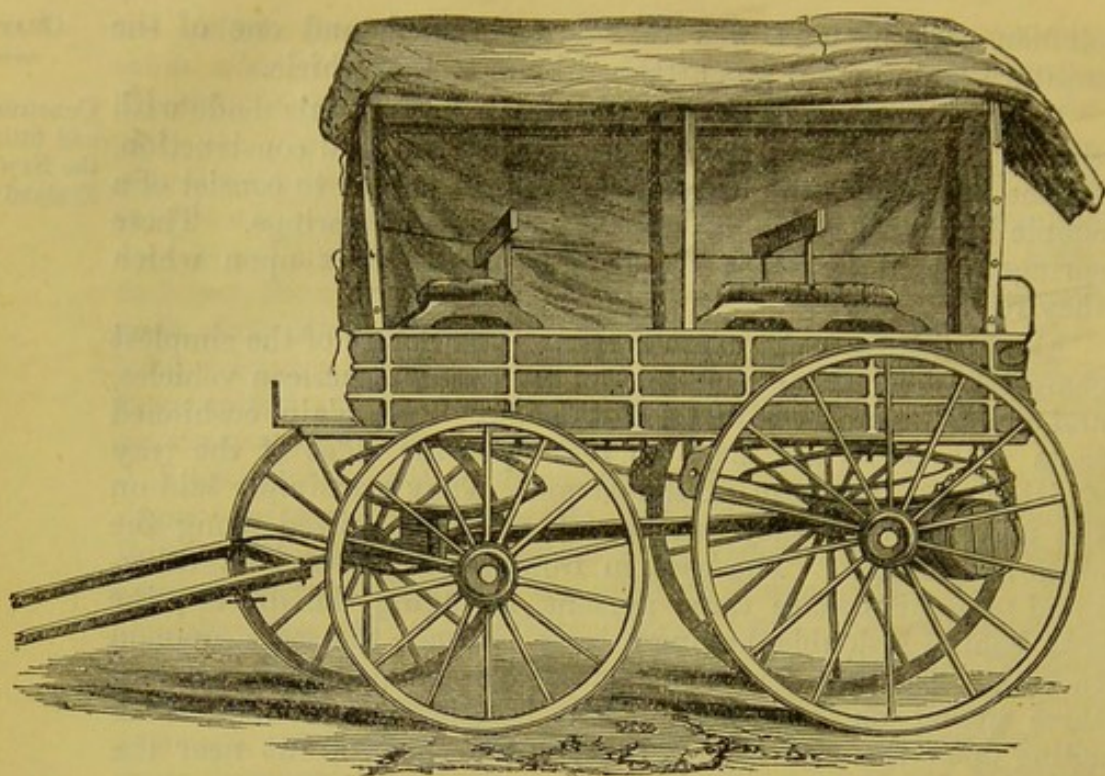
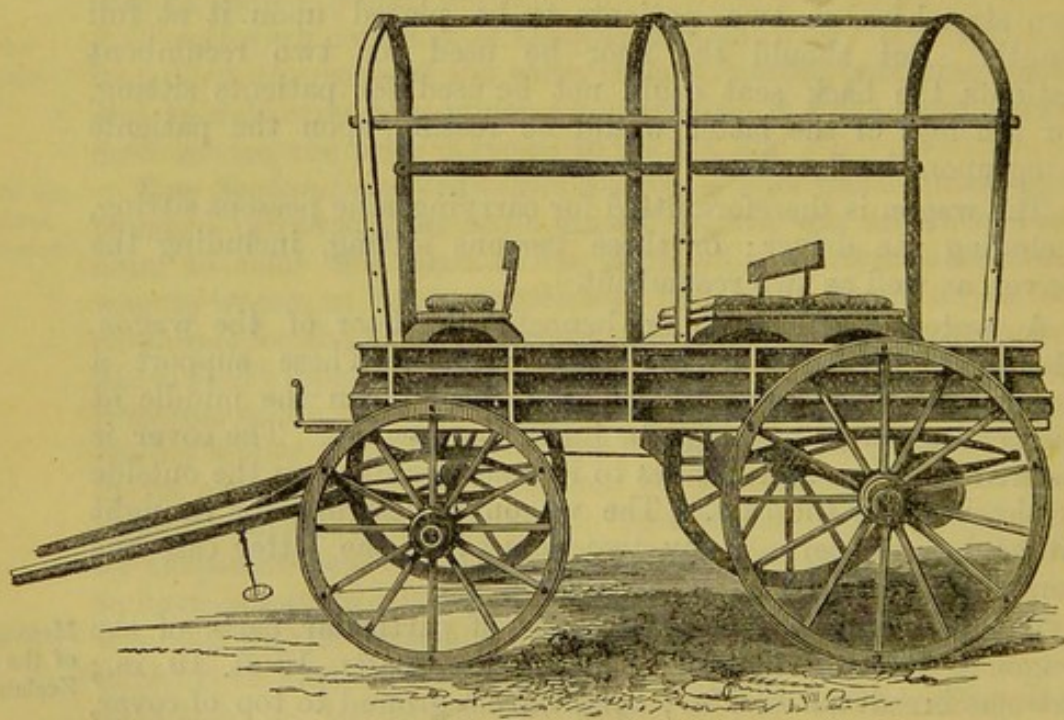


Fig. CLXX.—Perspective view of the New Zealand Ambulance Wagon, with and without its cover.



Observations on
the New
Zealand sick-
transport
wagon.

The leading feature of this wagon is its lightness, and this is undoubtedly a very great advantage. Its weight is about 9 cwt. It is also simple in construction, well and strongly built, and is of easy draught. Another good quality is that owing to the lowness of the sides, when the cover is not used, the patients carried up on it, whether recumbent or sitting have a full amount of fresh air. The wagon would not answer for receiving patients lying on the ordinary Regulation stretchers, there being nothing pre-

pared to mitigate the hardness of the floor ; but this inconvenience is readily met by putting straw, fern, hay, or any soft medium, upon the floor before laying the stretchers upon it. The moderate height and ready access to the floor causes it to be easy for wounded men whether lying down, or able to sit up, to be put into, or taken out of the wagon. These are its chief advantages ; the objections which occurred on examining the vehicle in respect to its fitness for general use in the British service were the following :—

1. No provision is made for the vehicle turning in a narrow road. It was found that the least space the wagon could turn in, when only one horse was attached to it, was nearly nine yards. In a difficulty, however, by taking out the patients, it could be lifted up by three or four men, owing to the lightness of the vehicle, and in this way the turning could be facilitated.

Want of means for turning in narrow roads.

2. The system of placing two sets of double elliptical springs in line does not appear to be so good for sick-transport vehicles as the system of supporting it on platform springs, or the system of slinging the body of a wagon from springs. The New Zealand wagon was found to be very jolting, owing apparently to the arrangement of the springs, when passing over ruts or uneven ground ; and more jolting, when passing over well made roads, than the Regulation ambulance wagon.

The springs of the New Zealand wagon.

3. The impermeable canvas cover, owing to the manner in which it is secured to the outsides of the tray, could not be kept closed in bad weather, not only on account of there then being no provision for ventilation of air within, but also because the front seat would be covered, so that the driver could not see to drive. In such a case, the only resource for the driver would be to walk and lead his horse. If the cover be opened and turned back at the ends, its purpose of protecting the interior from rain would be proportionably interfered with, and no arrangements were found for fastening the ends of the cover back.

The wagon-tilt

4. Other reasons were met with which rendered it necessary to remove the hooped cover altogether during the trials. It was so contracted that the number of persons which the wagon was designed to carry in a sitting position, could not remain within it with any comfort, for the men at the ends of the seats could not sit upright. It was also extremely hot and close, in warm weather, almost insufferably so, when the cover was closed at the sides, and there was no provision for raising them without taking the cover off altogether.

Contracted dimensions of the tilt.

5. The position of the driver, on the front seat between two patients, renders it very difficult for him to have proper command over the horse.

Position of the driver.

6. No provision is made for the carriage of kits, firearms, and accoutrements. They would have to be laid on the floor of the cart, and a certain amount of risk of damage would always attend this mode of disposing of them.

Absence of place for stowage of kits.

7. It is not likely, notwithstanding the lightness of the vehicle, that it could be drawn by a single horse for any long distance,

Draught of the New Zealand wagon.

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Portability of
the New
Zealand wagon.

Concluding
remarks on the
New Zealand
wagon.

History of the
sick-transport
wagon, adopted
for the Cape of
Good Hope.

certainly not over heavy or hilly roads, with the complement of patients it is designed to accommodate. One of the best horses of the Military Train could scarcely draw the wagon when nine men were in it, along a road having a moderately steep incline. The number of patients the vehicle is ostensibly calculated to carry must be reduced, or the addition of a second horse would be usually necessary; and in the movement of European armies, it is generally held to be objectionable to increase the length of columns by attaching horses tandem-fashion to any description of transport vehicles.

8. Although the wheels, springs, break, hoops, and cover are capable of being taken asunder and partly packed within the body of the wagon for stowage, more time is necessary for doing so as well as for putting the vehicle together than would be desirable on active service. The diameter of the hind wheels is too great to admit of them being placed within the body of the vehicle with the other parts.

The lightness and simplicity of this wagon are such valuable qualities, that it may readily be understood how it found favour when used in so partially civilized a country as New Zealand. The general surface of the country in most parts of Europe, and the circumstances of European warfare, are so different from those which were experienced by the British troops engaged in New Zealand, that it by no means follows that a mode of transporting sick which was there found most suitable, should also be the most serviceable for the general wants of the British army. Some of the disadvantages, which have been noticed in the New Zealand wagon might be removed by alterations in the details of its construction without interfering materially with the main features of its design; but there would still remain important points unfitting it for general service, and to remove these would involve the necessity of a change in the scheme of the whole conveyance.

Cape of Good Hope sick-transport wagon.—The experience at the Cape of Good Hope well illustrates the necessity which occasionally exists for conveyances of special construction being provided to suit particular colonies. Some of the Regulation ambulance wagons built in this country, which at least appeared strong and solid enough to be turned to use in any country with practicable roads, were sent out for service to the Cape of Good Hope, but, after trial, they were reported to be useless. They broke to pieces under the severe shocks to which they were subjected in travelling over the peculiarly rough and precipitous roads of that colony. In consequence, in March 1861, a Board of officers was assembled at King William's Town to consider the description of sick-transport conveyance which would be most suited for the country of the Cape. The Board, after full consideration, came to the conclusion that the best vehicle they could recommend for ambulance purposes was the common cartel, or wagon of the country, with certain modifications. The cartel was to be provided with inside fittings in the shape of cots and seats; direct concussion and lateral motion were to be pre-

vented by such means as spiral springs, elastic bands, and other contrivances; and the whole carriage was to be furnished with a covering to shelter the occupants from wind and rain.

That a judgment may be formed of the difficulties which may be experienced in devising a suitable sick-transport conveyance in consequence of special features presented by the country in which it is to be used, I subjoin some remarks by Inspector-General Taylor, C.B., on the travelling and state of the roads in the interior of the Cape colony, at the time the Board just mentioned was engaged in discussing the best means of conveying sick or wounded troops over them. They were written when Inspector-General Taylor was the principal medical officer at that station, and just after he had been on a tour of inspection to the frontier posts. The following are the remarks I refer to:—

Nature of the country over which sick-transport wagons have to pass in the Cape colony.

“The roads through the interior of the colony are rarely other than simple cart tracks from one station to another. When the track is at any part worn so irregular as to be impracticable, a supplementary track is made and so on. The surface soil is generally scanty, and, if the irregularities of the rock beneath, and the boulders plentifully scattered, do not from the first make the track a very rough one, the weather acting on the surface soon brings about that result.

Inspector-General Taylor's experience.

“Generally between every two stations the bed of a river has to be crossed once or twice, or even as often as five times; such places are called ‘drifts.’ The wheels have generally to pass over large bare boulders in these places, rendering the passage very trying, not only to the wood and ironwork of the vehicle, but also to the safety and soundness of the passengers. Such is the extent and state of the roads, that it does not appear to me they are for many generations likely to be improved so that a severely wounded or sick man can be conveyed over them in any wheeled vehicle without much agony. I was furnished by the Commissariat with their best description of two-wheeled and spring mule-cart, and, though along the edge of the roof on either side pads are fixed for the head to jerk against, yet the oscillations of the cart were frequently so violent that the buffeting was very unpleasant. The neck too was frequently sprained by the violent concussions the cart was subjected to even with careful driving. Such a conveyance, I was satisfied, would be intolerable to any but a sound man. The mules that I saw were much too small for the chairs or litters like those used in the Crimea.”

Inspector-General Taylor thought that the plan recommended by the Board before mentioned, though not likely to prove unobjectionable, was yet the least painful mode of transport practicable under the existing circumstances of the country, and he agreed in recommending that a trial of it should be made. This recommendation was approved, and has been carried into effect. The following is an account of the construction of the conveyance which was eventually adopted. It is abridged from a descrip-

Construction of the sick-trans-

CHAP. V.

port convey-
ance adopted
for the Cape of
Good Hope.

tion, illustrated by photographs, which Inspector-General Dr. Lawson, who succeeded as principal medical officer at the Cape colony, was kind enough to send me in the spring of 1866.*

The conveyance when complete for use is composed of a frame supporting the seats and litters, and an ordinary bullock-cartel within which the framework is suspended. On removing the frame with its seats and litter the wagon is as suitable as before for carrying ordinary loads. It is to the construction of the litter-frame that the chief attention has been given, more particularly with regard to its mode of suspension, and the best disposal of the space afforded by it for the carriage of patients.

The frame is made of wood, 9 feet 7 inches long, exclusive of footboards, and 3 feet 4½ inches wide. It consists of two side pieces and one shorter centre piece, these being connected by two cross pieces, nearly two feet apart, at each end. Upon this frame are placed two stretchers along the middle portion, and at each end a seat for two persons sitting. Each stretcher is six feet long exclusive of the handles, and twenty inches broad; each seat sixteen inches broad. The seats are provided with backs and footboards, as well as with leather cushions on each side to keep the occupants clear of the sides of the wagon. The stretchers are also each fenced on the outer side by pieces of wood fastened along their upper surfaces, so as to prevent the men lying on them from rolling against the side of the wagon when much inclined; while between them, fixed simply by iron pegs passed into holes in the centre longitudinal piece of the frame, is a padded upright piece of wood for the purpose of keeping the occupant of one stretcher from rolling against the occupant of the other stretcher. As thus arranged the frame is able to support two men recumbent and four sitting.

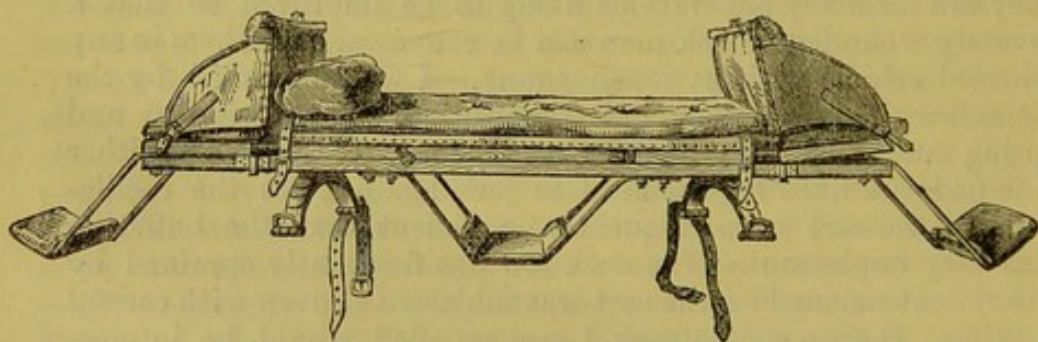


Fig. CLXXI.—Side view of the sick-transport frame prepared for suspension in the common cartel, or bullock wagon, of the Cape of Good Hope, with stretchers and seats fixed. One strap only is shown in each spring.

* The Commissariat store-transport wagons used at the Cape of Good Hope are also special wagons made from local designs at Graham's Town, in Caffraria, and not wagons suitable for general service. They are drawn by mules, and they travel from six to eight miles an hour. Commissary-General Drake has mentioned that one of these wagons went from Graham's Town to Port Natal and back, about 650 miles each way, without any injury whatever. See evidence by Commissary-General W. H. Drake, C.B., before the Transport Committee, on the 27th of Nov. 1866.

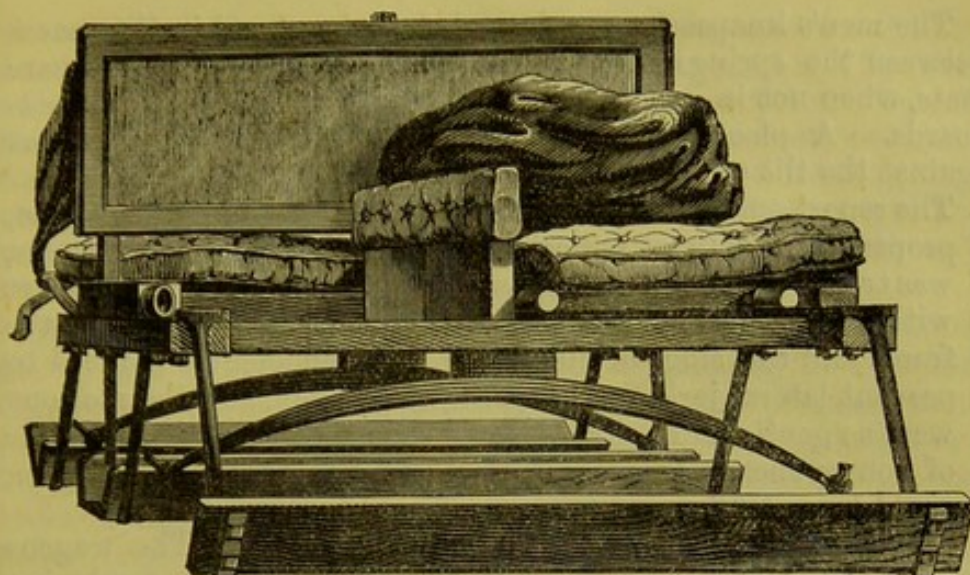


Fig. CLXXII.—End view of the ambulance frame; one stretcher being removed, and the straps taken out of the springs.

If it be desired to carry four men sitting, instead of the two recumbent, arrangement is made for this being done in the following way:—The stretchers and their cushions are removed, the central upright partition between them lifted out of its holes, and these are slung up against the inside of the tilt of the wagon. Two spare seats which, when not required, are carried beneath the frame, are now fixed in the place which was occupied by the stretchers, facing inwards. The occupants of these seats use a footboard common to both (*see* Fig. CLXXI.), which is fixed beneath the middle of the frame. Their legs pass between the side and central longitudinal pieces of the frame. When thus arranged, eight men can be carried sitting, four in the middle, and two, as before, at each end.

The framework, with its seats and stretchers, just described, is suspended from the sides of the cartel, by leather straps attached to the ends of two steel semi-elliptical springs fixed beneath the frame. The springs are fixed at their centres to the two cross-pieces nearest to the middle portion of the frame, as shown in Fig. CLXXI. The manner in which the strap is attached to the spring is shown in the following sketch:—

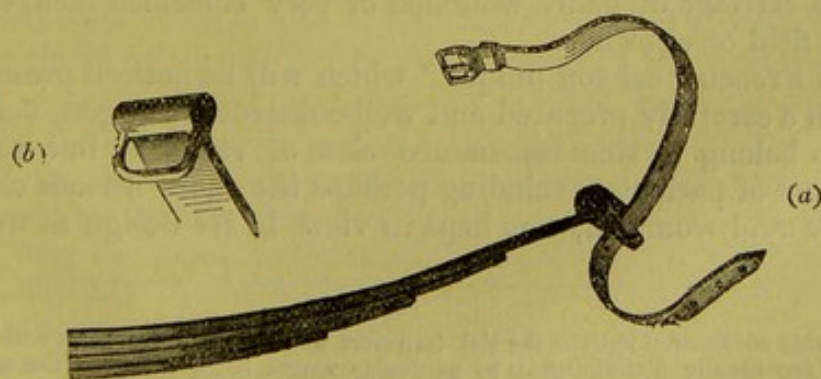


Fig. CLXXIII.—(a), end of spring with suspension strap attached; (b), loop of spring through which the strap is passed.

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Result of trials
with the Cape
sick-transport
wagons.

The men's knapsacks are intended to be placed in the spaces between the springs and the central footboard; the two spare seats, when not in use, between the springs and the two end footboards. A place is arranged for slinging the men's fire-arms against the tilt of the wagon inside.

The report sent with the description states that :—" The frame, properly slung in a bullock wagon, and carrying six persons, was tried over rough ground, such as would be occasionally met with on service at the Cape. When the play between the frame and the sides of the wagon was sufficiently reduced to prevent lateral jerking, the springs acted well, and the motions were as gentle and easy as could be expected with any mode of conveyance over such a surface; on smooth ground, nothing could be easier."

General obser-
vations on
wagons de-
signed for
carrying either
sick and
wounded or
stores.

Sick-transport wagons of the second category.—The wagons included under "(Bb)", four-wheeled conveyances, combining particular adaptations to fit them both for the carriage of sick and for the transport of stores,* remain to be noticed.

The number of wagons belonging to this category is very limited. As a general rule, the wagons which are specially prepared for the reception of sick and wounded men have to be provided with so many fixtures and appliances, that they can not readily be dismantled, so as to leave the interior clear for the reception of stores, having due regard, at the same time, to the convenient stowage and proper security of those parts which ought to be at once forthcoming when required for the use of the sick. Moreover, certain details of construction, the adaptation of the springs for example, interfere with the double employment of these vehicles for carriage of light and heavy burdens. Ambulance wagons are, therefore, usually found of two distinct forms, sick-transport wagons and store-transport wagons; * each kind specially constructed for the particular service in which it is destined to be employed. Some wagons are so primitive in construction, that they may as well be employed for the carriage of stores as for the carriage of sick; but these examples can scarcely be regarded under any aspect as sick-transport vehicles, for they are destitute of the particular adaptations which are almost essentially necessary to make them suitable conveyances for the carriage of badly wounded or very enfeebled men, either in the field or elsewhere.

The French "caisson unique," which will be noticed presently, though a carefully prepared and well-constructed wagon, may be said to belong to this last-named class of vehicles; but as the transport of patients, excluding perhaps the more serious classes of sick and wounded, was kept in view in its design as well as

* Among continental nations the sick-transport and the store-transport ambulance wagons are usually distinguished by particular names being given to the wagons themselves. Thus the French designate sick-transport wagons as "*voitures d'ambulance*," while store-transport wagons are called "*fourgons d'ambulance*." We have no such distinguishing names for these vehicles.

the transport of stores, it is included under the second category. In Director-General Smith's ambulance wagon, presently described, the removal of the fittings prepared for the carriage of the sick, and the conversion of the vehicle into a store-transport conveyance, were provided for by special contrivance and certain adaptations, which would have been unnecessary had the wagon been intended only for use in transporting sick and wounded.

Director-General Smith's ambulance wagons.—These were the wagons which were sent out with the brigade of the Hospital Conveyance Corps at the commencement of the Crimean campaign, to which allusion has been made elsewhere. The following description of these conveyances was published by the Director-General himself in the departmental memorandum before quoted on the "Personnel and Matériel of the Medical Department of the Army of 30,000 men ordered to Turkey under Command of Lord Raglan."

Director-General Smith's description of the sick-transport wagons sent to the Crimea.

"Each wagon," writes the Director-General, "is capable of carrying from the field, or from the field hospitals to hospitals in the rear, ten persons, namely, four badly, and six slightly wounded men, each in a separate compartment. By this arrangement every individual will be insured against inconvenience or injury from his immediate neighbours, which would, did no partitions exist, certainly prove most detrimental, especially to weakly and severely wounded men, who might have to be transported along an irregular, broken, or sloping road, or over a country where no roads exist.

"The slightly wounded, as will be seen on reference to the illustrations, are accommodated towards the front of the carriage, placed back to back, separated from each other by wooden partitions, and prevented from falling outwards by each compartment being provided with a chain covered with leather, to be passed across the chest when the seat is occupied, with a view as well to safety as to support. The badly wounded, extended on elastic stretchers, six feet six inches long, and two feet wide, are placed behind, and, as already stated, in separate compartments, into or out of which the stretchers glide with facility, from their being provided with rollers. Each of the compartments is fitted with a ventilator from end to end, which can be closed or opened by the person lying on the stretcher.

"A waterproof roof, supported on wooden hoops, covers the body of the carriage, and under it is a depository for fire-locks, knapsacks, caps, accoutrements, &c. There is also under the seats for the slightly wounded men a large capacious locker, in which may be placed water-sacks (for barrels soon become useless, especially if exposed to weather and sun), bedding, and other articles, which the medical officers of the army may consider as likely to be useful; and under the hinder parts of the wagon is a convenient box, in which medicines, instruments, &c. can be carried, if required.

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"At the back parts of each vehicle there are two iron brackets, which fold down to support a stretcher, and so afford the means of forming a convenient table. This plan I from the first preferred to one which was strongly urged on me, namely, to form a table by placing a stretcher across two panniers.

"In the event of the Flanders wagons intended for the carriage of bedding, stores, &c., not proving sufficient for the purpose, the wagons intended for the transport of sick and wounded are capable of being quickly dismantled internally, and made available to supply the deficiency."

The following are copies of the illustrations to which reference is made in the foregoing description. They show with sufficient clearness the plan of construction of the wagon and the manner in which the patients are intended to be carried. Each wagon was drawn by four horses, and was conducted by two men riding and driving postilion fashion.

Failure of the
Crimean sick-
transport
wagons.

These wagons proved a failure from several causes, but a great deal of obloquy was thrown upon them which they did not deserve. In a French account of these conveyances the plan of carriage adopted was called a painful method of transporting sick soldiers, which it certainly was not, when the horses employed were equal to the power of draught demanded, and the drivers were sufficiently skilled in their duty. The sick* were said by the same critic to be deprived of the benefit of pure air and daylight; but as each compartment was fitted on one side with a jalousied shutter extending its entire length, and on the other was only separated from its fellow compartment by an open trellis-like frame, the interior could be very fairly aired and lighted whenever considered desirable. Its weight

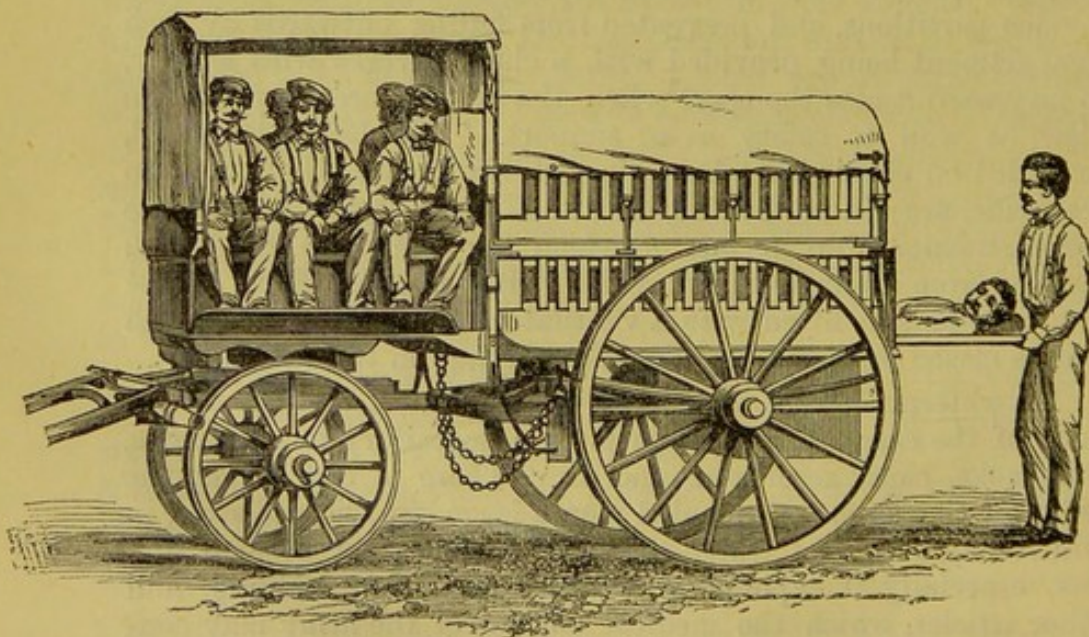


Fig. CLXXIV.—Side view of Director-General Smith's Sick-Transport Wagon.

* "Moniteur de l'Armée," 20th October 1854.

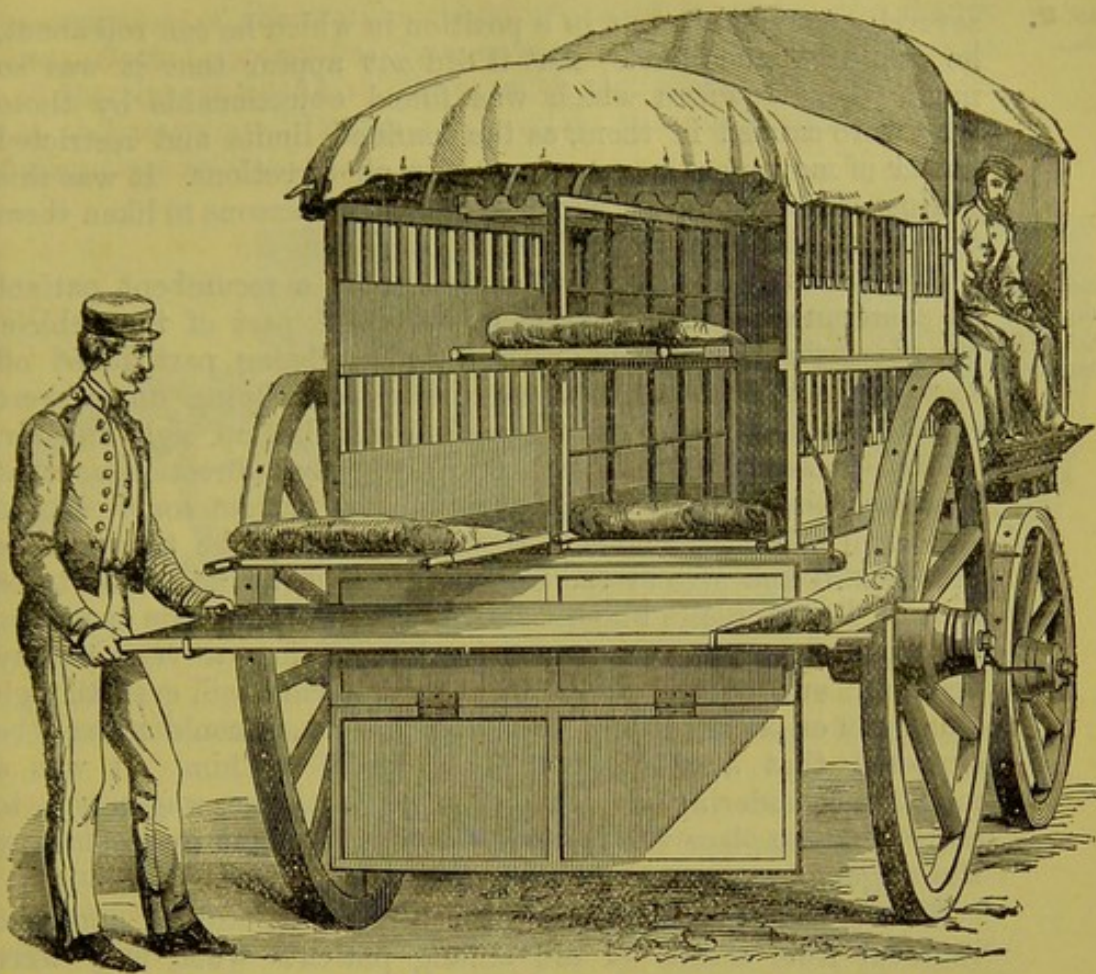


Fig. CLXXV.—Perspective view of Director-General Smith's Sick-Transport Wagon, showing the compartments for patients carried recumbent, and the plan adopted for forming an operation-table in rear of the vehicle.

was really its chief objectionable feature in actual use. Its weight was too great under any circumstances, but was especially so when the horses were deficient in strength, the drivers untrained and careless, and the roads bad ; and this was the condition of things when they were first employed. The weight of each wagon was nearly twenty-two hundredweight when empty ; to this the weight of ten men with their arms and kits, and two drivers and their kits on the horses, had to be added when the conveyance was loaded. The draught of the wagon was also rendered heavy by the distance between the fore and hind wheels. The fore wheels were short and turned under the front section of the vehicle, in which the sitting patients were carried. As regarded the patients, although the four compartments of the hinder part of the wagon had together full means of ventilation, the limited dimensions of the space within which each inmate had to lie, the impossibility of sitting up owing to the closeness of the tier or roof above, caused sensations of restraint and of helplessness in case of accidents that were very objectionable to many. The compartments were made narrow designedly. The Director-General, Dr. Smith, stated that his object in not having them made wider was, because if a man

Causes of their failure.

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Defects of the
ambulance
wagons sent to
the Crimea.

severely wounded be put in a position in which he can roll about, he would be much hurt. But it did not appear that it was so much the narrowness which was found objectionable by those who were carried in them, as the confined limits and restricted power of movement in consequence in all directions. It was this feeling of imprisonment which caused some persons to liken them to "cells," and even to "coffins."*

There was again no provision to enable a recumbent patient to communicate with anyone in the front part of the vehicle, the place for the patients carried sitting being partitioned off and distinct from that where the patients lying down were carried. When the back of the vehicle was shut up, light and air, and all communication were excluded in that direction, so that the only direction in which a recumbent patient could call the attention of anyone outside the vehicle would be through the jalousies in the side of the wagon in which he happened to be lying. But to make himself heard through these side openings, he would have to turn and raise himself into a very uneasy position; and with the noise from the vehicle itself, even though a surgeon or orderly might be riding close by, it could scarcely be expected that a patient would be heard by him. It was a mistake, considering the number of patients the wagon was to carry, that no place was allotted for an attendant to accompany the wagon.

The effects of this sense of confinement and of apparent removal from means of aid among patients when they were closed in by the shut up back of the vehicle were noticed by the committee in the Crimea that reported on the ambulance conveyances in January 1865. "There is an objection," the report stated, "on the part of both officers and men to be packed away "in the catacomb fashion in which the wagons are constructed." The real leading fault, however, was their weight. This had been no objection when tried in England, because they were drawn by strong English horses, with well-fitting harness, and were driven by men who understood their work over fair roads, but was fatal to their employment when all these conditions were reversed, as was the case when they were used in Turkey and the Crimea, and as is not unlikely very frequently to happen under the circumstances of campaigning.

Conversion of
the Crimean
sick transport
wagon into a
store transport
wagon.

The plan by which the sides of the recumbent section of the vehicle were lowered down to half their height, and the whole of the interior cleared to fit it for use in carrying stores was ingenious; but as it is chiefly of interest in this treatise in its aspect as a wagon for transporting sick and wounded, a particular

* A great deal of evidence regarding the wagons under description, and the effects of carriage in them, may be found in the Report, &c. of the War Office Commission sent to the Crimea by order dated October 23, 1854, to inquire into the state of the hospitals of the British army there and at Scutari, and also in the Minutes of Evidence taken before the Select Committee of the House of Commons on the Army before Sebastopol in the year 1855.

description of the mechanical adjustments by which the change was effected appears hardly necessary. Moreover, a comparison of the drawing which follows, with the preceding illustrations of this wagon, will sufficiently explain the main features of the alterations referred to.

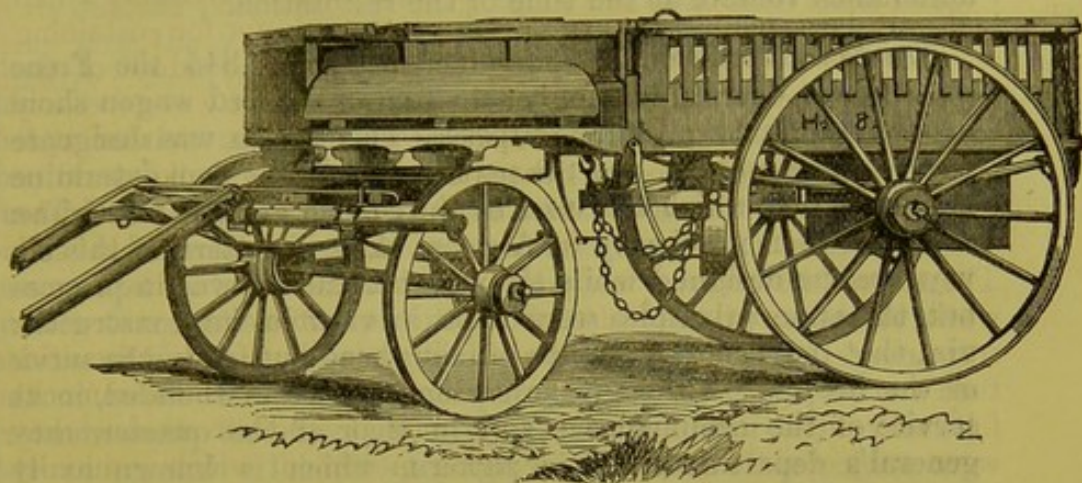


Fig. CLXXVI.—Side view of Director-General Smith's Sick-Transport Wagon, altered for use as a store-transport wagon.

Flanders wagons.—These were the store wagons sent with the Hospital Conveyance corps at the same time as the special wagons for the conveyance of wounded just described. They were like them in appearance, but without the coupé or compartment for the six persons sitting in front. They were placed on springs and calculated upon as suitable, on their contents being removed, to be used for the carriage of sick and wounded. They were, however, like other wagons in which the transport of stores has been the primary consideration, not well suited for this second service, owing to the want of proper adjustment between the strength of the springs and the lighter weight of the number of sick who could be placed upon them. There was, in addition, an absence of the proper internal fittings necessary for the safe carriage of sick or wounded men. At the same time it is to be remembered that they were only supplementary to the regular wagons provided for sick-transport purposes, and only intended to be used in case of emergencies when all the space available in the former had been occupied. Nine of these Flanders wagons were sent with twenty wagons of the preceding description, as the complement for one Hospital Conveyance Brigade.

Caisson d'ambulance Français.—This is the only wheeled conveyance authorized for ambulance transport in the French army. It is principally employed for the carriage of stores, but is also intended to be used for the removal of sick and wounded from the field hospitals to the regular hospitals of a stationary kind in rear, mule cacolets and litters being the only conveyances regu-

The French
caisson unique.

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larly employed in the French army on and near a field of action. Notwithstanding, as before mentioned, that the French were the first to introduce special wheeled conveyances for the removal of sick and wounded from fields of action, they have not been systematically employed since the breaking up of the ambulance volante at the time of the restoration.

The French caisson unique.—In the year 1845 the French government decreed that only one kind of covered wagon should be adopted for all military purposes. This wagon was designated the “caisson unique,” and the pattern which was then determined upon was that which was used by the French army in the Crimea, as it had been previously in Algeria. A new pattern of this conveyance was designed while the war with Russia was in progress, but the same principles were kept in view in its construction, viz., that it should be capable of being made use of in the service of the hospitals, either for carrying stores or wounded, in the service of the commissariat and in that of the quartermaster-general's department. This pattern, which is known as the “caisson Français, modèle du 20 Août 1854,” still remains the regulation military wagon of the French service.

Construction of
the caisson
d'ambulance.

This caisson, which is styled “caisson d'ambulance,” when employed in the service of field hospitals, is a long narrow wagon, being 3 metres 10 cent. in length, 1 m. 10 c. in breadth, and 80 cent. in height; it is supported on strong double elliptic steel springs and drawn by four horses. The fore wheels are short, being 11 decimetres in diameter, while the hind wheels are 15 decimetres in diameter. The body of the wagon has two wells beneath its floor, a space being left between them for the reception of the fore wheels, so that the wagon may turn with facility. Its cost is moderate, according to M. Boudin, 700 francs, or 28½ sterling.*

The French caisson is quite hollow, and with the exception of a few examples in which folding benches have been hinged within the sides, has no special arrangement to adapt it for the carriage of wounded men. Its primary purpose is as a store wagon; the use as a conveyance for carrying sick is secondary. When following the army and attached to its moveable field hospitals (caisson d'ambulance) it contains the surgical instruments, medicines, means for two thousand primary dressings of wounds, medical comforts, field cooking utensils, and all the necessary stores for a field hospital. These are distributed in twenty-one detached panniers and cases, each being numbered and having its contents specified in a lithographed plan, and having its special place in the caisson; and the infirmiers who are attached

* “Système des Ambulances des Armées Française et Anglaise, par M. Boudin, Médecin-en-Chef, &c.” “Annales d'Hygiène Publique, et de Médecine Légale, 2^e série, 1855, tome iii.”

to the ambulances or field hospitals are trained to unpack and repack the different cases and panniers and to replace them in the caissons with the utmost care, speed, and precision. Above the cases, on the top of the wagon, an operation table, three stretchers and blankets, and certain implements are placed, each in its definite position. Four of these caissons, with loads complete, form the complement for the ambulance of each division of infantry; three of cavalry.

All the stores above named have to be removed before the wagon can be employed for the conveyance of sick or wounded. On the other hand, the empty caissons which have been employed in carrying the camp equipage or in bringing up the commissariat stores are equally available for hospital service; and, as the service of the whole of the *équipages militaires* is administered by a central authority, the exigencies of the medical department as to numbers requiring removal can be met at any given time by the necessary orders for their disposal to meet these exigencies. Thus if circumstances render it advisable to keep the hospital caissons of a given force packed ready for movement the commissariat or other caissons are capable of being rendered available for clearing the field hospitals of their patients.

But when employed for the conveyance of wounded the want of some special appliance to break the force of the jolts and concussions to which they are inevitably subjected in the movement over rough roads becomes painfully felt, notwithstanding the use of bedding or other soft materials placed on the floor of the vehicle; and this is the chief defect of the caisson d'ambulance as regards this particular service. The strength of the springs, which are necessarily made very stout to fit the wagon for carrying the heavy loads for which it is destined as a store wagon, is out of proportion to the weight in the wagon when a few wounded men only are carried; they do not act, and the wagon, as regards them, virtually becomes a conveyance without springs. One of the first requisites of a good ambulance conveyance is therefore wanting in these wagons.

Defects of the
caisson d'am-
bulance.

The weight is also excessively great, viz., 1,300 kilog., more than $25\frac{1}{2}$ cwt., when empty, and about 4,000 kilog., or about 78 cwt.* when filled with its full complement of hospital stores. This heavy weight causes the progress of the wagons to be retarded when the roads are bad or surface of country rugged, and in rapid military movements leads to the liability of their being absent at a time when the stores which they contain are most required, as is said to have happened in some of the battles of the Italian campaign of 1859.

* "Notice sur le Perfectionnement du Matériel des Ambulances volantes, par H. Arrault, Paris, 1861," p. 14.

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As before alluded to, some caissons d'ambulance have been fitted with benches, secured by hinges to the side walls of the interior of the vehicle, so that, on the stores being taken out, the benches can be raised and used as seats for patients. But they appear to be comparatively few in number.

The drawing which follows represents the caisson of the pattern adopted in August 1854.

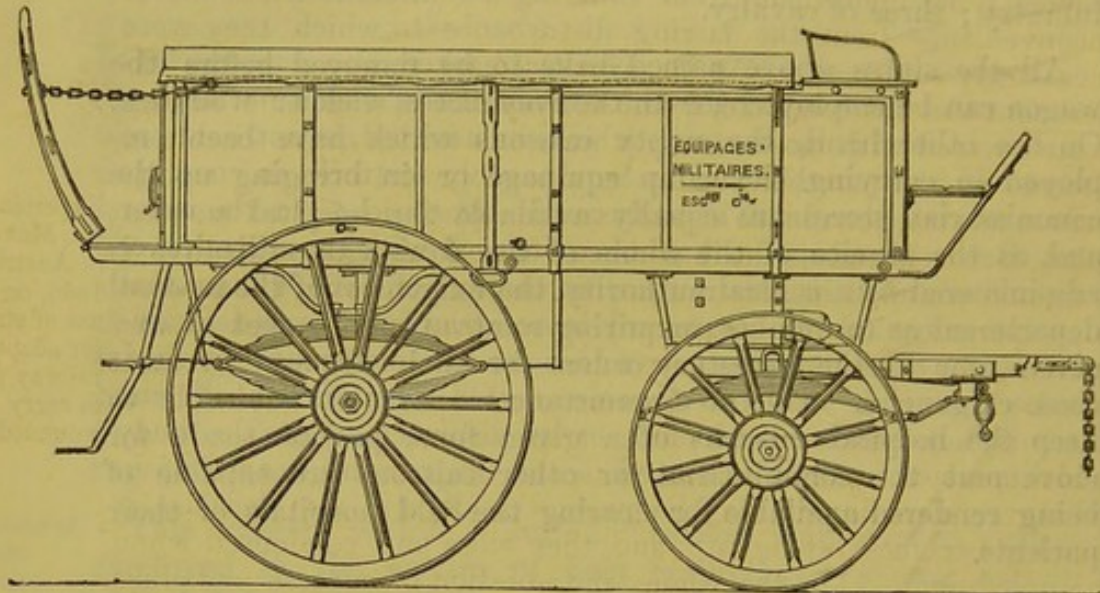


Fig. CLXXVII.—Side elevation of the French ambulance wagon (Caisson Français modèle du 20 Août 1854).

CLASS V.—CONVEYANCES MOVED BY STEAM POWER ON RAILWAYS.

SECTION I.—GENERAL REMARKS ON THE USE OF RAILWAYS AS REGARDS THE TRANSPORT OF SICK AND WOUNDED IN TIME OF WAR.

The universal employment of railways and of carriages drawn by steam power in Europe, and the rapid increase of this method of locomotion in all civilized parts of the world, sufficiently indicate the vastness of the extent to which this powerful means of rapidly concentrating large bodies of troops and military stores, will be used in all future wars of importance. Recent campaigns have, indeed, shown how much the strategical arrangements of the commanders have been bent to accord with the facilities of movement offered by following the directions of the lines of railway running through the countries which have formed the theatre of warfare, and have served to prove beyond all doubt that the positions of railways will continue to bias the plans of military operations on the occurrence of wars hereafter.

But however great may be the influence and importance of railway transport as regards the general movements of armies and their power of destruction, in no part of the military operations are railways capable of being employed more largely, or more usefully, if proper arrangements be previously made, than in the transport of the sick and wounded among the troops. In considering this subject from a military point of view, the urgent necessity and important strategical advantages of speedy relief of the active part of an army from its encumbrances of sick and disabled men; and, further, the advantages of rapidly conveying ineffective soldiers to situations, and placing them under circumstances where they will not only be secure against attack or disturbance, but where also they will find the best assistance as regards accommodation and hospital appliances, and where, therefore, they are most likely to be quickly restored to a capability for fresh active service, at once force themselves on the attention.

Other important advantages arise out of those which have just been named. If the sick and wounded can be quickly carried away and dispersed among hospitals in towns, camps, or other places appropriate for their reception far away from the immediate theatre of warfare, as a consequence of this dissemination, there will be all the less risk of disease being generated and of epidemics springing up among the active portions of the army. Again, if the sick can be rapidly and regularly removed to places at comparatively remote distances from the scene of active hostilities, there will be no necessity for large ambulance establishments being kept with the forces operating in the field. The hospital establishments of armies, the articles and necessary materials for the care and treatment of the sick and wounded among the troops and the vehicles for their transport, have always been a source of

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Railways in
time of war.

Probable extensive use of railways, in future wars, for transporting wounded soldiers.

Advantages offered by the use of railways for transporting sick and wounded.

Probable influence of railways on ambulance establishments in the field.

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Probable influence of railways on surgical treatment of wounded.

Experience in Germany.

Probable influence of railways on intermediate field hospital establishments.

difficulty and objection to military commanders, and they have become so more than ever since the progress of civilization and science has required the sick and wounded to be provided for in a manner more adequate to their necessities than formerly was ever contemplated. But with the advantages of railway communication at hand, the amount of ambulance stores and transport may be limited to the probable wants of a single action, and only a small medical staff will be required to supplement the surgical assistance which will be always in company with the troops, either as regimental, brigade, or divisional medical officers.

Many serious primary surgical operations, which have now to be performed inconveniently on the field itself, may under the circumstances contemplated be postponed until the arrival of the wounded at a fixed hospital, where they can remain undisturbed after their performance; for with good management the railway conveyance may be so arranged as to carry them there with no greater disturbance than has hitherto happened in the transport of wounded from a field of action to the general hospitals in rear, while the journey can be performed with such speed that there will not be sufficient time for those symptoms of fever and irritation to arise, which, when they exist, counterindicate amputation or other surgical interference of a primary nature. Certain other surgical operations of a conservative kind, that, from their nature could hardly under any circumstances be attempted with propriety on the field itself, and that would be almost equally unjustifiable in hospitals, the temporary nature of which would render the patients liable to be moved to other hospitals more remote shortly after their performance, may be resorted to without any special risk if the hospitals to which the patients are at once transported possess a more permanent character. The Prussian surgeons during the late wars in Schleswig-Holstein and Bohemia, were in numerous instances enabled to avoid amputations, and to resort to more intricate operations in the interest of their patients, owing to the speedy removal of the wounded from the neighbourhood of the scenes of action to fixed hospitals. It was not merely from the fact of these hospitals being fitted with all the necessary appliances that the surgeons were induced to undertake the special operations referred to, but what also materially influenced them was that they knew their patients could remain in them without any necessity for further removal until they were in a proper condition to undergo the transportation without danger of irritating their wounds and interfering with the process of cure.

The circumstance of railways being made available for ambulance transport will also probably cause intermediate field hospitals—always burdensome, costly to manage, and too often hiding-places for idleness, as experience showed during the Peninsular war—to be established in less proportion than has hitherto happened in war, for it will be far more easy and economical to add to the hospital accommodation already existing in towns and large centres of communication, at a distance from the theatre of warfare, than to open hospitals in fresh situations, a plan which

necessarily involves great outlay at starting, as well as continued expense from the transport of stores, and from the loss produced by wear and tear and accidents inseparable from such movements.

The very distance to which the wounded may be carried when railway transport and free communication are available, is in itself an advantage. All the inconveniences that attend the transference of sick and wounded from field hospitals to depôts and intermediate hospitals, as well as those arising from the circumstances of a retreat, or a change in the strategical positions, being liable to bring these hospitals within the sphere of military operations, are avoided. Strategical movements too are now so rapid, that the concentration of detached groups of sick and wounded soldiers in intermediate hospitals is a matter of daily increasing difficulty. The town or place in which it may be to-day convenient to establish an intermediate hospital, may to-morrow be out of the line of communication with the army operating in the field.

Influence of the transportation of sick by railway on the active part of an army.

From all that has been now observed, it is obvious that when the base of operations happens to be a seaport, as must always be the case if British troops are engaged, as allies or otherwise, in foreign expeditions, when a line or lines of railway exist between it and the front, when carriages are available for the sick and wounded to be rapidly and regularly moved to the base, to be thence transferred either to hospital ships or to naval transports for removal to fixed hospitals away from the neighbourhood of the sphere of conflict, or when a continental power is operating from a base in its own dominions, the active part of the army, as well as the troops which have become disabled for service, will be equally benefited by taking advantage of the opportunities afforded by the railways for ambulance transport.

Recent campaigns have afforded some experience of the use which may be made of railways for the transport of wounded in time of war. The Italian campaign of 1859, the German-Danish war of 1864, the late civil war in the United States on a still vaster scale, and the war between Prussia and Austria in 1866, have all exhibited this mode of conveyance of wounded in actual operation.* In some of these instances, the opportunity has been afforded of observing the application of railways to military sick-transport purposes where no previous preparations had been made for this particular service; in some, of studying the advantages of certain peculiar contrivances, additions to ordinary passenger carriages, which had been expressly provided for its execution. In other instances, carriages have been specially constructed with the necessary fixtures and appliances for receiving and taking care

Examples of railway ambulance transport afforded by recent wars.

* In 1855, in the Crimea, after the railway between Balaklava and the camp before Sebastopol had been completed, it was occasionally used for conveying sick from the camp hospitals; but only the wagons constructed for carrying stores to the front being available for this service, and they being unprovided with any contrivances to make them suitable for invalids, no patients so infirm or injured as to require a recumbent position were sent by it. This was the first time that any railway was employed for transporting sick and wounded soldiers from a scene of actual hostilities to the rear.

The English railway in the Crimea.

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The need of systematic preparation for the transport of sick by railway shown by the experience of recent campaigns.

of wounded men labouring under all kinds of injuries and in every condition of physical prostration, and have been extensively employed in the service for which they were designed.

The result of this varied experience has been to show it to be particularly important, having due regard to the necessities which are liable to occur in time of war, that the methods best adapted for meeting such wants efficiently, and the most economical plans for carrying these methods into execution, should be fully considered during the leisure of time of peace. When war has commenced, and while it is actively proceeding, all military exigencies arising out of the circumstances of the time, acquire special urgency; for success in any strategical operation usually depends upon these exigencies being met at the instant they occur, so that no avoidable risk may be undertaken, and no opportunity of advantage may be lost. If the system of railway ambulance transport be not settled beforehand, when the necessity occurs the military and medical authorities will probably be harassed by conflicting views as to the best steps to be taken to meet the emergency; and that, too, at a time when they ought to be able to give their undivided attention to the urgent need which will then press for immediate action. The sick and wounded will also not improbably suffer from the same cause, for everything under such circumstances usually has to be sacrificed to the main military object, which is to get such encumbrances away almost at all hazards. Individuals will be little regarded while the thoughts of those in authority are directed to clearing away the wounded as a mass; so long as accumulations of disabled men remain with an army, they cannot fail to fetter the movements, to detract from the strength and activity of the main body, and also, in a certain degree to distract the attention of the commander from the object of chief importance which he has in hand.

Economy of systematic preparation.

That the method to be adopted for transporting sick by railway should be perfected in all its details before the time of need comes, is also important from pecuniary considerations. Little heed can be given, when the want presses, to suggestions for pecuniary economy. That which appears at the moment to be the most practicable, and so the most advantageous mode of proceeding, will have to be adopted irrespective of cost. Not unfrequently it will happen that the military exigencies are such that they must be met by any method that may offer itself, even by one which is manifestly faulty, owing to there being no longer time to make any preparation for one that is known to be better, but not at the time available. It appears to have happened thus in respect to the method of railway sick-transport conveyance in use during the Italian war of 1859. No suitable provision had been previously made for the carriage of disabled soldiers by the railways, the military movements were so rapid that no time was afforded for making proper preparations for their conveyance after the campaign had opened, and the sick and wounded, who suddenly became accumulated in immense numbers at the front and in numerous improvised hospitals, must either have not been removed

Railway ambulance transport in Italy during the war of 1859.

at all from the theatre of warfare, or have been brought away, as they were, by railway carriages in the ordinary condition in which they are used in peace time for the conveyance of persons in health and strength, and in the wagons employed for carrying goods and cattle. Unfortunately there was a deficiency of ambulance transport in the field, as well as of sick-transport provision on the railways. The inevitable consequence was that the removal of the wounded was greatly obstructed. Many men died from being detained in over-crowded and ill-provided field hospitals, who might have escaped had there been adequate means for their transport; while those who were brought to the railways and then removed, suffered greatly during their journey, from being chiefly carried in open trucks, or in third-class carriages, without any arrangements for breaking the violent concussions arising from the oscillations, or the jostling against each other of the carriages, beyond the use of some straw placed on the floors to protect them from the hard planks above which they were lying.

But although a large amount of individual suffering, which might have been avoided by previous arrangements and preparation was thus brought about, the general good that resulted from the opportunity of removing the wounded with even comparative rapidity from the ground of conflict by means of the railways was immense. It is evident from a discourse pronounced by Baron Larrey, the eminent chief of the medical service with the French army in Italy, at the Imperial Academy of Medicine in Paris,* that, had there been an amount of ambulance transport with the armies in the field, primary and secondary, proportionate to the need, had there been the number of mule-conveyances and wheeled vehicles necessary for keeping up the regular communication between the field hospitals and the railways, especially when the latter were at a distance from the field of battle, as at Solferino, the good results would have been still greater. But, as it was, the sick and wounded were systematically removed as fast as the wheeled transport available could carry them to the railways: prolonged over-crowding of hospitals was prevented: the wounded came to be widely disseminated: improvised hospitals with many unavoidable deficiencies were gradually exchanged for established hospitals furnished with all the necessary appliances for every occasion that could arise: and, most important of all, as Baron Larrey has pointed out, owing to the dissemination of the sick thus effected by means of the railways and steam transports, both the armies in the field, and the country in which they operated, were spared the incalculable evils of epidemic disease, which, under other circumstances, judging from past experience, would almost certainly have occurred.

Good results of dissemination of wounded during the Italian war of 1859.

All the good, however, which resulted from scattering the sick and wounded during and after the Italian campaign of 1859, might have been equally effected, and at the same time, the suffer-

* Bulletin de l'Académie Impériale de Méd. Paris, vol. xxvii.

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The best methods of transporting bodies of troops and war matériel by railways have been largely tried in England, but not of wounded.

ing which attended the rough mode of transport by the railways have been prevented, had some means been provided for rendering the railway carriages employed in transporting the sick and wounded suitable to their condition. With such painful experience, it is evidently most important for every European country to fix upon some regular system beforehand, so that, in case of similar necessities again appearing, a recurrence of the evils which have just been glanced at may be suitably obviated. The appliances most appropriate for converting the various classes of railway carriages into conveyances proper for the transport of sick and wounded should be determined, and certain regulations settled by which the transport may be expected to be most safely and most expeditiously accomplished. It is well known that experiments have been largely made and definite conclusions arrived at regarding the best and most rapid modes of moving by railway, and concentrating, bodies of troops, not only abroad, but also at home, at any spot where they may be required for active service, as well as for conveying the guns and other war materials which are required to go with them; but, as far as known to myself, no such conclusions have yet been arrived at in England, respecting the best means to be adopted for the transport of the sick and wounded, a want which will inevitably be felt if the transportation by railway, and the concentration of troops for hostile purposes should ever unhappily take place in this country. The one necessity will involve the other as a matter of course.

SECTION II.—OBSERVATIONS UPON THE VARIOUS KINDS OF CARRIAGES IN PRESENT USE UPON RAILWAYS, ESPECIALLY ENGLISH RAILWAYS, SO FAR AS REGARDS THEIR FITNESS TO BE APPLIED TO THE TRANSPORT OF SICK AND WOUNDED IN TIME OF WAR.

Construction of railway carriages commonly used in Europe unfit them for sick-transport purposes.

The necessity, which was dwelt upon in the previous section, for determining beforehand the best mode of transporting sick and wounded troops by railway conveyances in time of war, will be found on a little examination, to be no imaginary one. Most of the passenger carriages in ordinary use in England, and, in general, upon European railways, are quite unsuited in their actual condition for the removal of any but persons who are in the possession of the full use of their limbs and bodily powers. In addition, these vehicles are so constructed that many difficulties occur in devising efficient plans for adapting them to the circumstances of persons who are debilitated by illness or disabled by wounds. In the United States, where no distinction is, or used to be, made as to classes of carriages; where no high partitions in them, dividing one part from another, exist; where each carriage resembles a large open chamber or gallery capable of holding from fifty to sixty persons, the conversion of a passenger car into a sick-transport car has been a comparatively easy undertaking. Carriages of nearly the same dimensions and similar in general construction, though not intended for all classes of passengers indiscriminately,

are in use in some parts of Europe. They are met with on some of the Austrian railways and in Switzerland. But a serious difficulty is met with at the first step in undertaking to fit the carriages in use on English railroads for the transport of sick and wounded. It is not merely that the two principal classes of carriages are divided into wholly distinct and comparatively narrow compartments, and that the third-class carriages are also partially sub-divided, but a still greater difficulty arises from the fact that the doors opening into the several compartments are of such limited dimensions, as to make it next to impossible to carry an ordinary stretcher, with a wounded man upon it, into any one of them. The doors of second and third class carriages vary in width, from twenty to twenty-two inches; the width of first-class carriage doors varies from twenty-two to twenty-four inches. A man of average size, walking face forwards and having command over all the movements of his body, requires twenty-one inches for a clear passage; so that it is only by assuming a certain amount of slanting direction as he moves through the doorway that a moderately stout person can enter into either kind of carriage. No class of *passenger* carriages can therefore be accepted as suitable for receiving into them badly wounded or sick persons, such as require to be carried into them on stretchers in a recumbent position, so long as the doorways remain as narrow as they now are. The only carriages which remain are those of the truck or goods' wagon kind, and horse-boxes. Litters bearing sick can be admitted into these vehicles without much trouble or risk; but, here again another difficulty occurs, for they are destitute of such springs or other adaptations as will serve to break the jars from oscillatory movements, or from the severe concussions which are induced from time to time by accidental irregularities in the joints of the rails, by the vans being brought up suddenly against each other, and by other such casualties, particularly when they are only carrying so trifling a weight as that of a few men. Hence the railway wagons constructed for the portage of heavy stores or for the carriage of horses, are quite unsuited for the purpose of sick-transport conveyance in their existing condition. Supposing, however, that the doors of passenger carriages could be made wide enough to admit stretchers with wounded persons upon them, and the difficulty already noticed of their entrance be thus removed, there would still remain further impediments to the reception of stretchers within the carriages. This fresh perplexity is brought about by the usual internal dimensions of the compartments of these vehicles. The length of the space occupied by two opposite seats measured from back to back, including the intervening passage, in a compartment of a first-class carriage, is greater than the corresponding space in a second-class compartment; but in the former it is under five feet, generally four feet eight inches. It would, therefore, be impossible to cause a stretcher bearing a man in a recumbent position to rest upon the opposite seats of either a first or second-class carriage. The rounded, sloping form, and the comparative

Subdivisions of railway passenger carriages.

Narrowness of the doors of railway passenger carriages.

Goods' wagons on railways.

The springs of goods' wagons.

Field stretchers cannot be placed on the seats of passenger carriages.

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narrowness of the adjoining seats, the partitions which are usually applied to cause partial separation and to form arm-rests between them, would equally prevent a stretcher from being supported along either side of the carriage. The only plan that remains to be adopted for accommodating a patient in a lying down position in a first-class passenger carriage, is to have cross-supports resting upon the opposite seats, and on the frame so formed to place a stretcher specially constructed for the purpose. This stretcher will have to correspond in width with the width of the interval between the seats, and one patient only can be accommodated in each compartment. This is evidently a plan not likely to be generally adopted, although special litters have been constructed in accordance with it, and although it may be employed in occasional instances. The special litters referred to will be described hereafter. Corresponding difficulties are met with in trying to convert third-class carriages into conveyances for sick and wounded, although they are not divided into compartments, and the interior partitions are only raised high enough to form backs to the seats. The narrowness of the doors, as well as of the wooden benches inside, are impediments both to the admission and to the support of recumbent patients on stretchers. The only wounded persons, therefore, for whom any of these passenger carriages can be rendered generally suitable will be such as are capable of maintaining a sitting position; and special arrangements, in addition to the ordinary furniture of the carriages, will have to be made for a certain number of these patients, according to the nature and situation of their wounds, in order to make them suitable for their reception. Special contrivances have been devised to enable third-class carriages to accommodate recumbent patients, but it is questionable, as will be shown presently, whether any of them are suitable for practical application on an extended scale.

Patients for whom ordinary passenger carriages are suited.

Patients for whom passenger carriages are suited when certain appliances are added.

Patients for whom ordinary passenger carriages are not suited.

It results, therefore, that, firstly, railway *passenger carriages* as they are constructed in this country, and in most countries of Europe, are already capable of affording fair accommodation for such wounded men as are fit to be removed in a sitting position without mechanical assistance beyond that which can be applied to their own persons, such as arm slings, splints, and similar local contrivances; that, secondly, they are not capable, without the adaptation of special fittings, of furnishing accommodation for such wounded as can only be moved in a sitting position with the aid of special mechanical supports separate from those applied to their own persons, such as are necessary in fractures or other serious injuries of the leg or foot; and that, thirdly, they are not, for general purposes at least, able to furnish accommodation for those who require a recumbent position.

It is evident then that the following points have to be considered:—

(A.) What are the contrivances necessary for adapting passenger carriages to the necessities of such wounded as require special fittings in the carriages themselves, and how

these contrivances can be best applied or attached to them; and,

- (B.) Can luggage vans, goods' wagons, and cattle trucks be adapted for receiving and conveying the severely wounded, to whom a recumbent position is essentially necessary and for whom the passenger carriages are unsuitable, and, if so, what are the best means of converting them into suitable conveyances for such wounded persons.

(A.) The contrivances needed for men whose injuries, though severe, do not unfit them for being moved in a sitting or semi-recumbent position, provided certain appliances are added to the carriages in which they are placed, will be found to be chiefly such as are useful in supporting the lower extremities, especially the legs and feet. Serious wounds to the trunk, the pelvis, and mostly also to the thighs and knees, cause a recumbent position to be indispensable for the patients who are the subjects of them. The roofs of railway passenger carriages, though not strong enough to bear the strain of heavy weights, are sufficiently strong to carry such light supports as are needed under the circumstances above contemplated, and they can be readily secured to them by various simple mechanical contrivances, without any preparation so far as the carriages themselves are concerned. In the greater number of first-class carriages they can not only be suspended from the roofs, but they can also, if preferred, be slung from the tops of the partitions which divide the seats from each other. If a fixed, instead of a swinging, support be required, any ordinary plank of wood of proper width, or two or more narrow planks placed side by side, can be reduced to such a length as to convert two opposite seats of a carriage into a couch sufficiently long to enable a person to travel in a sitting position with the legs elevated. The addition of an ordinary double-inclined plane, or of some of the various forms of splints specially contrived to meet the object proposed, placed upon this couch, will serve to support a knee joint bent at any angle that may be required. Several kinds of special appliances have been constructed to answer the purposes now in view. There seems, therefore, to be no difficulty in adapting any passenger carriage to meet the wants of the wounded included in the second category, or in attaching to it the appliances necessary for their safe conveyance.

Appliances to adapt passenger carriages for the conveyance of patients hurt in the leg or foot.

The second point (B.) is one which requires more lengthened consideration. It may easily be surmised and, indeed, it is already known by experience that if alterations of a sufficient extent be made, *covered luggage vans* may be converted into convenient conveyances for sick and wounded troops. The doors of these vehicles are double, and open wide enough to admit the passage of a stretcher, no steps are employed to lead up to them, their floors being nearly on a level with the platforms of stations, and there is ample space in the interior of each van to admit of accommodation being provided for several recumbent patients, and any fittings

Appliances to adapt luggage-vans and goods' wagons for the carriage of recumbent patients.

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Railway ambulance transport at Châlons-sur-Marne.

Construction of the Châlons ambulance carriage.

necessary for their protection. A railway sick-transport carriage constructed out of a long wagon of the description named has been in use in connexion with the French camp at Châlons ever since the year 1857. It was established under the direction of Inspector-General Baron Larrey. The camp is about seven or eight miles from the town of Châlons-sur-Marne, in which there is a large military hospital of a permanent character. There is a railway station near the camp as well as at Châlons itself. The hospitals at the camp are more or less temporary in construction, resembling in many respects the ambulances which would be with a French army in the field, and consequently all the worst cases, and those most likely to occupy a long time in their treatment, are sent to the permanent hospital in the town of Châlons. The railway carriage employed to transport the sick from the field hospitals to the fixed general hospital in rear is strictly, therefore, part of the ambulance equipment of the force assembled in the camp, and is designated an ambulance car. The objects gained by providing a special ambulance car were, firstly, the removal of the sick in an appropriate conveyance, and, secondly, an assurance of that conveyance being always at the disposal of the military authorities. Moreover, as the ambulance car had to be attached to the ordinary trains, it was necessary to isolate the sick soldiers from the general passengers who might be travelling at the same time, as well as to have them together in one carriage so as to economize the services of the infirmary non-commissioned officers sent in charge, and to facilitate any attention or treatment the sick might require during the transit. All these purposes were attained by the use of a special conveyance. The Châlons van was fitted with five benches, these benches being together sufficient for the accommodation of twenty-five men sitting. In addition, two mattresses were supplied for patients in a recumbent position, one on each side of a part of the van, partitioned off for the breaksman's seat. The benches were made removable at pleasure, so that hospital litters, previously constructed of proper length to suit the width of the wagon, could be inserted in their stead, or in place of any number of them. A certain number of these railway-car litters were ordered to be always kept in readiness at the divisional ambulances, and to accompany the troops at their field evolutions; and thus, in case of a soldier meeting with such an injury as a severely injured limb or with any other sudden accident of a serious kind, either in camp or during the field exercises in its vicinity, the man could be carried on one of these litters to the camp railway station, and without removal from it or change of posture, could be transferred directly to a place in the railway ambulance car, and in like manner without disturbance could be taken from the railway to the hospital in the town of Châlons. Patients labouring under diseases of an ordinary nature could also be removed from the ambulances in the camp in a similar way as occasion might require.

But although in a standing camp like that of Châlons or Aldershot, with a railway close at hand, it is easy enough to convert by

means of suitable fittings an empty van into a car for sick-transport purposes, with stretchers specially prepared and adapted to its dimensions, this is obviously not what is usually wanted. Such a plan cannot be regarded as a fit method of converting railway vehicles into suitable conveyances for meeting the general wants of military service. The great desideratum is to determine whether a simple contrivance cannot be devised by means of which such carriages as are found universally on railways may be readily converted, that is, without much previous preparation, into appropriate conveyances for the removal of parties of sick and wounded men. The surgical, as well as the military object to be attained is, that whenever an engagement happens to take place in the neighbourhood of a line of railway, the wounded may be carried from the field without delay to the nearest fixed station; and the carriages on the line be at once turned to account for their speedy removal from this station to any place in rear which may be fixed upon as the most suitable for receiving them. The means of accomplishing this object with any approach to scientific fitness, or with proper consideration for the safety and well-being of the wounded who may have to be transported, so far as ordinary railway carriages, such as are met with in England, are concerned, have not yet been satisfactorily determined.

The surgical and strategical objects chiefly sought after in railway ambulance transport.

It may be here remarked that the carriages which will be most extensively and constantly available for purposes of ambulance transport in anything like a prolonged campaign, will be almost always the wagons employed in carrying heavy stores or cattle to the field and to the depôts and magazines in rear of the scene of active operations of the army. Such wagons, having discharged their contents, will be sent back empty towards the base of operations, unless turned to account for carrying back sick and wounded. Passenger trains will be used for conveying troops, but they will only be sent to the front occasionally, while trains of wagons carrying stores of all kinds will probably be despatched at regular and frequent intervals. On this account, therefore, as well as because they are free from division into compartments, and other impediments, the best mode of making store wagons and trucks subservient to the transport of sick and wounded in time of war particularly demands inquiry, especially to the transport of such patients as require a recumbent position, for whose accommodation the construction of passenger carriages presents so many difficulties. At the same time, it is right to determine the best methods of adapting the various classes of passenger carriages to sick-transport purposes also; for, if not otherwise forthcoming, they can always be rendered available for service by order when they are required, and, as already noticed, they possess certain qualities, especially the adaptation of their springs, which render them valuable as regards the conveyance of patients capable of maintaining a semi-recumbent or sitting posture.

The railway vehicles chiefly available for the transport of sick in time of war.

Nothing thoroughly satisfactory as regards the conversion of railway wagons into sick-transport carriages for recumbent patients

Conversion of railway wagon

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into sick-trans-
port vehicles.

can be settled without actual experiments; but one of the plans which at once occurs as both practical and expedient is the suspension of field stretchers within them. The question to determine, the most simple and secure way of effecting the suspension, is a mechanical one, which can be best answered by an engineer versed in such subjects, and it has yet to be settled. Perhaps part of the plan adopted for converting the commissariat cart invented by Veterinary Surgeon Cherry into a carriage for sick and wounded soldiers, in which stretchers are suspended from ropes attached to the sides of the conveyance, or some modification of this plan, might be advantageously adapted to the various kinds of wagons and trucks used on railways.* If so, it would be one of the simplest and readiest contrivances that could be had recourse to. To carry out the plan there would be merely required a supply of ropes and holders, or iron rings capable of being screwed into the sides of the wagons, through which the ropes would have to be passed. It would apparently be an easy matter to secure temporarily iron hooks, or suspenders, to the poles of field stretchers, to enable them to be used with such a contrivance. Their capability of application would, however, depend upon the width of the carriages being suitable for receiving them. If not suitable, then special stretchers for the railway trucks and wagons must be constructed and kept in store, and in such a case they would have to be so made as to be available for all the ordinary purposes of stretchers for carrying patients from the field or elsewhere, when not required for use in the railway trains.

Urgent reasons
for using only
ordinary field-
stretchers in
railway ambu-
lance wagons.

So much suffering is unavoidably inflicted in lifting up and placing wounded and feeble patients from one stretcher to another, and particularly in removing them from the stretchers to put them into their places in railway carriages as ordinarily constructed, that it is especially desirable to prevent the necessity of these changes. If brought from a field of action, the shattered frame or limb of a wounded man must be held in the hands of the bearers and must be moved with their movements, from the moment the patient is lifted off the stretcher until, after being got into the wagon or carriage, he is placed upon another stretcher. Under any circumstances, even when no such change of litter takes place, it is a difficult operation, and usually a very painful one, to get helpless patients into and out of a railway train, and it can easily be understood how much the difficulty must be increased, and proportionably the pain also, if the patient is to be carried to the train by one litter, transferred and settled in another, and again removed by a third in the course of his journey. In making arrangements, therefore, for the transport of sick and wounded by railway, the plan adopted should always include means by which those patients, whose condition is such as to render a recumbent position imperative, may remain during the whole of their transit upon the same stretchers on which they have been brought, whether from the field or from hospital, to the railway

* See page 370.

train. When the patients have arrived at the place of their destination, the stretchers on which they have been carried should be collected by some responsible person and sent back to the quarter from whence they came, so that they may be available for further use. It was one of the advantages of the system of hospital trains employed in the United States during the war of the Rebellion, as it is also of that recently adopted in Prussia, to be presently described, that badly wounded soldiers were not required to leave the stretchers on which they had been brought to the railway until they were transferred to the hospital beds which they were appointed to occupy for the remainder of their treatment.

SECTION III.—DESCRIPTION OF THE PLANS HITHERTO ADOPTED, OR PROPOSED TO BE ADOPTED, IN FOREIGN COUNTRIES, FOR THE TRANSPORT OF SICK AND WOUNDED OF ARMIES BY RAILWAY IN TIME OF WAR.

Two series of inquiries on the continent have principally served to attract attention to the subject of railway ambulance transport in Europe; in the United States it was forced into notice by the exigencies of the late Civil war in that country. The first series of inquiries in Europe consisted of certain experiments which were conducted for the purpose of ascertaining the best modes of transporting sick and wounded by railway in Prussia in 1860; the second were the experimental trials made at the instigation of the societies for aid to wounded in time of war in 1867, at the Western Railway at Paris. The former experiments led to the adoption of the method which was followed by Prussia for the removal of the sick and wounded in the wars of 1864 and 1866, but which the experience then gained has caused to be since changed; the influence of the latter experiments, which were chiefly limited to trials of railway sick-transport contrivances in the Universal Exhibition of Paris, can hardly be said yet to have reached its full development, although the trials themselves led to strong recommendations for applying to railway vehicles the system of ambulance transport, and the mechanical contrivances, introduced by a French military surgeon, Dr. Gauvin. Dr. Gauvin's system has been already referred to, and will again be remarked upon hereafter.

Investigations concerning the transport of sick soldiers by railway.

Practical Experiments in Prussia in 1860.

The origin of the practical trials made in 1860 in Prussia was an essay, containing certain suggestions on the transport of wounded men by railways by Dr. Gurlt, Professor of Surgery at the King's University at Berlin. This treatise led to a committee being appointed by the Minister of War, with instructions to submit the proposals of Dr. Gurlt to the test of practical experiment, and to report upon their results. The chief feature in the plan suggested by Dr. Gurlt was that the wounded requiring to be carried lying down should be placed in hammocks or cots similar to those used on board ship, slung from the roofs of third-class

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Difficulties in the way of slinging hammocks in railway carriages.

carriages and luggage wagons. Professor Gurlt was himself appointed to be one of the members of the committee.

A serious difficulty was experienced, at the outset, in trying to put the system into practice. The roofs of the carriages, which had only been made for purposes of protection, not for sustaining weights, were found not to be sufficiently solid to admit of the hooks being made fast at some of the parts where it was necessary to insert them for the proper disposal of the cots; neither were they strong enough in some other parts, where the hooks could be inserted, to bear the weight of a man lying in a hammock. The screws of the hooks were drawn out and the hammocks fell. There were, however, a few positions where portions of the framework of the carriages were found to be sufficiently strong for sustaining the hammocks and men in them, but fresh difficulties then started up. Although the persons carried in the hammocks felt very little inconvenience from jolts or sudden shocks, they were subjected to a lateral swinging movement which gradually increased with the motion of the train, until it produced upon them an uneasiness of the same nature as sea-sickness, and occasionally caused the cots to be brought into collision with the sides of the vehicles in which they were suspended. It was obvious that such sources of disturbance would be injurious to sick and wounded men.

Plan of railway ambulance transport finally adopted in Prussia in 1860.

Efforts were then made to get rid of these objections by various changes in the mode of suspending the hammocks, but without success. Finally the committee recommended the adoption of a more simple plan of transport, viz., to cover the floor of each wagon with a thick bed of loose straw, to carry the patients to the trains upon ordinary straw paillasses, and then to lay the paillasses with the patients upon them on the straw-covered floor of the wagon. The paillasse intended for this service was to be furnished, on each side, with three canvas loops, these being designed for the reception of two stretcher-poles or lances, with a view to assist the bearers in the removal of the litter and its burden. By this arrangement a patient would be carried on the paillasse from the field or hospital, and without any change would be placed in the train, and again, without change, would be carried to his place of destination at the end of the journey. The Prussian regulations in force for the removal of wounded by railway were based on this system at the time of the German war of 1866.*

The Prussian system of railway ambulance transport tried at Paris in 1867.

Professor Gurlt, who originated the experiments and plan above mentioned, himself assisted at the trials of railway sick-transport contrivances conducted in Paris in 1867. Among them was the Prussian system just described. Two persons, one placed on a paillasse filled with straw, and the other on an ordinary sack filled with the same material, were carried to a goods' wagon. It was found in each instance necessary to employ five persons, including the bearers who had carried them, to effect the transfer of the

* A copy of the order relative to the transport of sick and wounded soldiers on railways, issued by the Prussian Ministry for War, will be found in the Appendix.

paillasses and persons on them into the wagon. The paillasses were simply laid on the floor of the wagon. On the train proceeding it was found that the vibrations impressed on the floor of the wagon were communicated to the paillasses, and in a short time their elasticity was proved to be insufficient to prevent the persons lying upon them from suffering a considerable amount of inconvenience from the jarring disturbance to which they were incessantly subjected. As Dr. Gurlt remarked, however, the experiment was not complete, from the floor of the wagon not having been covered with loose straw, which, he asserted, is not liable to become matted together and to be unevenly scattered in concrete masses as straw confined in paillasses is apt to do. On the other hand, Baron Mundy, who had been charged with the direction of trains of wounded in Austria during the war of 1866, stated that his experience led him to regard loose straw as a very defective material for obtaining elasticity under the circumstances described, not because it is liable to become matted together beneath the patients, but because it becomes easily displaced when the body which presses upon it is moved to and fro, remains heaped up in whatever direction it may be pushed aside, and also because it quickly becomes broken up, and then close and condensed when trampled upon. On the whole, the question of success or failure attending the employment of loose straw for breaking such concussions as are met with in the rougher kinds of railway conveyances when in motion seems to resolve itself principally into one of the quantity of material employed. If a large quantity is available and the bed of loose straw on the floor of the wagon is sufficiently thick, and if the paillasses are large and well filled, it is scarcely possible for the straw beneath the paillasses to be so much disturbed as to lose its elasticity in the course of one or two journeys. A far stronger objection to its employment appears to be that the large amount of clean straw which would be required to ensure efficient results, train after train, could not be obtained, or, at any rate, could not be depended upon to be forthcoming when required, under the circumstances of campaigning. It follows, therefore, that some other means of fending the impulses of the concussions and the jarring effects of the oscillatory motion belonging to railway transport, especially such as is met with in open wagons designed for the transport of heavy cattle and merchandise, must be sought for, if reliance is to be placed on these means proving effective and constantly available at the moment of need.

Experience of
Bn. Mundy
in Austria in
1866, on the
use of straw
for adapting
railway wagons
to carry
wounded men.

Objections to
the straw-sys-
tem of railway
ambulance
transport.

The Prussians have now adopted a system which promises to realize these desired advantages. In the month of October 1867 a new plan was decided upon at Berlin for the conveyance of men severely wounded in time of war, and this plan has since been made applicable to all the railways of the North German Confederation. It approximates closely to the system which was employed in the railway hospital trains of the United States, and applies only to patients requiring a recumbent position. The class of carriages which has been selected and prepared for conversion

New system of
railway ambu-
lance transport
adopted in
Prussia.

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Fourth-class
carriages on
German rail-
ways.

into ambulance conveyances is one of which we have no corresponding class in England. It is a fourth-class carriage, which is almost destitute of internal furniture. It is constructed without seats, and is only intended to carry persons standing upright. Carriages of this class have been running on the railways of the Hanoverian Railway Company, and indeed with many of the ordinary trains in the north of Germany for some years past. Their construction, which has been altered in some few particulars only, in order to adapt them to their newly intended purposes, may be described as follows:—Each carriage is fitted with eight square-cut strong upright posts, reaching from floor to ceiling, placed at certain intervals in the interior, four on each side. These posts are connected with other posts on the walls of the carriage by horizontal iron bars. There are two entrances into the carriage, one at each end, and these are severally reached by steps and a platform when it is used as an ordinary passenger carriage. There are no openings at the side. Each entrance consists of a double folding door, which, on being opened to its full extent, is nearly twenty-six inches in width. It is only since their adaptation as sick-transport vehicles that this plan of entrance has been adapted to these carriages. Previously the doors were at the sides, and they were not so broad. By order of the Prussian Minister of Commerce all fourth-class carriages in future are to be made after the new plan, with the doors at their ends. The whole space inside the carriage is thus rendered available for the reception of stretchers, while the four pairs of upright posts on each side form convenient means for their suspension, in much the same way as they were suspended in the American carriages.

Dimensions of
German 4th-
class railway
carriages.

The width of the interior of the German fourth-class carriage from side to side, exclusive of the walls, is 8 feet 4 inches; its length 24 feet 6 inches: its height, on the average, the ceiling being slightly arched, is 6 feet 6 inches. These dimensions enable twelve stretchers to be placed within the carriage, six on each side. They are arranged in the following manner:—

Construction of
these carriages,
and mode of
adapting them
for the carriage
of wounded.

The four pairs of upright posts along the middle of the carriage stand severally at a distance of 2 feet 4 inches from their corresponding side-posts. Each post is about 3 inches square. The two end-posts at each side are only 3 inches from the end-walls of the carriage, but intervening between them and the two central posts in the same row are three spaces, two of which occupy seven feet six inches and a half, while the middle space is eight feet in length. Six stretchers are suspended within these three spaces on each side, two stretchers, one above the other, within each space.

The stretchers
used in them.

The stretchers employed with these railway carriages are the same as those already described as having been employed in the formation of the Prussian army wheeled stretcher,* though of course destitute of the particular mechanism which is required to fix them to their supports when carried on wheels. They are

* See a drawing of this stretcher on page 255.

simply the stretchers attached to the sick-transport wagon of the Prussian army. It will be remembered from previous description* that these stretchers are provided with feet, with folding backs capable of being fixed at different angles of inclination, and also with hinged and padded sides of a curved form, two feet in length at the base by six inches in depth at the highest part. These sides answer not only for obviating the risk of a patient accidentally rolling off the stretcher while being carried into the wagon, but admirably serve the same purpose after their suspension within the railway wagon. The stretchers are each twenty-three inches wide including the side-poles, and these latter are eight feet nine inches long from end to end. As the length of the interior of the wagon is only twenty-four feet and a half, it is evident that three stretchers of the dimensions above mentioned could not be placed inside it on one and the same level; two of them, the two central stretchers, are therefore suspended on a lower elevation than the two adjoining stretchers on either side. The lower of the two stretchers in each end-space is nineteen inches above the floor; the lower of the two stretchers in the middle space is only eleven inches above the floor. The upper stretchers in all three spaces are placed at the same relative elevation, viz. two feet nine inches above the stretchers below them.

To effect the suspension of the stretchers strong projecting metal hooks partly covered with leather are firmly fixed into each of the central upright posts, and into the opposite faces of their fellow posts on the side-walls of the carriage. Two hooks only are fixed to the two end posts, and the same number in the opposite wall-posts; four hooks in each of the two intervening posts as well as at corresponding heights in the wall-posts opposite to them. These hooks are permanently attached to the carriages; they remain in them in time of peace, though they are not seen when the carriages are used for ordinary passengers, as the posts are partly boarded up to form supports for them to lean against. No alteration beyond the removal of this planking will be necessary to be made for fitting the carriages to receive the stretchers when the carriages are required to carry wounded in time of war.

When used for carrying stretchers a set of two connected rings is placed on each hook, and the handles of the stretcher are passed into the lower of the two rings. The upper ring rests on the part of the hook which is covered with leather, and consists of a stout circular coil of vulcanized india-rubber four inches in diameter; the lower ring, which depends from the india-rubber ring, is made of leather, and is large enough to receive and hold the stretcher-handle. The handle is left thicker at the extreme end, and is fashioned so as to form a notch below, and thus to prevent the risk of its slipping out after it has been inserted into its annular support. It is said that the arrangement of the two rings just described, together with the employment of the two different materials of which they are composed, leads to the production of

Mode of suspending stretchers in the German fourth-class carriages.

* p. 254.

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The Prussian mode of slinging the stretchers different from the mode used in the United States.

Favourable qualities of the German fourth-class carriages for sick-transport purposes.

Mode of carrying patients into the carriages.

an extremely perfect mode of suspension, and that, at the same time, the india-rubber is prevented from deteriorating so soon as it would if it were in direct contact with the metal hook above and the pole below. The Prussian method differs from that which was employed in the United States railway ambulance cars, in which a single ring of india-rubber was made to support each end of a stretcher-pole, and at the same time to connect it with the wooden peg or hook fixed to the carriage.

The German carriages appear in all respects well suited for the conveyance of patients under the circumstances in which they are likely to be required in time of war. They are well lighted, having four windows on each side, and one at either end; are well aerated, even when the windows are closed, by sliding ventilators in the side-walls near the ceiling, and by others permanently open and communicating with the outside air through the roof, which is double; they are not overcrowded with patients, and there is ample room for attendants, the space in the middle of each carriage between the two centre rows of upright posts being more than three feet in width. Moreover, any stretcher, of which the poles are not shorter or traverses wider than the spaces between the suspending supports, can as well be slung in one of these carriages as the sick-transport wagon stretchers at present applied to it.

Although there are side-steps leading up to the platforms at the ends of the carriages for the use of ordinary travellers, it is not intended that wounded men should ever be carried up by them. When patients on stretchers are to be placed in one of these carriages the carriage is to be unhooked from the adjoining one, separated a short distance, and each stretcher is then to be lifted to the height of the platform at one end of the carriage, and carried directly in at the door. No turning is required in this operation. Or the same object is to be attained without disconnecting any of the carriages by carrying the stretchers in at the last carriage of a train in the manner already described, and then by going on to the foremost carriage, in which the stretchers are to be placed, by passing through several carriages in succession. No impediment is offered to the progress of the bearers, for they walk from wagon to wagon by crossing over the bridges which are let down so as to connect one platform with another. These bridges occupy the middle space between the buffers, and are enclosed on both sides by upright iron rails. Under ordinary circumstances, when the side-steps are used, the bridges are fastened up, and then they form walls, as it were, or end-boundaries to the two platforms which lead to the front and rear entrances into the carriage.

The outline sketches which follow will serve, firstly, to convey a general idea of the form, construction, and general arrangement of the interior of one of the Prussian fourth-class railway carriages when the stretchers have been slung in their respective berths; and, secondly, to indicate more clearly the manner in which the suspension of the stretchers is effected. They have been reduced and simplified from some lithographic illustrations, printed under the sanction of the Prussian Minister of Commerce, which Professor

Gurlt was kind enough to send me. Since that date the magnificent atlas of coloured plates descriptive of ambulance matériel edited by Dr. Gurlt has been published, and among them may be found a series of technical drawings illustrative of every mechanical detail concerned with the method of railway ambulance transport just described. In the text connected with this atlas Dr. Gurlt states that, at the time of its publication (June 1868), seventy of the fourth-class ambulance wagons capable of carrying eight hundred and forty recumbent patients were ready for use. He also makes the following observations on the qualities of these railway wagons, so far as their capabilities for ambulance transport have been tested by the trials which have yet been made of them. After mentioning that the stretchers used in the wagons permit patients to be carried from a field of action or distant hospital without a single change, and in a very comfortable manner, he proceeds to the following effect:—

Number of German fourth-class carriages fitted for the transport of wounded in June 1868.

“The experimental trials made with this system of railway ambulance transport have demonstrated that if the stretchers, especially the upper tier, are subjected to oscillations during the journey, the caoutchouc rings attenuate to an extreme degree the vibratory motion and shocks, which is not the case in a system of suspension depending upon leather straps or ropes. The fourth-class wagons which have been adopted in Prussia by order of the Minister of Commerce offer many advantages for the transport of wounded men. They are well lighted, well ventilated, the sick recline in them commodiously, and suffer little from jolts; the beds are easily approached owing to the width of the passage which extends through the whole length of the wagon; the dressings of wounds can consequently be attended to with all desirable regularity; the wagons are joined together by draw-bridges, and this permits the wounded men to be watched, accidents, such as hæmorrhage, to be at once attended to, and the number of the sanitary personnel in attendance to be lessened.

Professor Gurlt's observations on the new system of Prussian railway ambulance transport.

“To make the system complete, however, it requires with each train a special wagon to be joined to the others by communicating drawbridges for the sanitary personnel. In this wagon the attendants should be able to wait, to repose, to prepare food, refreshments, medicines, surgical dressings, and to keep the necessary instruments and appliances. Passenger carriages on the system in vogue in the north of Germany are quite unsuited to this purpose. They do not afford the space necessary for the greater part of the objects which require to be kept at hand or prepared for use; their doors open at the sides, so that persons in them could only communicate with other carriages during halts at the railway stations. The organization above mentioned, on the other hand, would permit the sanitary personnel with the train to exercise at any moment and in any part of it control the most efficacious, and, at the same time, would enable them mutually to assist each other in their work.”*

* “*Abbildungen zur Krankenpflege im Felde*,” &c., Berlin, 1868; text, pp. 8, 9.

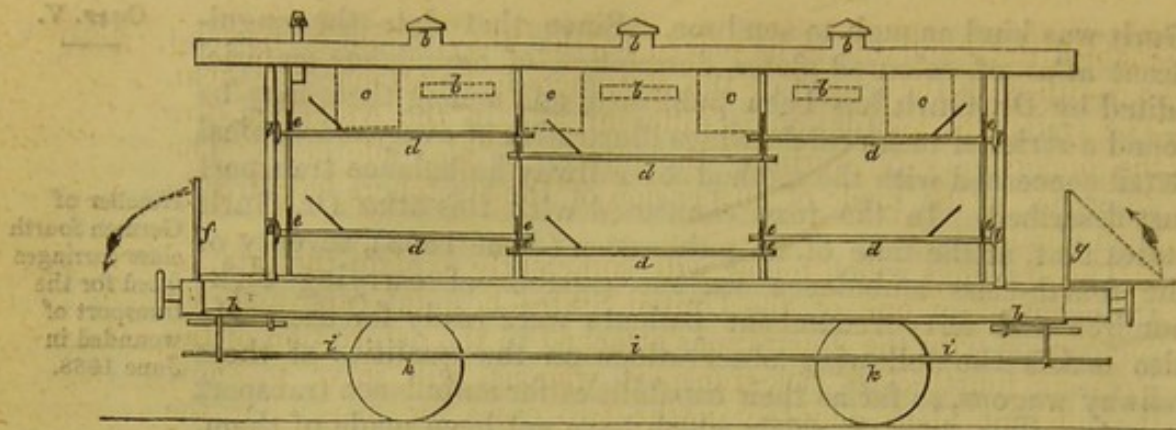


Fig. CLXXVIII.—Longitudinal sectional sketch, showing the general arrangement of the stretchers in one of the fourth-class wagons adopted in Prussia for the transport of wounded in time of war. Scale, quarter inch to a foot. *a*, lamp; *b*, lateral and roof ventilators; *c*, windows; *d*, stretchers; *e*, suspension apparatus; *f*, bridge up; *g*, bridge down; *h*, upper step; *i*, lower step; *k*, wheels; *l*, india-rubber pads.

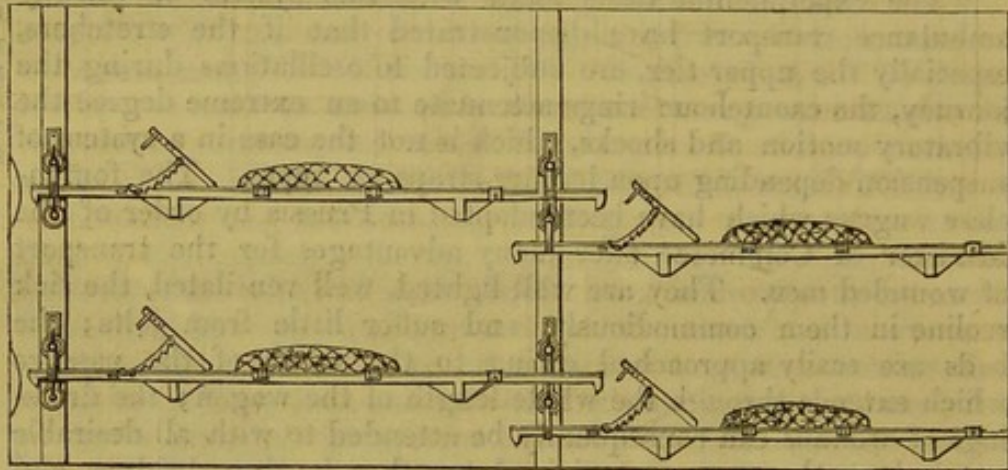


Fig. CLXXIX.—Sketch to show the method of suspending the stretchers in the fourth-class wagons adopted in Prussia for the transport of wounded. See description in text. Scale, half inch to a foot.

Adaptation of luggage wagons in Prussia for carrying recumbent patients.

A subordinate part of the Prussian system has been to make preparations for the covered luggage and merchandize wagons (*Eisenbahn-Güterwagen*), also to be utilized for the transport of wounded in case of need. Many vans of this description are used in time of war for the transport of horses to the front, and the swinging poles, which are then employed for the purpose of separating one horse from another, are economically arranged to be turned to account as supports for stretchers when wounded are required to be sent to the rear. Under ordinary circumstances the swinging poles are connected with the sides of wagons by chains or leathern straps only, but when so attached they are under the direct influence of every concussion to which the wagon itself is subjected. To obviate this inconvenience, in case of the poles being required for bearing wounded men lying on stretchers, the following plan has been adopted. The horse pole itself is unchanged; each of its ends remains protected by its ordinary iron cover and projecting iron ring, and the same kind of staple and ring is fixed to the side of the van as is usually employed for

being connected with the pole; it is the mode in which the union is effected between them, which is changed when they are to be used for sick-transport purposes. Under these latter circumstances a very stout caoutchouc ring and two short straps of leather with buckles are employed. The two leathern straps are passed through the india-rubber ring, one strap is then buckled to the ring hanging from the wall of the wagon, the other strap to the projecting iron ring at the end of the horse-pole. The pole being thus attached at both its ends becomes suspended and possesses the necessary amount of power of yielding to any concussions that may be impressed upon it, and so of lessening their impulse before they can reach anything which the pole may be caused to support.

A Prussian goods' van will carry twelve stretchers by their being placed in two tiers, six above and six below. For this purpose eight horse-poles have to be suspended. Four are suspended at a distance of rather more than a foot and a half above the floor, of course in the transverse direction of the vehicle, and four others immediately over them at a height of a little more than four feet above them. The width of the wagon admits of three stretchers, with intervals of more than half a foot between them, being laid upon each pair of poles, so that twelve stretchers can be laid upon the four pairs.

It is obvious on slight consideration that the system just described, with its two horizontal layers of wounded, one above the other, occupying the complete width of the goods' wagon, is inferior in every respect to that applied to the fourth-class passenger wagons.* Dr. Gurlt has remarked that the length of the poles of the six stretchers composing each one of the tiers leaves scarcely any space in the middle of the wagon for the access of attendants, and that the ventilation is also defective. The latter system can only with propriety be regarded as supplementary to the former, and as one calculated upon for meeting an emergency in case of a sufficient number of fourth-class passenger wagons not being at hand when required.

Observations
on the Prussian
plan of fitting
luggage wagons
for the carriage
of patients.

Practical Experiments at Paris in 1867 and 1868.

Having now described the Prussian experiments on railway ambulance transport and their final results, the trials which were conducted at Paris in 1867 on the same subject have next to be

Experiments
on railway
ambulance

* Now that some of the invalids from India are brought to England by the overland route, involving a railway transit between Suez and Alexandria, the question of the most efficient method of transporting sick by railway, assumes importance in reference to this particular service in Egypt. The Egyptian Railway Department had no vehicles specially fitted for carrying sick up to a recent date, and, I believe, are still without any. As most of the carriages employed on this line are got from Germany there would appear to be no difficulty in getting fourth-class passenger wagons from the same source, complete in all the details necessary for carrying out the system which has been adopted in Prussia. The most weakly invalids could then be carried in their litters from the hospital transports and boats at Suez, transferred in the same litters to the railway wagons, and re-transferred without change to the hospital transports at Alexandria. At present, as noticed elsewhere, the absence of the necessary accommodation on the Egyptian railway is one cause, among others, which prevents any invalids but such as are competent to maintain a sitting position from being sent by the overland route.

Transport of
invalids from
India by the
Egyptian rail-
way.

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transport conducted at Paris in 1867.

adverted to. They were executed under the direction of one of the sections of the International Committee of delegates from the societies for aid to wounded in time of war. The section referred to was deputed to submit to examination the sick-transport contrivances of every description, which had been collected from different countries, and were exposed to view in the park of the Universal Exhibition at the Champ de Mars. Among these objects was a considerable number of articles designed for facilitating the transport of wounded by the ordinary carriages and wagons met with on railways. The chief of these contrivances were exhibited by the Baden national committee, and had all been manufactured by Messrs. Fischer of Heidelberg. The Paris committee being desirous of submitting some of the contrivances selected from these articles to practical trials and of comparing them with some others proposed for similar purposes, a locomotive engine with a passenger third-class carriage and a goods' wagon were placed at their disposal by the directors of the Western railway, one terminus of which had been established within the enclosure of the Exposition grounds. An opportunity was thus afforded of subjecting not only Messrs. Fischer's contrivances, but several other plans of transport, such as the spring-stretcher of Dr. Gauvin, straw paillasses, and loose straw, to the test of a railway train in motion.

The Baden contrivances for carrying wounded in railway carriages.

Trials of the Baden stretchers upon suspended poles.

Swinging litters suspended from the backs of seats in third-class passenger carriages or from the sides of goods' wagons.—The Baden apparatus selected for practical trial were swinging litters formed by stretchers carried upon poles or rafters (*schwebebalken*) suspended from the benches of a third-class carriage, or from the sides of a goods' wagon. The general principle of the contrivance was the same as the Prussian system designed for application to covered luggage vans, which has been already described. The Baden stretchers were differently constructed in several respects, but the most important difference was the plan adopted for lessening the length of the side poles. They were not furnished with wooden handles, nor, indeed, did the side poles extend beyond the traverses; but instead, to enable them to be carried by the bearers, they were provided with handles made of iron tubing three-quarters of an inch in diameter, which could be drawn out for use whenever necessary. The handles were equally capable of being pushed aside, in the same way as door bolts, within the frame of the stretcher when they were not required for use, and proportionably less space was therefore occupied by the stretchers when they were carried within a wagon. On trial there was found to be great difficulty in getting these stretchers through the doorway of the third-class carriage, owing to the entrance not being sufficiently wide, but once within the carriage there was no difficulty in supporting them between the backs of the seats upon the poles provided for the purpose.* The Baden poles were very similar to

* One of the Baden stretchers, supported upon a pair of swinging poles between two benches constructed to resemble those usually met with in third-class railway carriages, is in the Museum of Mil. Surg. at Netley. See Spec. No. 1338.

the horse-box poles used in the Prussian plan. Each end of one of these poles was enclosed in an iron shoe terminating in a projecting loop of the same metal through which a short strap and buckle were passed. This strap held at the other end an iron hook-piece, having a rather long neck between the hook and the eye by which the hook-piece was connected with the strap. This arrangement enabled the poles to be hooked upon the tops of the upright backs of the seats in the third-class carriage, and also, within certain limits, to be adjusted to the dimensions of the spaces between them. When the poles were required for suspension within a goods' wagon where no such supports as the backs of seats could be obtained, the addition of an eye-bolt with a ring into which the hook could be inserted, clamped into the wall of the wagon, became necessary. The poles being suspended in either way the Baden stretchers were laid upon them in the same manner as the Prussian stretchers were perched upon the horse-box poles before described.

The question which was chiefly raised when the Baden plan of suspending the stretchers was tried on the railway between Paris and Grenelle was whether the grasp of the hooks strapped to the supporting poles was sufficiently secure. The oscillations of the carriage caused the hooks to shift upon the backs of the benches, and there seemed to be no doubt that had the vehicle been subjected to a sudden violent jolt it would have caused some of the hooks to jerk off, and all the stretchers in consequence to be upset. This accident, however, as observed, could be easily guarded against by making the hooks deeper, by the use of one or two straps, or other simple means. The persons who placed themselves on the litters experienced no inconvenient movement as the train went along. The transit was equally easy on another occasion when they were slung within a goods' wagon. Three of the Baden stretchers were placed upon the suspended poles in this wagon and it was demonstrated that six such stretchers with patients upon them could be suspended in it if desired, while four other recumbent patients could be placed in certain contrivances designed for the purpose on the floor of the wagon.

Results of the trials.

Baden hand-stretchers and suspended litters for being placed on the floors of railway wagons.—These contrivances consisted of swinging litters suspended by leathern straps within frames. Each litter is held in a separate open frame, the base of which is rectangular and made to rest with the whole of its surface touching the floor.* The whole contrivance closely resembles in principle and construction Colonel Crichton's litter† and it answers the same purpose as this latter was intended to do when placed on the floor of a springless vehicle.

Construction of the Baden swinging litters for use on the floors of railway wagons.

The litters suspended within these contrivances are similar in their leading features to the litters, already described, which

* Spec. No. 1340 in the Mus. of Mil. Surg. at Netley is a pattern of this swinging litter and frame. The German designation of this conveyance is "Universal-Transport-Bett-schwebe und Tragbahre."

† See page 208.

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were exhibited by the Baden committee for being perched on suspended poles. They have like them four sliding iron handles and two supplementary leathern handles, a moveable headrest, a perforated wooden foot-piece, and a bottom of reticulated canvas girthing; in addition, six leathern straps are attached to them. Four of the straps are fixed beneath the stretcher at a short distance from its four corners, and serve to sling the stretcher within the frame. The straps are perforated at their free extremities. At the four corners of the frame, which is considerably longer and broader at the top than at the base, are projecting iron pegs for receiving the four straps. When the litter-straps are fixed on the iron pegs the litter itself lies within the four sides of the frame and moves freely in all directions, limited only by the length of the straps and the frame itself. The two remaining straps are fixed to the two side poles, midway in respect to their length, and are shorter than the straps near the corners of the litter. They can be buckled to the sides of the frame and can thus be employed to restrain lateral oscillation in case the movement should prove to be excessive. The following drawing, which is taken from the pattern in the Netley Museum, shows the stretcher slung within its frame.

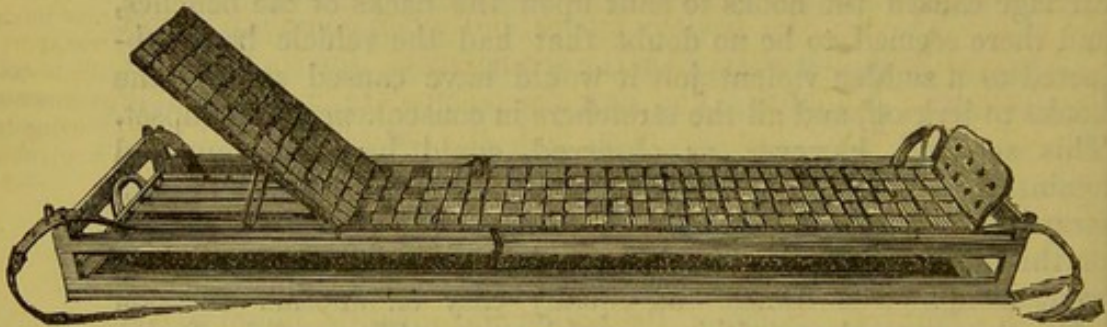


Fig. CLXXX.—Baden Swinging Litter, designed for carrying a wounded man on the floor of a railway wagon.

The Baden swinging litter convertible into a camp bed and bedstead.

The frame is destined to answer a second purpose, and the six straps of the litter, already described, are made to assist in its accomplishment; for the apparatus, litter and frame included, on being removed from the railway train is arranged to form a bed in a tent-hospital. To effect this object, the frame is reversed; the four corners which are uppermost when employed for suspending the stretcher being now placed on the ground and acting as feet. The stretcher is placed upon the part which formed the base of the frame in the railway wagon; the four straps by which the stretcher was then slung are now wound round the two ends of the frame and are buckled together beneath them, and the two short middle straps of the stretcher are also fastened to its sides. The stretcher is thus securely connected with its support, and the broad part of the frame, which was uppermost when the stretcher was slung within it, now acts as a stable base to the whole contrivance. A patient lying on this camp bedstead is raised about a foot and a half above the ground. The swinging litter changed into a field-hospital bed is shown in the following drawing.

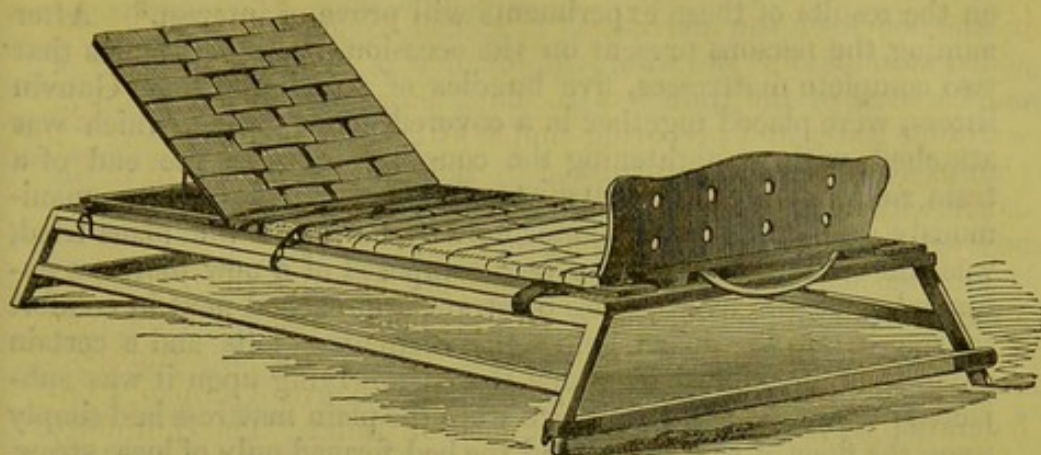


Fig. CLXXXI.—The frame of the Baden Swinging Litter reversed, and the litter fastened to form a field-hospital bed.

The Gauvin spring-stretchers placed on the floors of goods' wagons and applied to railway ambulance transport.—A drawing of Dr. Gauvin's spring-stretcher removed from its wheels has been given on page 251 of this treatise, and in the accompanying description of the contrivance, it was mentioned as one of its qualities that it was capable of use on railway wagons. In order to test its value in this respect, it was placed on the floor of the goods' wagon used in the experiments conducted between Paris and Grenelle, and several persons laid themselves upon it in succession during the transit. The reports concerning it were very favourable. It was found that the insertion of the stretcher, with a person lying upon it, into the wagon could be easily managed by three persons, while other stretchers required four and even six persons to manœuvre them. In the instance of Dr. Gauvin's stretcher, the construction, especially the side-wings, helped to keep the person secure on the stretcher during the movement, and the small wheels attached to the lower part of the frame facilitated the gliding of the conveyance along the floor of the wagon. The stretchers were not introduced from a raised platform, but from ground on the same level as the rails, so that the elevation of the floor of the wagon increased the difficulty. The persons who reclined upon the Gauvin stretcher found their position very easy during the journey to Grenelle and back; so much so, that Baron Larrey and Professor Gurlt who, among others, tried the effects of the contrivance, were induced to say that the gently rocking movement caused by it had a tendency to lull a person to repose and even sleep.

Trials of the Gauvin spring-stretchers on the Western railway in 1867.

The results of these trials, and the favourable reports concerning the Gauvin spring-stretcher, caused it to be subjected to further experimental trials. These trials were conducted at the Eastern railway of France by the inspector and other officers of the railway company on the 20th of January 1868, under the supervision of two members of a committee appointed by the Minister of War for inquiring into and organizing the service of the transport of wounded soldiers. Some extracts from a report

Fresh trials of the Gauvin spring-stretchers in 1868.

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Report on the
results of these
trials.

on the results of these experiments will prove of interest.* After naming the persons present on the occasion, the report states that two complete mattresses, five bundles of straw, and some Gauvin litters, were placed together in a covered goods' wagon which was attached, without tightening the coupling irons, at the end of a train running round the outskirts of Paris, and that it was unanimously agreed the most comfortable by far of all the plans tried, was the Gauvin litter. The bed, composed of a new mattress extended upon the five bundles of straw, approached next in comfort to the litter, its defect being the oscillating jolts and a certain amount of instability to which the person lying upon it was subjected; while the most defective were the plain mattress laid simply upon the floor of the wagon, and the bed formed only of loose straw. The superiority of the Gauvin stretcher also, as regards loading and unloading the wagons, was demonstrated by repeated trials. A man carried on a mattress or without any litter under him, required at least four bearers, beside an assistant in the interior of the wagon, and in spite of all their precautions very serious disturbance and shaking could not be avoided. With the Gauvin stretcher manœuvred by two bearers, the person lying upon it was not subjected to any derangement of his position. The introduction of the stretcher was facilitated by its small wooden rollers.

Experiments on
the effects upon
the stretchers
of collisions in
the train.

The following experiment was performed in order to ascertain how the Gauvin stretchers on the floor of a wagon, if wounded men were lying upon them, would support the collisions and counter-shocks resulting, not from accidents, but from the ordinary movements of carriages at stations when they are not done with care. During a halt at one of the stations on the line, the persons engaged in the experimental trials placed themselves on the stretchers and straw litters in the wagon, while some of the railway people of the station, with the committee of inquiry and soldiers on duty, pushed it from a distance of about a hundred and fifty yards against a train which was standing still at the time. The collision took place at a rate of speed rather less than four miles an hour. The stretchers placed in advance, in respect to the direction of movement, did not quit their places, but the springs connecting the two frames became disconnected at the heads of the stretchers, so that the upper frames fell down upon the lower frames. The stretchers placed in rear, in respect to the direction of movement, ran from their positions upon their rollers and struck against the stretchers lying in front of them. The result of the experiment proved the necessity of two improvements:—firstly, the consolidation of the spring connexions between the upper and lower parts of the stretcher; secondly, the adoption of some means, and many readily suggested themselves, for keeping the stretchers steadfast in their places as soon as they were deposited on the floor of the wagon. The persons who occupied the straw litter and the

Effects of
collisions upon
straw litters.

* The whole of the report from which these extracts are taken, will be found in the Appendix to the "Conférences Internationales des Sociétés de Secours aux Blessés Militaires," &c, deuxième partie, p. 282.

mattress underwent such a degree of sliding movement that, if they had not taken the precaution of facing the direction towards which the wagon was pushed, their heads would have been knocked against the end of the vehicle which was stopped by contact with the stationary carriages.

The experiment, moreover, demonstrated the necessity of placing recumbent patients longitudinally in the direction of the railway.

The report states that the matériel of the Eastern Railway of France in one description of wagon only, would suffice for the transport of 30,984 severely wounded men. The company possesses 3,873 vehicles of the kind referred to, and each one can accommodate eight Gauvin stretchers on the floor; the dimensions of the stretchers being 2m. 35, or about $7\frac{1}{2}$ feet in length, by 0m. 52, or $20\frac{1}{2}$ inches in width. These dimensions are somewhat less than they were in the stretchers originally constructed by Dr. Gauvin. Passenger carriages would remain for the disposal of men slightly wounded. Supposing a requisition to be made for the transport of 15,000 wounded, of whom 5,000 were suffering from wounds necessitating a recumbent position, it would be necessary to put on service 703 wagons of the kind already alluded to, and the same number of passenger carriages with four compartments; there would then be a seat or a bed in every vehicle for a guard or hospital attendant in addition to the patients.

Calculated number of wounded that could be carried at one time by the Eastern Railway of France on the Gauvin system.

The manner in which the stretchers would be disposed according to the calculation above stated is shown in the following sketch.

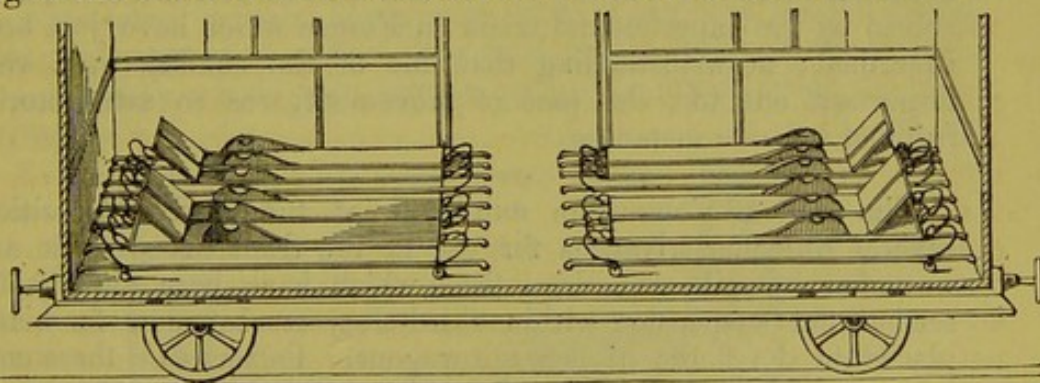


Fig. CLXXXII.—Perspective view of a Goods' Wagon containing eight Gauvin spring-stretchers.

Admitting, however, what appeared to be demonstrated by the experimental trials on the several occasions mentioned, that the transport of severely wounded patients may be effected with all the ease that can be expected to be obtained on railways, either in the Baden litters suspended from the sides, or in the Baden swinging litters within frames and the spring litters of Dr. Gauvin placed on the floors, of railway wagons, the question still remains how far such methods of transport are suitable for the general purposes of transporting sick in time of war? The Baden litters, from their weight and complicated construction, and from the absence of several of the qualities described in the remarks on the subject of hand-litters, are not fit for use as field stretchers, and, as elsewhere remarked, it is very desirable that the stretchers used

Observations on the several kinds of suspended litters just described.

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in railway carriages employed in time of war for ambulance transport should be the same as those which are ordinarily used in the field. One of the best features in the new Prussian system is that neither the stretchers nor the carriages in which they are to be used are specially constructed for the service. Dr. Gauvin's spring stretcher, excellent as it is as a secondary stretcher, is also from its complex design and construction unfitted for use as a primary field stretcher. If applied to wheels they might be employed advantageously for bringing patients from the field or from hospital to the railway, and the wheeled supports, being carried in the train, might equally well serve for carrying the stretchers without disturbing their occupants from the railway carriages to their places of destination; but it can scarcely be expected that any administration will sanction the provision of such special contrivances as the Gauvin wheeled litters, or the Baden swinging litters, in numbers at all adequate to meet the wants which are likely to arise in time of war. Their cost, bulk, weight, and doubtful durability would prove insuperable objections to the proposal if it were made. The Gauvin litters have greatly the advantage over the Baden swinging litters in respect to weight and portability, but their complicated construction would cause them to be soon disabled for service under the trying circumstances to which they would be subjected in campaigning. The conditions of the problem for determining a simple and efficient mode of carrying sick and wounded troops in time of war by such railway carriages as are in ordinary use in Europe has not, therefore, been solved by the experimental trials in France which have just been described; notwithstanding that one of the conditions, a very important one too, viz., ease of movement, was so satisfactorily fulfilled in some instances.

The Baden Committee exhibited, at the Paris Exposition, several other contrivances for use in the transport of sick and wounded by railway besides those which have been already described for suspension within third-class carriages or for being placed on the floors of luggage wagons. Patterns of these contrivances are contained in the Museum of Military Surgery at Netley, and it will be useful to explain briefly the nature and construction of the chief examples among them.

Litter for a recumbent patient in a first-class railway carriage.

Coupée-bett und Tragbahre. *—This contrivance is a full-length stretcher designed for use in a compartment of a first or second-class railway carriage. It is arranged for carrying a wounded patient in a recumbent posture into the compartment, and also for being left and supported in it so as to act as a bed for him during the journey. The litter is made narrow so as to admit of being carried in and out of either door of the compartment, in order that the patient may be taken from the train as well as put into it without any disturbance. Its chief peculiarity consists in being fitted with two short horizontal scantlings of wood, three or four inches broad, beneath its frame, and in these battens being made capable of shifting their position from a longitudinal to a transverse

* Spec. No. 1336 in the Mus. of Mil. Surg. at Netley.

direction by turning on a pivot. When the stretcher is carried into the compartment they are in one and the same line with the frame to which they are attached. When the litter is within the compartment the battens are turned round by the two bearers, and they then rest upon the opposite seats of the carriage and act as supports. The handles of the litter are made of iron tubing, and like the handles in most of the stretchers made by Messrs. Fischer of Heidelberg, can be drawn out, or pushed within the frame at pleasure. The litter is furnished with a head-piece capable of being raised to different heights, and also with two long lateral supports and a foot-piece. The foot-piece can be taken out and shifted into corresponding openings made at intervals in the sides of the frame, so as to adapt the stretcher to persons of different heights. The cost of the pattern in the Netley Museum was three pounds eighteen shillings, but stretchers of the same design could obviously be constructed at a much lower cost if a large supply were required.

This form of litter is stated to have been found very useful during the war of 1866 on the Baden railways, especially for the transport of wounded officers. Its expense, however, not simply as regards the cost of the stretcher itself, but also in respect to the amount of space occupied by it, for there would be only room in the compartment of the carriage for an attendant beside the patient, would probably militate against its adoption for the general purposes of military transport; still, for occasional special cases its use may be found desirable. The manner in which it is employed as a stretcher, and its appearance after it has been placed within the compartment of a first-class carriage are shown in the following sketches, which were sent to me by the inventors of the contrivance:*

Mode of supporting the litter within a first-class carriage compartment.

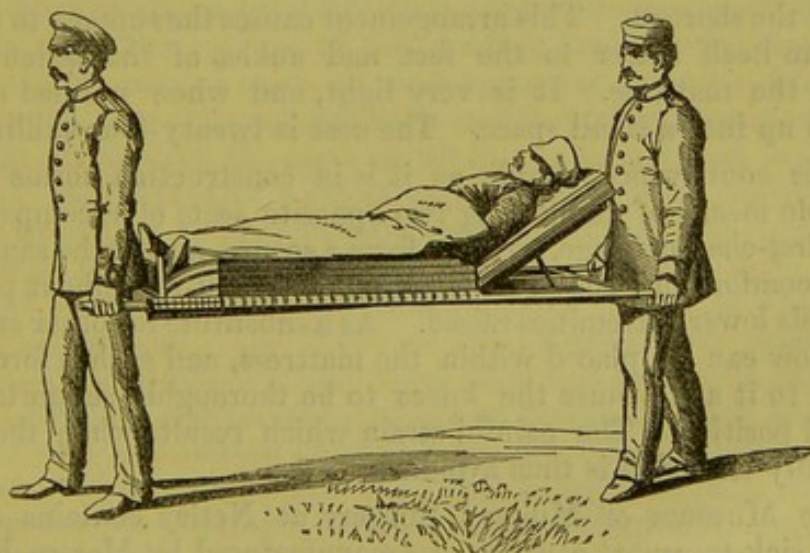


Fig. CLXXXIII.—Contrivance designed for conveying a recumbent patient in a Compartment of a First-class Railway Carriage, in use as a hand-litter.

* Messrs. Fischer, of Heidelberg, who are the most extensive manufacturers of field-transport appliances and hospital apparatus in Europe, have lately published an illustrated and descriptive catalogue of their inventions and manufactures, which will repay the trouble of examination. It is entitled "Catalog sämtlicher Apparate und Geräthschaften zu Heilzwecken, von F. Fischer & Cie., in Heidelberg. Mit mehr als 300 lithographirten Abbildungen. Heidelberg, 1867."

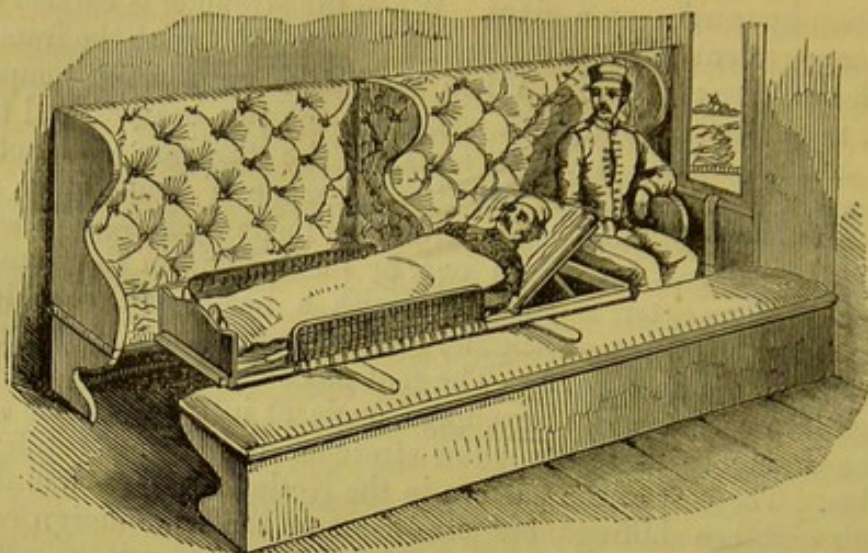


Fig. CLXXXIV.—The same contrivance in use within the Carriage.

Litter for a semi-recumbent patient in a first-class railway carriage.

Portable mattress for first-class carriages (coupée-quersitz). — The construction of these contrivances is very simple. Each consists of a strong canvas mattress about three feet in length, with an opening above, so that it may be filled with hay, straw, or any other suitable material, and then be buttoned up. The under surface is padded, and strengthened by being strongly secured to five longitudinal smooth ribs of wood, each being about one inch in width. These ribs are fastened three inches apart from each other. The two outer ribs form the two sides of the padded support. Two strong leathern handles are firmly nailed to the two ends of each of these outer ribs. All the ribs are at a level at the upper end of the litter; at the lower end of the litter the three inner ribs are shorter than the two outer, the middle of the three being the shortest. This arrangement causes the support to accommodate itself better to the feet and ankles of the patient lying upon the mattress. It is very light, and when unfilled can be rolled up into a small space. The cost is twenty-four shillings.

This contrivance, simple as it is in construction, forms an admirable means of connecting two opposite seats of a compartment in a first-class carriage, so as to form a secure, and at the same time very comfortable, couch for a patient in a semi-recumbent position with his lower extremities raised. As a substitute for other stuffing, a pillow can be placed within the mattress, and such a form then given to it as to cause the knees to be thoroughly supported in a flexed position. The painful strain which results when the limbs are fully extended is thus avoided.

The Museum of Military Surgery at Netley contains several other sick-transport contrivances manufactured by Messrs. Fischer of Heidelberg, for use in *first* and *second*-class railway passenger carriages, but as they are constructed on the same principles as those already described, and are only modified in special portions, it does not appear worth while to make further allusion to them.

* Spec. No. 1336a, in the Mus. of Mil. Surg. at Netley.

*Portable jointed litter-support for third-class passenger carriages (gegliederte coupé-unterlage).**—This contrivance is designed for producing a substantial and level surface for the reception of recumbent patients, by connecting together and filling up the space between the opposite wooden benches of a compartment in a *third-class* carriage. It simply consists of a series of nine ribs or narrow planks of wood, each four feet in length, nearly two inches in width, and one inch in depth. These battens are placed seven inches apart from one another, and are secured together by three strong bands of webbing, each three inches in width. These connecting bands are nailed on at a distance of sixteen inches from each end of the wooden laths, and being separated from each other by a space of three inches, the three bands occupy about sixteen inches of the central portion of the contrivance. When rolled up, the circumference of the litter-support is twenty inches. On being unrolled, and on the ends being laid upon two opposite benches, a platform is formed, the length of which is five feet ten inches, and the width four feet. On this support either mattresses or layers of straw alone may be laid, and a bed be so contrived for the reception of two or three wounded men lying in a direction corresponding with the length of the original seats, the opposite direction to that in which they are ordinarily used. This contrivance is very simple, is of very little cost, the price of the pattern obtained from Heidelberg for the museum at Netley being seven shillings, and is capable of being manufactured rapidly and anywhere. Its use, moreover, does not entail any change, or any injury, not even the fixing of a screw, to any carriage in which it may be employed.

Like the several contrivances, however, which have been already described for being laid upon and connecting the seats of first and second-class carriages, this third-class jointed litter-support depends entirely upon the springs of the carriage itself for its elasticity. The patients carried upon all such apparatus must be subjected to the same jolts and concussions as ordinary passengers are liable to when sitting upon the seats on which the contrivances are made to rest. The effect is more objectionable as regards the contrivances which cause the recumbent patients to be placed transversely to the line of movement of the carriages, than it is with those which admit of patients lying in the same direction as that in which the train is travelling. The whole of the patient's body under the former circumstances becomes rolled from side to side in case of a sudden jolt, in a manner which he has no power to resist; and even without any such sudden impetus a feeling of instability and discomfort is usually engendered by lying across a carriage which is not experienced when the person is placed longitudinally, corresponding with the direction in which the train is travelling. The sense of discomfort is probably due to the transverse direction being contrary to that which is naturally assumed by the body in the act of progression; partly it may be, also, to some disturbance, caused by the peculiarity of the movement, to the circulatory fluids of the body.

CHAP. V.

Contrivance for transporting recumbent patients in third-class railway carriages.

Advantages of this contrivance.

Objections to all apparatus laid upon the seats of passenger carriages.

* Spec. No. 1,336b, in the Mus. of Mil. Surg. at Netley.

CHAP. V.

Transport of Sick and Wounded Soldiers by Railway in the United States.

Early transportation of wounded during the war of the Rebellion in the United States.

System introduced at the end of the year 1863.

Passenger cars in the United States.

Transport of wounded of the army of the Potomac in June 1863.

United States' hospital trains.—For a considerable period of the late Civil war in the United States, the railway transportation of the sick and wounded of the Northern as well as of the Southern armies was carried on in the ordinary passenger and luggage cars, and is generally described to have been attended with severe suffering from the absence of necessary appliances and from the motion of the vehicles. Dr. Letterman, of the United States' army, Medical Director of the Army of the Potomac, however, mentions having moved some thousands of sick and wounded in railway carriages with great comfort by adopting a plan similar to that which has been already described as the system which was authorized for use in Prussia during the campaign of 1866.*

Towards the end of the year 1863, the United States' Government adopted a system of specially-fitted sick-transport cars for the lines of railway running in the directions on which the armies were operating. These railway ambulance vehicles were first contrived, it is stated, at the suggestion and in accordance with the designs of Dr. Harris, a member of the United States' Sanitary Commission. They were only calculated for the reception of patients who required a recumbent position. The external frame and the general arrangement of the carriage itself remained the same as when employed for the conveyance of ordinary passengers in a sitting position, but the furniture of the interior was entirely changed. A passenger car in America consists of a large carriage with a door at each end, not at the sides, and a central passage down the whole length of the vehicle. On each side of this passage there is a row of seats, each capable of accommodating two sitters. Outside both ends of the car is a platform, with steps at its sides by means of which the passengers ascend to the car

* As Dr. Letterman's work is not much known in this country, the following extract, describing his arrangements for transporting a large number of patients by railway on the army leaving Fredericksburg for Maryland in June 1863, will be of interest:—"The railroad from Fredericksburg to Aquia Creek depôt had a single track, with short sidings. Over this road had to be transported, in a very short time, more than nine thousand wounded and sick, with all the hospital tents, medical and surgical supplies, stores, &c. required for their care, together with the accumulated supplies of the Quartermaster's, Commissary, and Ordnance Departments. I sent Medical Inspector Taylor to Aquia Creek to receive the wounded and send them by hospital ships to Washington. The network of telegraph wires made by the Signal Corps enabled me to regulate the shipment of this large number of men without difficulty or accident. I had directed that all who could not sit up, or who would be injured by so doing, should be carried by hand upon the beds they occupied in the hospitals (some of which were more than a mile from the railway), the beds placed upon hay in the cars, removed carefully from the train and placed in the transports, so that the sufferers should not be removed from the beds on which they lay in the camp hospitals until they reached the hospitals in Washington. Medical officers, with supplies, accompanied every train, and, when required, were sent with their men to Washington. Many of those most severely wounded, cases in which the femur was extensively fractured, assured me they had not suffered the slightest discomfort or fatigue up to the time of their being placed on the transports." The removal of this convoy of sick and wounded, numbering nine thousand and twenty-five, began on the morning of the 12th of June, and before six o'clock in the evening of the 14th of June, all had left the depôt at Aquia for Washington.—"Medical Recollections of the Army of the Potomac, by J. Letterman, M.D., &c., New York, 1866," p. 150.

doors; and the junction of the platforms, which are all made on an uniform level, belonging to adjacent cars, enables a communication to be kept up throughout the whole of the train, even while the cars are in motion. There is no division of carriages into compartments as in England. The cars which were built for hospital service were constructed with similar end doors, central passage, and communicating platforms; but on each side of the interior, instead of the ordinary seats, standing frames were erected, so that stretchers could be secured to them for recumbent patients.

Conversion of passenger cars into sick-transport cars in the United States.

The standing frames were thus constructed. Two rows of square upright posts of wood, secured to the floor, and continued up to the ceiling of the car, were placed at intervals along each side of the central passage. They were fixed at such distances apart that the space between every two of them corresponded in length with the length of an ordinary field stretcher. Each pillar was furnished with six strong projecting wooden pegs. Three of these pegs were placed one above the other, at certain distances between the floor and the ceiling on the face of the wooden post looking toward the central passage, and three others at a slightly higher level on one of its sides. Each of the posts adjoining the passage had a fellow post fixed against the corresponding side of the car between the windows, and fitted with pegs at like distances above the floor. The width between any two of these fellow posts was rather less than the width of a field stretcher, the difference in dimension being the same as the depth of the upright post. This arrangement was adopted in order that one of the side-poles of each stretcher might rest inside of the upright post next to the wall of the carriage, and outside of the upright post next to the central passage of the carriage. The suspension of the stretcher was rendered easier than it would have been had it been placed entirely between the upright posts. The projecting pegs were intended for the reception of massive circular bands of vulcanized india-rubber, and the india-rubber bands, when suspended, to receive the ends of the stretcher-poles. When a litter with the weight of a patient upon it was made to rest within these bands, the bands were put on the stretch, and drawn down from the pegs which formed their fixed points of support. The patients thus not only had the benefit of lying on the soft and somewhat yielding canvas of the stretcher, but had all the advantages he would have had from a litter on springs, owing to the elasticity of the bands by which the litter was supported.

Mode of slinging stretchers in the United States sick-transport cars.

Objections have been raised in this treatise to the use of india-rubber springs when applied to sick-transport wagons and carts. But this is one of the occasions in which no objection could be made to the use of well-prepared vulcanized india-rubber bands of proper strength and consistence. There could scarcely be time under the circumstances in which railway conveyances are likely to be employed in time of war for the molecular changes to take place, which so frequently render vulcanized caoutchouc articles useless. Moreover, any number of these bands could be speedily got ready for use, and from the facilities

India-rubber rings employed for slinging stretchers in the United States cars.

CHAP. V.

Ventilation and lighting of the United States sick-transport railway cars.

Hospital equipment attached to trains of sick-transport cars in the United States.

Comparison between the United States, and the new Prussian systems of railway ambulance transport.

of communication between one part of a railway line and another there would be no risk of not being able to replace them from the stores in case of loss or injury of those which had been issued for service. Some of the india-rubber rings which had been employed in railway hospital cars in the United States were at the Paris Exhibition of 1867, and appeared to be still in perfect order.* They were not made in separate strands like the india-rubber springs of which a drawing is given on page 420, but consisted each of one solid circular mass.

The American cars were well lighted by windows in the sides and doors of the vehicles, as well as by panes of glass along a portion of the roof which was elevated, like a ship's skylight, above the general level. This raised portion of the roof rested upon the two central rows of posts, and corresponded in size with the central passage of the carriage. The whole of the interior was capable of being very quickly and freely ventilated by opening the windows and doors, at the same time that the admission of rain was guarded against by projecting eaves. Each carriage was also furnished with a stove, so arranged that by its means the carriage could be both heated and ventilated in case of severe weather preventing the windows from being opened. It was essential for a good system of aeration to be provided, on account of the large number of wounded patients, thirty-two, which each sick-transport car was prepared to accommodate.

When a train of ambulance cars was travelling along a line its nature was plainly indicated by a hospital flag near the engine, and by the words "Hospital Train" in large letters on the van next to the engine tender.

A train of ambulance cars carried with it nearly all the appliances and materials necessary for the sick and wounded that would be found in a fixed hospital. In one carriage was a specially arranged stove for heating water, and suited for such culinary purposes as preparing tea, soup, and other simple restoratives and nourishment for the patients. A certain number of hospital attendants, as well as surgeons, accompanied the trains, and even means were supplied for verbal communication between the surgeons and attendants by speaking tubes being fitted along the carriages. It is also mentioned, with regard to the hospital cars furnished by the United States Sanitary Commission, that most of them were grooved to run upon railways of different gauges, so as to avoid needless transfers of patients. These cars and the Government cars were constructed on the same general plan.

It will thus be seen that the United States' hospital cars, when fitted with standing frames, closely resembled the new Prussian fourth-class sick-transport wagons described elsewhere. The chief difference between them arises from the greater length of the United States' cars. The great length of the American cars

* Having had many opportunities of practically comparing vulcanized caoutchouc articles manufactured in the United States with similar articles manufactured in England, I have invariably found the former more consistent and durable. Vulcanized india-rubber was an American invention.

enabled the standards to be placed so that they should correspond in width with the length of the stretchers to be attached to them. The system of ventilation is different, and in the American cars the opportunity of warming the interior is also afforded. The difference in the mode of suspension of the stretchers has already been alluded to.

The drawings which follow will sufficiently explain the interior arrangement of one of the United States' hospital cars, and, by comparison with the illustrations attached to the description of the Prussian fourth-class sick-transport wagons, will serve to show the different plans adopted in the two cases for suspending the stretchers.

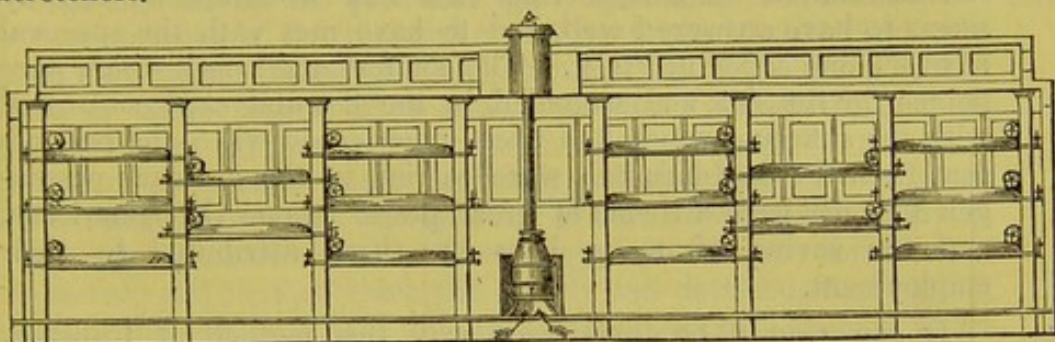


Fig. CLXXXV.—Side elevation of the interior of an American hospital car.*

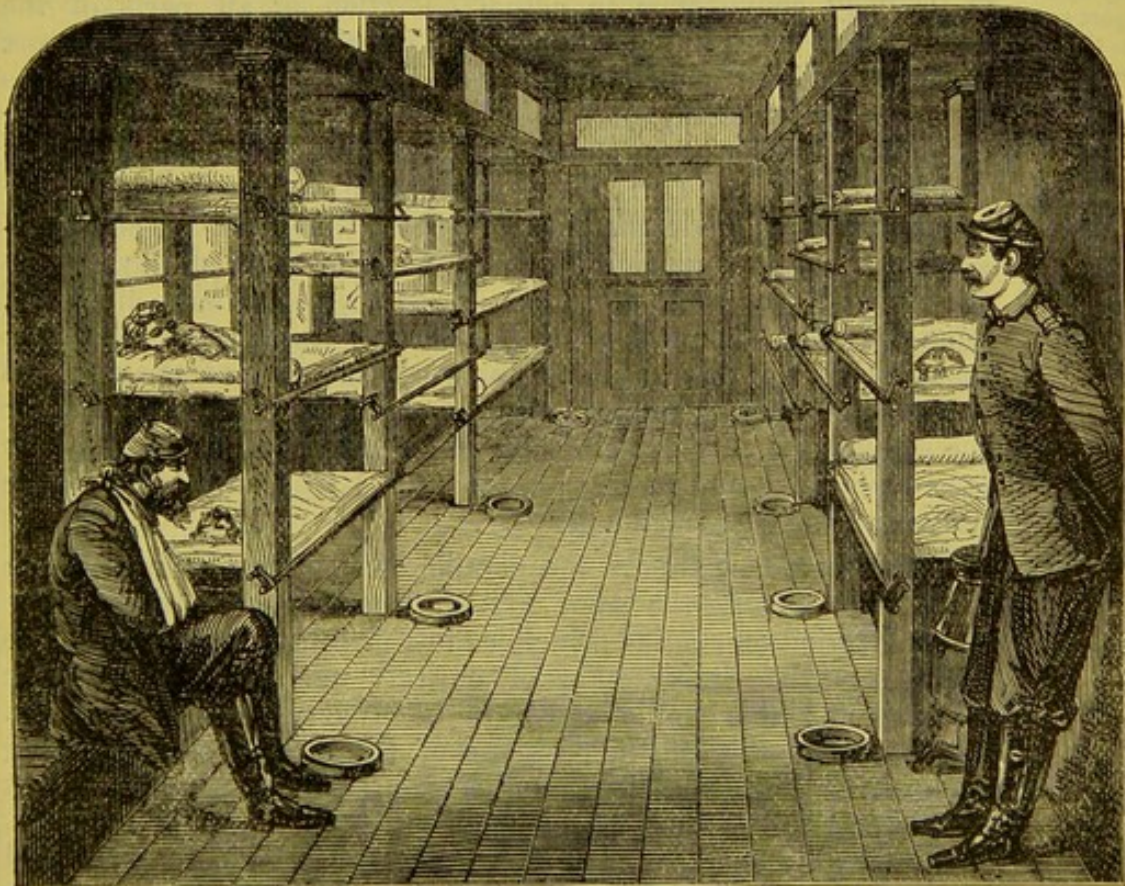


Fig. CLXXXVI.—Perspective view of half the interior of an American hospital car conveying wounded soldiers.

* This drawing is copied from one of the illustrations in a work by Dr. Evans, entitled "La Commission Sanitaire des Etats-Unis," and published by G. E. Dentu, Paris, 1865.

CHAP. V.

Carriage of patients into the United States' sick-transport railway cars.

The stretchers suspended in the United States hospital cars being the field stretchers in ordinary use, when a patient was brought to the train there was no necessity for moving him from the position in which he had been carried to the station. The stretcher with the patient upon it was lifted into the space between the pillars before described and properly adjusted, the caoutchouc rings hanging from the pegs were slipped over the ends of the poles, and the patient was at once in his place ready for transportation. No contrivance for shifting a wounded man from the field to the train could be easier for the patient or for the bearers.

This method of transporting sick and wounded by railway seems to have answered well, and to have met with the approval of every one concerned in it. The comfort and safety which were gained for the sick and wounded in the hospital cars, contrasted with the suffering which had been experienced when the patients sent from the field hospitals were carried in the ordinary passenger cars, has been a theme of great praise among the Americans, and the saving of many lives has been attributed to their employment.

Causes of the success of the railway sick-transport system in the United States.

It can readily be understood why this method of transport proved successful. It was in accordance with the general system of railway conveyance in actual operation in all parts of the country; it necessitated no new form of carriage for the transport of the wounded from the field, or of sick from camp; there was no necessity for changing the patient from one litter to another either on entering or on leaving the hospital train; jarring and painful concussions during the transportation, which was usually conducted at a moderate rate of speed, were almost wholly prevented; food and medicines could be administered during the transit and surgical attention given, without any difficulty, whatever the distance of the journey. Lastly, the plan was inexpensive, for neither the framework nor any of the essential parts of the railway car were altered, while the fittings put up for the support of the stretchers could be readily removed when no longer required, and replaced by the seats in common use in the passenger carriages of the country.

Difficulties in applying the same system to English railways.

There would be almost insuperable difficulties, however, in the way of introducing the same system into England. Ambulance transportation on similar principles in this country would at once necessitate the construction of entirely new carriages for the purpose, and this would prove to be a very costly proceeding. But independently of the cost, and of the difficulty of providing such carriages in sufficient numbers to ensure their presence at all the particular places where they might happen to be required, the great difference between the broad and narrow gauges adopted by certain railways in England, the necessary limitations as to the height of carriages, owing to the low pitch occasionally of the arches and tunnels which have to be passed under, and other such matters, would be further impediments to the introduction of ambulance cars on the American system in England.

The experience gained in railway ambulance conveyance during the late war in the United States can therefore be turned to but little account in this country.

There seems to be some probability that the plan, which now exists in America, of having sleeping carriages on railways for night travellers between distant stations, will be brought before very long into common use in Europe. Should such carriages be introduced they would apparently afford a ready means of transporting the sick and wounded in time of war whose condition may render a recumbent position a matter of necessity. The sleeping berths which would be provided for ordinary passengers would necessarily be provided with appliances to obviate the communication of the jolts and concussions which must every now and then occur, during a long journey, from unevenness in the rails or other causes, or at fresh starts after temporary halts at intermediate stations. They would thus answer for the conveyance of patients, more especially as when used for military sick-transport purposes, the speed of the trains would probably be lessened, and there would be fewer stoppages between the point of departure and that at which the convoy was destined to stop. If each of the principal lines of railway possessed two sleeping trains for night service, and two trains at least would be required for moving in opposite directions, it is obvious that, in case of necessity, the Government would have at once the means of collecting on any point of a particular line of railway a large number of carriages suited for removing the worst cases of wounds or sickness.

Probable introduction of the United States' sleeping cars upon English railways.

Easy conversion of sleeping, into sick-transport carriages.

Transport of Sick and Wounded Soldiers by Railway in India.

On looking, even superficially, over a map exhibiting the vast area of Indian territory, approaching a million of square miles, under direct British administration,—the development of the system of railways by which the main routes of this area have been of late years becoming gradually traversed,—and indicating, at the same time, the wide distances apart at which the British forces on duty in India are stationed, a mere glance will be sufficient to demonstrate the immense extent to which the transport of troops, both healthy and sick, must be resorted to, not only in case of warlike operations in the country, but also in time of peace. It will be useful to notice the chief sources of the railway transport of troops in general in India at the present time, to indicate the probable increased amount of this transport in future when the railways now in progress are completed, and to mention the arrangements which have been recommended for meeting these demands, especially as regards the transport of soldiers disabled by the effects of sickness or wounds.

Circumstances dominating the transport of troops by railway in India.

There are two movements among the troops quartered in India which occur every year as part of the ordinary routine service. These are the "moves in course of ordinary relief," and the "moves of soldiers proceeding from their regiments as invalids."

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Moves of regiments in India.

The first series of moves generally arises out of the departure of regiments which have completed their terms of service in India, and the arrival of fresh regiments from England to replace them. These regimental "reliefs" lead to numerous changes of stations among the troops remaining in the country; and as the chief military stations abut upon, or are approached by, the principal lines of railway, a great part of this system of departure, relief, and intermediate moves can now be most expeditiously and economically effected by railway transport.* Formerly the whole of the reliefs in the country were carried out by slow nightly marches, as it is still in parts not intersected by railways, often extending over periods of many consecutive weeks. The hospital establishment, which in India is a very large one, accompanied each regiment, dhoolies being issued for the transport of the sick and disabled in proportions which have been already mentioned elsewhere.†

Moves of invalids.

The moves of "invalids" are of two kinds. One is the removal of invalid soldiers recommended for change of air from the plains to convalescent stations in the hills; the other is the removal of invalids and inefficient soldiers recommended for change of climate, or for discharge from the army to England. The average annual proportion of soldiers invalided from India to Europe during recent years has been rather under 4 per cent. Supposing the number to be 4 per cent, there would be with a force of 60,000 men, which is about the strength of European troops in the country, 2,400 invalids to be sent home.‡

Method of moving invalids in and from India hitherto.

The removal of the invalids from the army of India has been hitherto effected as follows. The invalids of each season being collected in their respective military commands were brought down, partly carried in dhoolies, on gharries or hackeries, or by marching on foot,§ and partly by railway so far as the opportunity has existed, to the three presidency ports of Calcutta, Madras, and Bombay. At these ports they were placed on board invalid transports hired and specially fitted for their accommodation. Not only the invalids of regiments remaining in India, but also

* It is contemplated, I am informed, when the system of Indian railways radiating upon Bombay are completed, for the sake of economy and easy administration so to arrange the positions of regiments in the country, that they shall be successively quartered at stations approaching the port of embarkation in an order corresponding with the successive periods of expiry of their terms of service in India, and consequently with the nearness of the time for their return to Europe. But some years must elapse before this plan can be carried into operation.

† See page 177.

‡ In the year 1865, 2,558 invalids were sent home to England from the three presidencies of Bengal, Madras, and Bombay. The mean strength of the troops was 62,589, so that the proportion of invalids sent home was rather above 4 per cent. But this was above the average of several previous years. See Army Med. Reports, vol. vii., 1867, p. 145. A greater number arrived at Netley from India during the year 1867, viz. 3,078. Of this number, 1,639 invalids came from Bengal, 900 from Bombay, and 539 from Madras.

§ It must be remembered that in military phraseology the term *invalid* has a much more extended signification than it has in the language of civil life. Any soldier who is found by a committee of medical officers to be inefficient for service, not only from an actual state of ill-health but from any other cause, and is sent away from the army in consequence, is designated an "invalid."

those of regiments proceeding to England were sent in the manner described. The invalid transports were regarded as "hospital ships," and accordingly, special arrangements were made in them for the benefit of the sick passengers, more cubical space was allowed for each man, and an appropriate system of dieting, with other matters involving extra expense and greatly differing from what was contracted for in the instance of transports hired to carry sound and able soldiers, were sanctioned by the Indian Government.

In the year 1867, a new system for relieving the regiments whose term of service in India had expired was introduced. Capacious steam troop-ships were constructed, to carry out fresh and to bring home the returning regiments. Instead of proceeding, as the sailing transports had done, round the Cape of Good Hope, the troops were now moved by the "overland route," some of the naval transports steaming between India and Suez, others between Alexandria and England. As the railways constructed, or under construction, radiated from Bombay to Bengal and Madras, Bombay was decided to be the port at which the troops proceeding from England should be disembarked, and the port of embarkation for troops leaving India for England.

Transport by the overland route introduced in 1867.

Not only, however, does the new overland route system change the plan of moving the healthy troops, but when complete it will lead to corresponding changes in the arrangements for transporting the invalids to England. The new troop-ships are made capable not only of carrying healthy men, but are also fitted with the necessary hospital accommodation for invalids. A regiment proceeding to England need no longer, therefore, be separated from its invalids, at least not from those at the station where the regiment was quartered at the time of its receiving the order to leave the country. Some of the regimental invalids might be so far removed at convalescent stations in the hills as to be unable to join their own regiments in time to proceed with them, and they would have to join the general convoys of invalids for England. But, omitting these, every regiment proceeding by railway to Bombay for embarkation can carry home with it a certain proportion of sick and disabled men. Hence arises need for a corresponding proportion of railway hospital accommodation with every regiment on its way to embark for return to England; for some of the invalids—men suffering from dysentery, hepatic diseases, and other tropical ailments, as well as casual injuries—can only be fittingly carried in a recumbent position, and with the means of medical and surgical attention at hand which their cases may require.

Effect of the new mode of transport on the invalids of regiments moving to England.

But a still greater need for railway hospital accommodation springs up under the new system when arrangements come to be made for the masses of invalids belonging to the regiments remaining in the country. These invalids sometimes proceed in "batches," or collected parties of two or three hundred together, and a portion of them are always bedridden men, incapacitated for assuming any but a recumbent position. It is obvious that not only carriages fitted with litters must be necessary for soldiers

Effect on the general batches of invalids.

CHAP. V.

The distances of railways increase the need of hospital accommodation upon them.

in such a condition, but that also one vehicle with every train should be supplied with hospital appliances, like the cars already described to have been in attendance with the hospital trains in the United States, so that they may receive the attention necessary for their care and protection.

The long distances over which the main lines of railway extend, and consequently the length of time occupied in travelling over them, add to the necessity of special hospital arrangements for sick passengers. Invalids proceeding from Delhi to go to Bombay have to travel by rail to Allahabad, a distance of about 470 miles, and thence, when the whole railway is completed,* will traverse a further distance by rail of about 800 miles. It is expected that the Delhi and Punjaub railway will be finished by the year 1870, and there can be little doubt but that it will be extended to Peshawur; when this is done there will be a direct line of railway from Calcutta to Peshawur of 1700 miles. At present, the time occupied in traversing the Indian railways is increased by single lines of railway only being laid down upon the greater portion of the distances over which they extend; and when the labour of carrying the rails and machinery from England to India is considered, it is evident that this source of delay must continue for some years to come.

The necessity for the construction of special sick-transport carriages and other hospital arrangements, to meet the circumstances which have just been described, has not been unseen or unattended to by the military medical authorities in India. In the month of June 1867, Inspector-General Dr. Beatson, the Principal Medical Officer of Queen's troops in India, submitted to the Government of India a systematic plan of hospital accommodation, both for the invalids accompanying regiments and for those conveyed in separate groups. The attention of the Inspector-General had been previously directed to the subject in a minor form, by the occasional difficulties produced from the absence of railway accommodation for the sick soldiers proceeding with their regiments on changes of stations. In November 1866, the surgeon of a regiment which moved from Meerut to Calcutta, above a thousand miles of the distance being performed by railway, officially represented the inadequacy of the means at

No means yet of sending bedridden invalids by railway.

* The whole line of railway between Allahabad and Bombay is not yet finished, but is gradually approaching completion. The line of the East Indian railway in this direction stops at Jubbulpore, and the railroad is complete to this point. The Great Indian Peninsula railway runs from Bombay to Jubbulpore, and a portion of this railway approaching Jubbulpore is still unfinished. In consequence, at the present time invalids coming by railway from Delhi to Bombay, on reaching Jubbulpore, have to travel by road in gharries, about 150 miles, down to Nagpore, and thence by rail into Bombay. From this circumstance, and the absence as yet of any appropriate carriages on the railways, no invalids requiring a recumbent position are sent by the railway route, but only invalids able to sit up. The unfinished state of the hospital at Suez, and the absence of recumbent accommodation on the Egyptian railway, have also aided in inducing the decision not to send very disabled invalids hitherto by the overland route. The South-Eastern line of the Great Indian Peninsula railway to Madras is also not yet complete.

disposal for the proper carriage of the sick men of his corps during the transit. Inspector-General Beatson, foreseeing that the larger question of the general carriage of invalids by railway must arise as soon as the new system of naval transports should come into operation, at that time called attention to the need of determining beforehand some regular scheme for conducting their conveyance to the port of embarkation.

The plan which Inspector-General Beatson laid before the Government in 1867, and which he proposed in concurrence with General Paton, the Quartermaster-General of the army in India, included various arrangements connected with the railway transport of healthy troops; such as the periods during which the successive stages of their journeys should be conducted, the halts necessary for meals, for sleep, and other matters having relation to the maintenance of health in a tropical country. These proposals, however, do not concern the subject of this treatise; but the arrangements recommended for the transport of the sick and disabled require to be described, for they are in their nature as applicable to the movement of wounded soldiers in case of war in India, as they are to the ordinary movement of sick soldiers in time of peace. The system of transporting invalids which may be carried into execution under the latter circumstances, whatever it may be, must be regarded as the most practical mode of trying, and the best method of affording an opportunity of improving, the means to be adopted for transporting wounded soldiers, should the occasion ever arise, in time of war.

Inspector General Beatson's plan of railway hospital accommodation in India.

On commencing to prepare the scheme of arrangements for the conveyance by railway of assemblages of invalids, it was found necessary to ascertain the proportion among them for whom a recumbent position would be absolutely required. Statistics were not available for furnishing accurate information on the question, but, after examination and inquiry, it was advised that recumbent accommodation should be provided for each batch of invalids at the rate of 18 per cent. Thus, supposing three hundred invalids were to be sent by long rail route through central India to Bombay, the invalid train would have to be furnished with the requisite gear for carrying fifty-four of the number lying down. If a regiment were moving with its own sick and invalids, then it was calculated that recumbent accommodation should be provided at the rate at least of three per cent. of the strength.

Proportion of bedridden patients in batches of invalids.

The plan of construction of the carriages for the recumbent invalids was left to the locomotive department of the East Indian railway, but the principles on which the vehicles should be designed were specified by Inspector-General Beatson in his correspondence on the subject. Among other points he recommended that, while the sick-transport carriages need not differ in shape from the ordinary passenger carriages used on the line, they should not be less than twenty-four feet in length when constructed to carry six patients, or thirty-one feet if built for eight bedridden patients. The litters were to be placed lengthways, three or four in one row on each side. The doors were to be

The sick-transport carriages proposed for Indian railways.

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Observations
on the plan of
Indian rail-
way hospital
transport above
described.

in the sides of the carriages.* Special appliances were to be added suitable for the wants of invalids in each carriage, and in one carriage of the train was to be a stove to provide means of warming water and preparing simple articles of nourishment. A plan of a carriage was furnished by the railway officials in accordance with these recommendations, but I am not aware whether any patterns have yet been constructed.†

On considering the system of transport just described it seems a matter to be regretted that a closer approximation to the plan employed in the United States, or to that of the sick-transport system adopted for the railways of the North German Confederation, is not likely to be attained in India. The continuity of the several carriages in which the sick are carried, which is established by means of end doors and platforms, affords immense advantages in respect to facilities of administration and general economy, when compared with the employment of carriages opening by side doors without any means internally of mutual communication. In India, however, the railway passenger carriages are constructed on the same principles as the carriages in England, consisting of first, second, and third-class vehicles, and doubtless, the same difficulties have been experienced there, in trying to convert ordinary passenger carriages into sick-transport carriages, as would be encountered if the same thing were now to be attempted in England.

If invalid trains could have been furnished on the same plans as the hospital trains in the United States, and sleeping accommodation be furnished not only to the bedridden, but to all the invalids, there would be no need for halts, so far as the sick are concerned, during the transit. All hospital wants could be attended to, and the necessary rest taken, while the trains were under way. But such a plan not being admissible, Inspector-General Beatson considered that the invalid trains should not proceed during night time. He recommended that standing camps should be placed at intervals along each line of route, that the time occupied in traversing the distances between them should be about ten hours, including a halt for a midday meal, and that the evening meal should be taken at the standing camp where the halt was to be made for the night. It was considered that men in health travelling need only halt for rest every other night, but that for weak and disabled invalids travelling in a tropical country, though at the cool season, a halt less frequent than every night would not merely provoke discomfort, but would prove greatly detrimental to the prospects of their convalescence.

* The door of each carriage was at first planned to be in the centre of the side, but it was found afterwards that it would be easier to introduce, and turn with, patients lying on stretchers, if the side door was placed nearer to the end of the carriage.

† A tabular statement of the number of vehicles completed and in course of construction up to the 31st of December 1867 is shown in the latest Report (July 1868) of the Directors of the East Indian Railway. Among the various kinds of carriages enumerated under the head of coaching stock, no invalid carriages are mentioned.

SECTION IV.—ON THE REGULATIONS WHICH ARE NECESSARY
TO ENSURE THE SAFETY OF SICK AND WOUNDED SOLDIERS
WHEN TRANSPORTED BY RAILWAY TRAINS.

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Whatever may be the plan eventually determined to be adopted for the transportation of convoys of wounded by railway, certain regulations will have to be enforced, whenever the necessity for applying it unhappily occurs, to ensure the safety and protection of the patients and to maintain general order.

The plan for most safely conducting convoys of sick and wounded by railway should be studied by army medical officers.

It may be useful to mention some regulations which will be necessary, or which, at least, will conduce to the attainment of these essential objects. This is one of the occasions on which a medical officer may have to exercise his own judgment and in a great measure to act on his own responsibility, and he should, therefore, have considered beforehand the leading features of the line of conduct which it will be necessary for him to pursue. If a combatant officer be placed in charge, the principal arrangements will devolve upon him. Under any circumstances, whoever may have the responsibility of the charge of the sick convoy, and whatever may be the arrangements settled upon, the details of the course of action laid down will be subject to alterations dependent upon exigencies arising out of the railway administration which the conductor of the train can alone be competent to judge of. The following directions, however, admit of general application.

(1.) If it be left to the medical officer to conduct the arrangements for the transportation of the sick under his charge, as soon as the order for their removal is received, he should carefully arrange with the principal railway manager, or ascertain that arrangements have been made by superior authority, as to the hour of departure, and the list of stations to be stopped at during the journey. In any case he should provide himself with a written copy of these arrangements.

Arrangements prior to bringing a convoy of sick to a railway train.

(2.) Every medical officer with a convoy of sick and wounded, and all who are in attendance upon them, must be made to understand that the utmost precision, as well as smartness, are necessary in all business connected with railway transportation. The want of a due appreciation of this necessity may lead to interruption of the service, and cause delay; and this delay may interfere with the movements of other trains on the line.

Strict attention to regulations essential.

(3.) Every one connected with the convoy should be made aware that it is a duty implicitly to follow, so far as the railway administration and service are concerned, the instructions and recommendations of the railway officials whose special function it is to direct the management of the train, who are responsible for safely conducting its movements, and also for the general protection of those who are carried by it. In many respects a body of military passengers when they are being conveyed by railway, whether sick or well, may be regarded as being in a similar position as that in which troops are placed when on board ship; for, in both cases, much of the general management and direction must be exercised by others than the military authorities.

Authority of the railway officials.

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Proper disposal
of the field-kits
of the sick.

(4.) Special arrangements must be made for the carriage of the men's knapsacks; they cannot be placed in charge of the sick, as they are with able-bodied troops. Care should be taken that they are protected from the effects of weather and from dust by tarpaulins, in case they are placed in open trucks. It will save time after the sick have arrived at their place of destination, if a piece of paper with the name and number of the patient who owns it, be pasted on the bottom of each knapsack before the men are moved to the train. It will also add to security against loss, if each pack is labelled separately by the railway officials in the same manner as is done when private luggage is moved, a number being posted on the pack and a corresponding number being given to the owner or a responsible non-commissioned officer. The hospital steward or sergeant, who has received the knapsacks and kits of the sick in charge, and who has probably given receipts for the same to the colour sergeants of the companies to which the sick men belong, should, if possible, get receipts for the same from the railway officials who take charge of the baggage. In case of loss he may otherwise find himself held responsible by the military authorities for them.*

Supplies of
food, water,
&c. during the
transport.

(5.) Forethought should be exercised, and arrangements made, so that there may be no uncertainty as to the sick receiving the necessary food and refreshments during the transport according to the distance to which they are to be transported; no dependence should be placed on supposed opportunities of obtaining what may be required at any of the stations where it has been arranged for the train to make brief halts, unless a definite agreement has been arrived at for the requisite supplies to be forthcoming at one or more of them on the arrival of the train.

When the journey to be undertaken is a long one, a supply of the usual extra sick-comforts should be provided, for the progress of the train may be delayed by a failure in motive power of the engine or various other causes, and, in case of such an accident occurring, the sick should not be left without the means of obtaining refreshments. The disbursement of this extra supply will have to be accounted for after the arrival of the train at its destination in the usual manner.

Carriages to be
marked.

A supply of water for drinking purposes should be also carried. (6.) In case of the convoy being a large one, it will save confusion and prevent delay if the number of sick and wounded to be placed in each carriage be marked with chalk upon the panels by the surgeon or an assistant. If any carriages are designed to

* I have been informed of an instance in which, on a regimental detachment accompanied by a small body of sick, moving by railway for change of station, the knapsacks and kits of two of the sick men could not be found at the end of the journey; they had either been left behind, or had been lost or stolen on the way. The receipts given by the hospital sergeant for the knapsacks and their contents were produced, and he was put under stoppages for their payment. The general officer, who decided the question, held that the knapsacks were as fully under the charge of the hospital sergeant during the removal of the sick from one station to the other, and that he was as much responsible for them, as if they had been still in the pack-store.

receive special cases, they should also be marked to that effect, for the information of those who are attending on the sick. This should be done before the patients are brought on to the platform of the station.

(7.) The admission into the carriages should be carried out in an orderly, systematic, and expeditious manner. Each patient should be made successively to take his place, and once seated, or in his litter, should be warned not to alter his position till the rest of the convoy is installed and the doors are shut. The surgeon should direct the hospital attendants not to permit any delay in the movements.

Admission of the sick into the carriages.

(8.) When all the sick are reported to be in their appointed places, the surgeon in charge, with the officer commanding if one be present, and the conductor of the train, should make a passing inspection of all the carriages in succession, and if any alterations are necessary they should then be made. The surgeon should on no account omit to make this inspection so as personally to ascertain that everything connected with his charge is correct. Before taking his seat he should inform the conductor that all the sick are settled in their places and the convoy ready to start.

Inspection of the train before starting.

(9.) Smoking should be strictly interdicted to all patients lying upon litters, not only at the stations, but also during the whole transport.

Smoking in carriages.

(10.) Especial watch should be placed over the carriages on the stoppage of a train at a station. No one should be allowed to leave his place or to purchase or receive into a carriage any article without the knowledge and sanction of a medical officer, or, if he is not present at the spot, without the knowledge of a non-commissioned officer of the hospital corps in attendance.

Stoppage of the train at stations.

(11.) If the halt be long enough to permit it, the surgeon, who will be in possession of a copy of the route, will inform the non-commissioned officers that there is time for those who are able and desirous to get down from the carriages to do so. The men must be looked after by the attendants in charge, and care taken that none of them get beyond the limits of the station, and that they are in the carriages again before the time fixed for departure.

Halts during the route.

(12.) Notices cannot be given by bugle or drum as when able-bodied troops are moving by railway, and therefore, more activity is required on the part of the officer directing the whole service, and the more necessary it becomes that the non-commissioned officers and attendants on the sick should be constantly attentive and alert in seeing all orders and instructions carried out, both as regards themselves and the patients under their supervision.

Issue of orders with convoys of sick.

(13.) On arriving at the place where the patients are to be removed from the train, no one should be allowed to leave the carriages, on any pretence, until the surgeon in charge has ascertained that the necessary litters, wagons, or other means of conveyance provided for their removal, are at hand and ready to receive them. If this rule be not enforced, straggling will almost certainly occur, and the inevitable result will then be delay, and probably confusion, in the removal of the convoy.

Arrangements on reaching the place of destination.

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Removal of the
sick from the
train.

(14). The more helpless and severely injured patients should be first attended to, and should be got to their destination as quickly as the arrangements render possible. Whenever practicable, these patients should remain during the journey on the same litters which brought them to the train, so that they may be again carried upon them to their destination, and the repetition of pain in moving from one stretcher to another be thus avoided.

It is presumed that on all occasions when sick and wounded troops are moved by railway the departure of the train and all necessary instructions will be telegraphed to the place of their destination, so that all the requisite arrangements for the reception, removal, and accommodation of the patients may be prepared and ready for them on the arrival of the train at the end of its journey.

The regulations thus sketched out in many instances apply more particularly to trains consisting of the composite, partitioned, and comparatively small-sized carriages and wagons in ordinary use in most parts of Europe. Where a system of transport is available, such as was in force in the later periods of the war of the Rebellion in the United States, and such as will in future be employed on the railroads of the North German confederation, the direction and management of a convoy of wounded by railway becomes a far more simple service than it would be on an English railway.

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NOTE 1, page 43. ARMY HOSPITAL CORPS.

It is mentioned at page 43 that the subordinate purveying and medical duties of British military hospitals are performed by branches of the Army Hospital Corps. It was recommended by the committee appointed to inquire into the administration of the transport and supply departments of the army that the purveying branch should be separated from the medical branch of the Army Hospital Corps, and that the former should be transferred to the corps responsible for the general service of army supplies. This change has been decided upon, and the necessary steps to carry it into effect are now (October 1868) being taken.

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NOTE 2, p. 65.—ON THE PROPORTIONS OF CASUALTIES OF DIFFERENT CLASSES IN BATTLES.

In order to be able to form an estimate of the amount of transport which will probably be required for the conveyance of the wounded of an army after a general action it is necessary to ascertain what the ratios of wounded to numbers of troops engaged have hitherto been, more especially in recent wars. Secondly: in order to estimate for the particular descriptions of transport likely to be needed, the usual proportions of soldiers wounded severely, and therefore requiring to be carried lying down, and of soldiers wounded slightly, and therefore capable of being carried sitting, should be determined.

The difficulties in the way of obtaining reliable information on these topics have already been indicated in the "General Remarks on Estimates for Sick Transport with Armies on Active Service," in the third chapter of this treatise.¹ The stated ratios of casualties to combatants in particular battles are found to vary greatly according as different authorities are consulted on the subject. Differences are alike met with as to the numbers of the troops engaged, and as to the numbers and nature of the casualties. It is easy to trace in some instances, on the part of the rulers on the vanquished side, efforts to curtail the extent of the calamity which has happened to their country; equally easy to observe attempts on the part of the victors to exaggerate the injury which they have inflicted on their opponents. But we not only find different statements as to losses in the published accounts of the countries opposed to each other in the battles the histories of which happen to be inquired into, but even in the records of the same country. Without imputing dishonest or interested motives as the sources of all these discrepancies, there are several fertile sources of contradiction in the mere manner in which the alleged facts happen to have been

¹ See p. 65.

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obtained and put on record. It may be useful to point out a few of these causes of conflicting statements.

In some instances the number stated to have been killed in a particular action represents the number actually killed during the fight and left dead on the field; in other instances those who have died within a certain time subsequently from the effects of wounds received in the action are included in the number of killed. The discrepancies which arise from this source become multiplied according to the number of days or extent of time which may have elapsed before the "returns of deaths" have been collected and added up.

Errors as to the numbers wounded in battles arise in a similar way. The difference of a single day in the time of collecting the returns of casualties will cause an important difference in the sum of the number wounded on a given occasion.¹

There is always a strong and praiseworthy desire to send off returns of casualties as early as possible after an engagement, in order to satisfy the anxiety for intelligence among the countrymen, as well as the relations and friends, of the individuals of which an army is composed. It is almost impossible, under the circumstances in which troops are usually placed at this time, to avoid numerous errors in making up the lists out of which the general returns of casualties are framed. In the columns of "killed" are sometimes placed absentees who are either lying wounded in some of the temporary field hospitals or who have strayed from their respective corps; in the columns of "missing" or "disparus" are placed some who, as afterwards proved, should have been accounted for in the columns of killed or wounded. Men with slight injuries appear in the first returns as wounded, but, joining their ranks for duty without entering a hospital, appear the next day in the lists of effective soldiers; and then, in order to balance the respective figures of "strength" and "losses," they cease to be counted among the number of wounded. These are only a few among many sources which lead to differences in the sums total of casualties in particular engagements as exhibited in the numerical returns collected shortly after the actions have transpired and those sent in at subsequent periods. Sometimes the early official returns, sometimes the rectified accounts, are quoted by writers, and hence some of the discrepancies which are met with in historical records on the subject.

The term "losses," too, is employed with such various significations that it is frequently difficult to determine with precision what its meaning is intended to be in the accounts given of early battles by writers. Sometimes the expression is used to indicate the number of casualties of all kinds, including prisoners and missing, that is, the loss in the effective strength from all causes; sometimes it includes only the killed and wounded; sometimes the "losses" refer to no others but the deaths, the wounded being spoken of separately.

It is generally understood with regard to the numerical losses attributed to many continental battles of the last century and early part of the present century, that the large numbers of soldiers who died from disease induced by various causes during the movements of the armies, as well before as after the battles referred to, were accounted for by

¹ M. Boudin mentions that the official report respecting the assault of Constantine in Algeria, on the 13th October 1837, gave a total of 506 wounded, of whom 38 were officers, among a force of 12,453 combatants; but on the following day, the 14th, the number of wounded at the hospital was only 309, of whom 27 were officers.—*Système des Ambulances des Armées Française et Anglaise*, p. 7. Paris, 1855.

being included in the losses of the battles themselves.¹ The national and military feelings were less hurt by a large number of casualties being shown to have occurred in battle than if they had been accounted for as the result of sickness brought on by fatigue and exposure; and, moreover, military and medical statistics were neither so strictly kept then, nor were such as were put forth so capable of being analyzed, as they have been of recent years.

But whatever may be the difficulties in determining the number wounded in particular battles, the difficulty of ascertaining the ratio of casualties to numbers actually engaged in action is far greater. Yet this is the important point to be informed upon when trying to estimate the average amount of transport required for the wounded of a stated force. The number of wounded that may result from an action in which only half or one-fourth of the army has been engaged as combatants, should be set down as the proportion of wounded to the strength, whatever it may be, of that half or fourth section of the army, not to that of the whole army, of which part, though exerting perhaps an important military influence as a force in reserve, cannot fairly be reckoned in a computation of the ratio of wounds to combatants, as if they had been active participators in the fighting. Two divisions of the British army were not engaged in the action on the Alma; in estimating the proportion of casualties to fighting men the strength of these two divisions should clearly be separated from that of the forces which were engaged in the battle. It is stated that 80,000 men who formed part of the Prussian army in 1866 at the battle of Königgrätz never fired a shot; these, therefore, ought to be excluded from the number of combatants when estimating the proportion of hits to troops engaged.

It is generally stated that the proportion of casualties to combatants has gradually diminished since the introduction of the improved weapons of recent years. In the journal of the United Service Institution for 1862 is an article in which the writer questions the general superiority of the rifle over the smooth-bore musket as a weapon of destruction in armies, and in a portion of this paper the following are given as the ratios of casualties in particular battles:—"During the

¹ So persistent is the impression with regard to this former practice, that even with regard to so recent an action as the battle of the Alma, it was stated in a work of no mean repute (*Medals of the British Army, &c.*, by T. Carter, &c., &c., Lond., 1861, p. 20), "The French casualties were reported as about 1,400 hors de combat; these are believed to include all those who died in the Dobrudscha," that is, men who died two months before the battle, and when the French army was in Bulgaria. Statistics, however, are too carefully scrutinized nowadays for such a falsification as this to be practised without speedy detection. We now know that the total French loss at the Alma closely approached the number at first stated. Dr. Chenu's returns, founded on the names of the officers and soldiers concerned, show that the French casualties at the Alma were 141 killed, 1,197 wounded, and three unaccounted for; total 1,341. The losses of the French in the Dobrudscha are separately given by Dr. Chenu, and he shows that they were far greater than is supposed in the quotation above given, or than they were generally believed to be at the time they occurred. The number of officers and men attacked by cholera in that fatal expedition was 3,138, and of them 2,277 died. Altogether in July 1854, in which month the Dobrudscha expedition started on its fatal errand, there were 8,239 cases of cholera in the French army in the East, and 5,030 men, or one-eleventh of its total strength at the time, succumbed to the scourge in that month. The plain unvarnished narrative by Dr. Chenu of the sudden visitation and effects of the cholera by which the advance of the troops under Generals Espinasse and Jusuf in the Dobrudscha was arrested is one of the most moving episodes in his great work on the medical and surgical history of the French army of the East.

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"late Italian war both sides had rifles, the French had also rifled cannon. How was it that the mortality, the carnage, instead of being greater, was actually much less than in any previous wars with the smooth-bore of old?

"At Austerlitz the loss of the French was 14 per cent. of their army, that of the Russians 30, that of the Austrians 44.

"At Wagram the French lost 13 per cent., the Austrians 14.

"At the Moskowa the French loss was 37 per cent., the Russian 44.

"At Bautzen the French lost 13 per cent., the Russians and Prussians 14.

"At Waterloo there fell of the French 36 per cent., of the Allies 31.

"And now at Magenta, on the 4th of June 1859, we find that the French lost 7 per cent., and the Austrians 8 per cent.

"And at Solferino the Franco-Sardinian army lost 10 per cent., the Austrian 8 per cent."¹

The same ratios were mentioned in the House of Lords in July 1868, in the course of a discussion upon the use of explosive bullets in war, by the Earl of Malmesbury, who said that he had received them from a French officer whom he understood to be connected with the French War Office. Lord Malmesbury also pointed out as a natural inference from the figures that, "it must not be taken for granted that these new military inventions and improvements in military projectiles necessarily occasion a greater destruction of life than formerly occurred." Corresponding statements have been put forth in another form. It has been said that the losses of the victory in the following great battles have been:—At Waterloo, one-fourth; at Borodino, a third; at Talavera, an eighth; at Marengo, a fourth; at Inkerman, before rifled guns and breech-loaders were in use, a third; while at Magenta and Solferino the losses were only one-eleventh, and at Königgrätz, one-twenty-third.²

There can be little doubt that these statistics and the deductions drawn from them are, to say the least, very incomplete, and in some respects from this cause, calculated to mislead. They show the proportions of casualties (the term "losses" in the foregoing quotations evidently comprehends killed, wounded, and missing) not to troops actually engaged, but to the strength of the whole army of which the troops engaged formed part. The per-centages given are often materially influenced by the loss of men unwounded but taken prisoners, these being included in the column of missing. The number of troops brought on the field in some battles is comparatively limited, so that they are all actually engaged in the conflict, perhaps, too, for many consecutive hours. The 24,000 British troops at Waterloo were all exposed to fire, and a large proportion of them were in repeated close conflict with the enemy. Hence the large ratio of casualties in that battle. At the present day the facilities of rapidly concentrating troops and their matériel are immensely increased. Such armies as were opposed to each other at Solferino and Königgrätz present numbers so enormous—in the former instance 298,358, in the latter 427,100 men under arms being said to have been brought together—that it becomes impossible for all the troops to be engaged in the battle. The firing,

¹ Military Gymnastics of the French. By A. Steinmetz, Esq., Lieut., Queen's Own Light Infantry Mil., &c., Journal of the United Service Institution, Vol. V., p. 385.

² Memorandum on the Prussian Army in relation to the campaign of 1866, by Colonel Reilly, R.H.A.

of the infantry especially, being restricted to almost directly opposite fronts, large bodies of troops acting as supports or as reserves in such vast armies are almost necessarily excluded from active interference as combatants, as "troops actually engaged." But in estimating the comparative losses, as above quoted, the strength of the whole army including the reserves has been taken as one figure, and the casualties which have really occurred in particular portions of that strength, in the bodies of troops brought to close quarters in the combat, have been distributed amongst the whole. No deductions as to the qualities of the weapons employed on the different occasions referred to can be drawn from such calculations. As well might it be argued that clubs, swords, and lances were more destructive than fire-arms, because, as is well known to have been the case, the usual proportion of *injuries* to the number of combatants was greater before the application of gunpowder to weapons of offence than it has been since; the real explanation being that in the battles of early times, when hotly contested, each individual came to be engaged in a hand-to-hand encounter in which one or other was sure to receive some injury or other. It is evident that, besides the nature of the weapons used, the particular circumstances of battles, whether engagements in the open field, assaults, &c., the tenacity of the respective opponents, the numbers actually brought into collision, the duration of the fighting, the nature of the casualties comprehended under the general term "losses," must all separately be considered before one battle can be properly compared with another as regards the destructive power of the weapons employed by the combatants. So far as the ratios above quoted go, they serve to show that when all troops, not only those actually brought into action, but also those acting as supports and reserves, or otherwise on the strength of an army, are included, modern tactics cause the chance of a casualty of any kind happening to each of the units composing that army to be considerably less than it was formerly; but, notwithstanding this general deduction, numberless facts, which it would be out of place to bring forward here, concur to prove, as regards particular bodies of troops opposed to each other in actual fighting, that the numbers of wounds inflicted within corresponding periods of time are far greater than they ever were before the introduction of rifles and breech loaders.

A few years since I had the following table put together with a view to ascertain the per-centages of the various descriptions of casualties in certain great battles as recorded by continental historians. The figures were extracted by Mr. Otto Striedinger, then secretary to the Army Medical School, chiefly from German historians, but also, in some instances, from French sources.¹ Where blanks occur the necessary information could not be obtained from the authorities examined. According to the showing of this table the per-centage of wounded to troops engaged varied in the eleven battles mentioned from 5 to 44 per cent. fractions omitted. For reasons already given, the accuracy of the figures is open to many sources of doubt. One thing is evident from the table, that very great differences in the ratios of killed and wounded occur in different battles irrespective of the qualities of fire-arms, only smooth-bore weapons having been employed in the several battles quoted.

¹ The following are the historians from whose writings the figures contained in the several columns of the table were obtained:—Schloezer, Meyer, Rotteck, Becker, Luder, Soltyk, Roeder, Pelet, Gourgand, Ségur, Buturlin, Larrey, and others.

APPENDIX. No. 1.—TABLE showing the PROPORTION of KILLED, WOUNDED, and MISSING in various BATTLES.

Battles.	Total No. said to have been actually engaged.	Numerical Losses.				Per-centage to Number engaged of			Per-centage of Killed to Sum of Killed and Wounded.
		Killed.	Wounded.	Missing.	Total.	Killed.	Wounded.	Total Losses, K., W., & M.	
Blenheim, 13th Aug. 1704 {	British & Allies	56,000	5,000	8,000	0	13,000	9	14	23
	Gallo-Bavar.	60,000	12,000	14,000	14,000	40,000	20	23	67
Ramillies, 23rd May 1706 {	British & Allies	60,000	1,066	2,867	0	3,933	2	5	7
	Gallo-Bavar.	62,000	2,000	5,000	6,000	13,000	3	8	21
Belgrade, 17th Aug. 1717 {	Austrians	40,000	8,000	—	8,000	20	20	20	—
	Turks	140,000	28,000	—	28,000	20	20	20	—
Kunnersdorf, 12th Aug. 1759 {	Prussians	40,000	8,000	15,000	3,000	26,000	20	38	65
	Russ. & Austr.	60,000	24,000	—	24,000	40	40	40	—
Marengo, 14th June 1800 {	French	—	6,000	1,000	7,000	—	—	—	—
	Austrians	—	8,000	4,000	1,200	—	—	—	—
Austerlitz, 2nd Dec. 1805 {	French	70,000	12,000	0	12,000	—	—	17	—
	Austr. & Russ.	84,000	26,000	—	26,000	—	—	31	—
Wagram, 6th July 1809 {	Austrians	90,000	24,000	1,000	25,000	27	28	40	30
	French	140,000	25,000	7,000	32,000	17	19	41	—
Badajos 17th March to 6th April 1812 {	British & Allies	16,000	3,000	7,000	0	10,000	19	44	63
Moskowa or Borodino, 12th Sept. 1812 {	Russians	125,000	15,000	35,000	1,000	51,000	12	28	40
	French	120,000	9,000	13,000	1,000	23,000	8	11	19
Bautzen, 20th May 1813 {	Pruss. & Russ.	110,000	² 7,500	16,000	0	23,500	7	14	21
	French	150,000	8,800	18,000	0	26,800	6	12	18
Leipzig, 16th to 19th Oct. 1813 {	Allies	300,000 ³	47,000	0	47,000	16	16	—	—
	French	171,000	15,000	30,000	15,000	60,000	9	18	36

¹ A very great number of troops who were drowned in the lakes in rear of the position of the Allies are included among the killed and wounded at the battle.

² These numbers include the losses on the 19th, 20th, and 21st of May 1813.

³ Some accounts give the strength of the Allies at Leipzig as 240,000, and place the casualties, especially among the French, at a much higher figure.

⁴ Fractions have been omitted throughout the per-centages inserted in this table.

⁵ The strength of the Austrian army at Königgrätz is given at 206,100. From this number the deduction shown in the table for men not engaged has been made arbitrarily. At the same time the per-centages have been given on the supposition of 200,000 Austrians having been engaged in the battle. The Austrian "missing" at Königgrätz is usually stated at 25,419, but as 19,800 Austrians are known to have been taken prisoners by the Prussians, this latter number is deducted in the table.

It may be observed with regard to the battles in which the Austrians were engaged that the figures show a much larger per-centage of missing for the Austrians than for their opponents, and the numbers of killed are also higher in proportion to the wounded among them than they are in the returns relating to their antagonists. It would seem that among the missing they must have lost many men as prisoners or by desertion, and that they reckoned the number of killed on a different system from the French and Sardinians or Prussians, possibly by reckoning all who died of wounds within a certain period of an action, as if they had been killed in it. As bearing on this point, it may be mentioned that the British loss in the Crimea from wounds was "killed in action," 2,598; "died of wounds subsequently," 1,761; or nearly three to two.

The next table exhibits the proportions of casualties in some of the great battles of the Peninsula, and of more recent periods. The calculations have been made by Inspector-General Dr. Lawson. The sources from which the figures in the respective columns have been obtained are mentioned in the foot notes.

NO 2.—STATEMENT of KILLED, WOUNDED, and MISSING in VARIOUS BATTLES.

Battle.	Nation.	Description of Force.	Numbers engaged.	Numerical Losses.			Per-centage of				Ratio of Killed to Wounded.
				Killed.	Wounded.	Missing.	Killed.	Wounded.	Missing.	Total Loss.	
Badajos (assault).	British	Rank and file	10,200	560	1,983	21	5.50	19.44	20	25.14	1 to 3.5
Salamanca	British	Do.	25,381	336	2,400	74	1.32	9.46	29	11.07	1 to 7.1
Salamanca	Portuguese	Do.	17,518	287	1,436	18	1.64	8.20	0.10	9.94	1 to 5.0
Vittoria	British and Portuguese.	Do.	60,486		4,626	—	—	—	—	7.65	—
Toulouse	British and Portuguese.	Do.	30,963		2,659	—	—	—	—	8.59	—
Waterloo	British	Do.	23,991	1245	4,261	558	5.19	17.76	2.33	25.28	1 to 3.
Waterloo	German Legion.	Do.	5,824	306	866	209	5.25	14.87	3.59	23.71	1 to 2.
Waterloo	Hanoverians	Officers, N.C. officers, and men.	11,220	328	1,321	358	2.92	11.77	3.19	17.88	1 to 4.
Alma	British	N.C. officers, rank and file.	21,480	337	1,540	19	1.57	7.17	.09	8.83	1 to 4.6
Montebello	French and Sardinian.	Officers, N.C. officers, and men.	8,227	105	549	69	1.28	6.67	.84	8.79	1 to 5.2
Magenta	French (only)	Do.	48,090	657	3,223	655	1.37	6.70	1.36	9.43	1 to 4.9
Magenta	Austrians	Do.	61,640	1365	4,348	4,500	2.21	7.05	7.30	16.56	1 to 3.2
Solferino	French and Sardinian.	Do.	135,234	2313	12,102	2,776	1.71	8.95	2.05	12.71	1 to 5.2
Solferino	Austrians	Do.	163,124	2386	10,634	9,290	1.46	6.52	5.70	13.68	1 to 4.5
Königgrätz	Prussians	Do.	141,000	1929	6,948	276	1.37	4.93	.20	6.50	1 to 3.6
Königgrätz	Austrians	Do.	150,000	4861	13,920	5,619	3.24	9.28	3.75	18.27	1 to 2.9
Königgrätz	Austrians	Assuming No. engaged to be.	200,000	4861	13,920	5,619	2.43	6.96	2.81	12.20	1 to 2.9

¹ The numbers for the Peninsular battles and Toulouse are taken from Napier's Peninsular War. The strength given is of effective sabres and bayonets, or of rank and file, exclusive of officers, serjeants, drummers, and trumpeters.

² The numbers for Waterloo from Siborne. The strength for the British and German legion taken as rank and file. If the serjeants, drummers, and trumpeters be included, the per-centage for the British force will be, killed, 5.56; wounded, 18.59; missing, 2.43; total, 26.58.

³ Strength of whole British army, inclusive of serjeants, drummers, and trumpeters, rank and file; more than half the number killed, and nearly half the number wounded, occurred in the four regiments of the light division which assaulted the Russian hill battery.

⁴ The Italian and German battles which follow include in the figures given officers, non-commissioned officers, rank and file, as is customary in continental armies.

The figures under the Italian battles of 1859 are taken from French official statements. The strength of the French army on the 4th of June (Magenta) was 127,453 of the allied French and Sardinian armies on the 24th of June (Solferino) was 187,956 combatants; the figures in the table show only the strength of the troops said to have been actually engaged.

⁵ The strength of the Prussian army at Königgrätz is understood to have been 221,000, but in the table 80,000 troops are deducted, who are said not to have been engaged in the battle.

⁶ See note on preceding page.

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Assistant-Surgeon-General C. H. Crane, of the United States' army, has at my request kindly supplied me with the numbers of troops stated to have been engaged, and with the numbers of casualties, in some of the principal battles of the late civil war in America. Although the figures have been given with the sanction of the Surgeon-General, the numerical losses among the Union troops are not to be received as officially exact, as they have not yet been sufficiently revised. When the medical and surgical history of the war, which is in progress, shall be finished, the numbers and descriptions of casualties in each battle will then be shown as accurately as they can be after complete investigation. The sources from which the alleged losses on the Confederate side have been derived are shown in the foot notes to each battle.

RATIOS OF CASUALTIES in some of the principal BATTLES of the late WAR of the REBELLION in the UNITED STATES.

Battle.	Forces opposed (Unionists and Confederates).	Strength of Army engaged (all Ranks included).	Numerical Loss in				Per-centage of				Ratio of Killed to Wounded.
			Killed.	Wounded.	Missing.	Total Loss.	Killed.	Wounded.	Missing.	Total Loss.	
Shiloh, 6 & 7 April 1862 -	U.	63,000	1,735	7,882	3,956	13,573 ¹	2.75	12.51	6.27	21.83	1 to 4.5
	C.	40,000 ²	1,728 ³	8,012 ³	959 ³	10,699	4.32	20.03	2.89	26.74	1 to 4.6
Murfrees- boro' -	U.	43,400 ⁴	1,533 ⁴	8,778 ⁴	—	10,311	3.53	20.22	—	23.75	1 to 5.7
	C.	35,000 ⁵	—	9,000	—	9,000	—	25.71	—	25.71	—
Antietam -	U.	87,164 ⁶	2,010	9,416	—	11,426	2.30	10.80	—	13.11	1 to 4.6
	C.	97,445 ⁷	3,500	16,339	—	19,839	3.60	16.76	—	20.36	1 to 4.6
Chickamauga -	U.	50,000 ⁸	1,644	9,262	4,945	15,851	3.28	18.52	9.89	31.70	1 to 5.6
	C.	53,000 ⁹	—	18,000 ¹⁰	—	18,000	—	33.96	—	33.96	—
Gettysburg -	U.	117,350 ¹¹	2,834	13,709	—	16,543	2.41	11.68	—	14.09	1 to 4.8
	C.	68,352 ¹²	—	27,217	—	27,217	—	39.81	—	39.81	—
Wilderness, 5 to 8 May 1864.	U.	100,000 ¹³	3,288	19,278	—	22,566	3.29	19.29	—	22.58	1 to 5.9

¹ Probably an under estimate.

² Probable approximation; exact number not known.

³ From General Beauregard's returns.

⁴ Strength and losses furnished by General Rosencrans.

⁵ From official report of General Bragg.

⁶ Strength of all arms present for duty and casualties reported by General McClellan. Medical Director Letterman's returns show 8,350 wounded, but he says, "many cases of slight wounds are not recorded."

⁷ Strength and losses of Confederates under General Lee estimated by General McClellan. The Quartermaster-General reported having buried 2,700 Confederates left dead on the field of battle. The estimates of General Lee's fighting strength is probably exaggerated, but the losses not over-estimated.

⁸ General Rosencrans states he had "less than 50,000 men in line of battle." The Adjutant-General of the army reported General Rosencrans' aggregate at this battle as 5,570 officers, and 88,706 men; total 94,276. But this is believed to include all the troops in the immense "department of the Cumberland." A very large number of the wounded of General Rosencrans' army were left on the field; these doubtless form part of the 4,945 reported as "missing."

⁹ Number of General Bragg's force after being reinforced by General Longstreet's corps.

¹⁰ Of this number 2,000 were prisoners.

¹¹ Number taken from the morning report of General Meade's aggregate force of July 1st, 1863. In this number large bodies of troops guarding trains, protecting lines of communication, &c. are included.

¹² This number is assumed, as General Lee is known to have had that number present for duty in June 1863. At the end of July he had but 41,135. The stated loss, 27,217, includes 13,621 men reported on the muster roll of the Provost Marshal of the army of the Potomac as prisoners. The remaining 13,596 are believed to have been killed or wounded.

¹³ Approximate numerical force.

The figures of losses obtained from the Surgeon-General's office are correct so far as is known up to the present date, and the preceding table has been formed from them. The same difficulty is met with in distinguishing between "strength of army under command" and "strength of troops actually engaged" in most of the battles under notice as in battles previously mentioned. The proportions of casualties are much higher than those of the recent Italian or German battles. They more nearly agree in numbers with the supposed losses in the great continental battles of the early part of the present century; but, as the ratio of killed to wounded is less in the American than it generally was in the latter, the *primâ facie* inference is that the wounds inflicted on the American battle fields were proportionally less severe.

Classes of Wounds inflicted in War.

The tables which follow have been formed with a view to determine approximately the proportion of wounded in battles requiring to be transported in a recumbent position. The published classified lists of wounds inflicted in some recent wars have been separated into two sets; one consisting of such wounds as may be supposed not to prevent the subjects of them from being removed in a sitting posture, the other set consisting of wounds which will probably necessitate a recumbent position for the patients during their transport from the field of action to hospitals in rear. No classified lists of the wounds received in the Italian battles of 1859, or in the more recent battles in Germany, are yet available for instituting such a comparison; and the classification of wounds recorded in the surgical histories of the wars in the Crimea, New Zealand, and the United States, have therefore been had recourse to for the investigation. The distribution of the wounds as shown in the tables has been arranged by Inspector-General Dr. Lawson. It is interesting to observe how nearly the same ratio is arrived at in the four columns. In a general way they all show that about one in every three wounds admitted for hospital treatment is of such a nature as to require the subject of it to be transported in a recumbent position. M. Scrive, the chief of the medical department of the French army in the Crimea, in his observations on the medical history of the war, made a division of the wounds inflicted according to their degrees of gravity, and he showed that "very severe wounds, calling, or not, for the removal of a limb" gave a ratio of 1 in 3·1, which indicates a very similar result to that arrived at in the following tables. M. Scrive divided the wounds into four degrees of gravity, their total number being 43,044. Of these 7,507, or 1 in 5·7, were fatal on the field; 13,284, or 1 in 3·3, were slight; 8,317, or 1 in 5·1, were of medium severity; and 13,936, or 1 in 3·1, were very severe.¹

¹Relation Médico-Chirurgicale de la Campagne D'Orient, par le Dr. Scrive, &c. &c. p. 470. Paris, 1857.

APPENDIX. CLASSIFIED TABLES (A.), (B.), and (C.) of wounds inflicted in certain wars arranged to show the ratios of wounded men capable of being removed sitting to those requiring transport in a recumbent position.

(A.)—SLIGHTER WOUNDS, the subjects of which might be transported sitting.

Description of Wounds.	Crimea, N.C. Offi- cers and Men. ¹	Crimea, Commis- sioned Officers. ²	New Zealand. ³	United States. ⁴
Wounds of head without depression or penetration of bone.	691	40	23	3,942
Flesh wounds of face, and wounds with slighter forms of injuries to bones of face.	382	33	13	2,588
Flesh wounds of neck - - - -	128	19	8	1,329
Wounds of chest (non-penetrating) - - - -	255	25	9	4,759
Wounds of abdomen (non-penetrating) - - - -	101	14	3	2,181
Flesh wounds of back - - - -	299	24	17	5,195
Wounds of upper extremities - - - -	2,083	106	145	25,620
Wounds of lower extremities (flesh wounds) - - - -	792	64	56	12,576
Total - - - -	4,731	325	279	58,190

(B.)—SEVERER WOUNDS, the subjects of which mostly require to be transported lying down.

Description of Wounds.	Crimea, N.C. Offi- cers and Men. ¹	Crimea, Commis- sioned Officers. ²	New Zealand. ³	United States. ⁴
Wounds of head, with depression or penetration of bone.	160	7	9	1,108
Wounds of face, implicating bones - - - -	151	7	6	1,579
Wounds of chest, penetrating, or injuring bones - - - -	165	29	22	2,483
Wounds of abdomen, penetrating - - - -	134	19	10	962
Wounds of perinaeum, &c. - - - -	55	4	5	468
Wounds of back, with injury to spine - - - -	27	5	5	187
Wounds of lower extremities, with or without fractured bones.	1,406	134	73	17,438
Wounds of nerves, vessels, and joints - - - -	154	12	6	—
Total - - - -	2,252	217	136	24,225

(C.)—TABLE showing the RATIOS of (A.) SLIGHTER WOUNDS, the subjects of which might be transported sitting, to (B.) SEVERER WOUNDS, the subjects of which mostly require to be transported lying down.

Description of Wounds.	Crimea, N.C. Offi- cers and Men.	Crimea, Commis- sioned Officers.	New Zealand.	United States.
(A.) Wounded patients for sitting position - - - -	4,731	325	279	58,190
(B.) Wounded patients for recumbent position - - - -	2,252	217	136	24,225
Total wounds specified - - - -	6,983	542	415	82,415 ⁵
Per-centage of (A.) patients sitting - - - -	67.9	60	67.2	70.6
Per-centage of (B.) patients recumbent - - - -	32.1	40	32.8	29.4

¹ The numbers in this column show the wounds of non-commissioned officers and men under treatment in the Crimea from 1st April 1855 to end of war.

² Wounds of officers under treatment in the Crimea from commencement to end of war.

³ The numbers in this column are taken from Inspector-General Mouat's report in the Army Statistical Reports for 1865.

⁴ The numbers in this column are taken from Circ. No. 6, War Department, Surgeon-General's Office, Washington, "Report on the extent of the materials available for a medical and surgical history of the Rebellion," &c.

⁵ This number is exclusive of 5,407 cases of wounds, the localities of which are not specified in the Washington Circular before named.

NOTE 3; page 65. THE GENEVA CONVENTION OF 1864.

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The following is the text of the Geneva convention of 1864, referred to on page 65. Another congress was assembled at Geneva in October 1868, with a view to extend the advantages of the convention to the wounded of navies, as well as to define with more precision the provisions of some of the articles of the convention of 1864. As, however, the newly projected articles have not yet received the sanction of the governments who are signatories to the original convention, it has not been thought necessary to insert them here; no alteration of the articles of the latter has been recommended in them.

ARTICLES of the CONVENTION, signed at GENEVA, August 2nd, 1864, for the AMELIORATION of the CONDITION of the WOUNDED in ARMIES in the FIELD, and acceded to by the BRITISH GOVERNMENT on the 18th February, 1865.

Article 1.—Ambulances and military hospitals shall be acknowledged to be neuter, and as such shall be protected and respected by belligerents so long as any sick or wounded may be therein.

Such neutrality shall cease if the ambulances or hospitals should be held by a military force.

Article 2.—Persons employed in hospitals and ambulances, comprising the staff for superintendence, medical service, administration, transport of wounded, as well as chaplains, shall participate in the benefit of neutrality whilst so employed and so long as there remain any wounded to bring in or to succour.

Article 3.—The persons designated in the preceding Article may, even after occupation by the enemy, continue to fulfil their duties in the hospital or ambulance which they serve, or may withdraw in order to rejoin the corps to which they belong.

Under such circumstances, when those persons shall cease from their functions, they shall be delivered by the occupying army to the outposts of the enemy.

Article 4.—As the equipment of military hospitals remains subject to the laws of war, persons attached to such hospitals cannot, in withdrawing, carry away any articles but such as are their private property. Under the same circumstances an ambulance shall, on the contrary, retain its equipment.

Article 5.—Inhabitants of the country who may bring help to the wounded shall be respected, and shall remain free. The generals of the belligerent powers shall make it their care to inform the inhabitants of the appeal addressed to their humanity, and of the neutrality which will be the consequence of it.

Any wounded man entertained and taken care of in a house shall be considered as a protection thereto. Any inhabitant who shall have entertained wounded men in his house shall be exempted from the quartering of troops, as well as from a part of the contributions of war which may be imposed.

Article 6.—Wounded or sick soldiers shall be entertained and taken care of, to whatever nation they may belong.

Commanders-in-chief shall have the power to deliver immediately to the outposts of the enemy soldiers who have been wounded in an engagement, when circumstances permit this to be done, and with the consent of both parties.

Those who are recognized, after they are healed, as incapable of serving, shall be sent back to their country.

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The others may also be sent back on condition of not again bearing arms during continuance of the war.

Evacuations, together with the person under whose directions they take place, shall be protected by an absolute neutrality.

Article 7.—A distinctive and uniform flag shall be adopted for hospitals, ambulances, and evacuations. It must, on every occasion, be accompanied by the national flag. An arm-badge (brassard) shall also be allowed for individuals neutralized, but the delivery thereof shall be left to military authority.

The flag and arm-badge shall bear a red cross on a white ground.

Article 8.—The details of execution of the present convention shall be regulated by the commanders-in-chief of belligerent armies, according to the instructions of their respective governments, and in conformity with the general principles laid down in this convention.

NOTE 4; p. 255. DR. GURLT'S ATLAS OF AMBULANCE MATÉRIEL.

Reference is made on page 255 to the Appendix for a short account of Dr. E. Gurlt's "Descriptive Plates of Ambulance Matériel."¹ These plates have been alluded to on several occasions in the course of this treatise.

Dr. Gurlt's work consists of an atlas of sixteen sheets of imperial folio size containing about 200 chromo-lithographic figures, nearly all drawn to scale, of objects and apparatus employed in connexion with sick and wounded in time of war. These plates are accompanied by a descriptive text in German and French of the various articles represented. The majority of the drawings are taken from the principal objects exhibited in the collection of the field hospital appliances at the Universal Exposition of 1867 in Paris, but others which were not exhibited there have been added to them. The drawings of the articles at Paris were executed by an engineer, Mr. Grund, who was sent for this purpose by the Minister of Commerce and of Industry in Prussia; the respective merits of these articles being at the same time examined and studied by Dr. Gurlt, Professor of Surgery at the University of Berlin, who was sent to Paris as a delegate from the Central Prussian Committee for aid to wounded soldiers in time of war.

The purpose of the work has been to place under view together a selection of objects either practically employed in the service of the field hospitals of the leading powers of Europe, or appearing to have special merits for such service. The selection includes means of transporting sick and wounded, articles of field hospital furniture, and surgical apparatus and appliances. It has also been the intention so to delineate these objects as to enable a workman to construct them, if required, from the figures in the atlas. Accordingly, nearly all the figures are drawn on a large size, and with the necessary measurements and scales attached to them. The materials employed in the construction, whether wood, metal, leather, or canvas, are also indicated very beautifully and clearly by the aid of chromo-lithography.

Among the means of transporting sick and wounded described in this treatise the following may be found, *drawn to scale*, and with all necessary measurements for construction, in Dr. Gurlt's atlas: 1. Prussian army wheeled stretcher; 2. Gauvin's wheeled stretcher; 3. Swiss

¹ Abbildungen zur krankenpflege im feld auf grund der internationalen ausstellung der hilfs-vereine für verwundete zu Paris im jahre 1867, und mit benutzung der besten vorhandenen modelle herausgegeben von Dr. E. Gurlt, &c. Berlin, A. Euslin, 1868. Price 35s. in England

wheeled stretcher; 4. Ruepp's Swiss wheeled stretcher; 5. English ambulance wagon stretcher; 6. Shortell's wheeled stretcher; 7. The Rucker sick-transport wagon; 8. Swiss army sick-transport wagon; 9. Howard's sick-transport wagon; 10. Prussian system of transporting wounded in fourth class railway carriages; 11. Ditto in luggage vans; 12. Baden system of railway ambulance transport, as designed by Messrs. Fischer of Heidelberg.

NOTE 5; p. 308. THE TWO AMBULANCE WAGONS WHICH GAINED THE PRIZES AT THE PARIS EXHIBITION OF 1867.

A committee, with Inspector-General Dr. Lawson as president, was appointed in the month of April 1868 by the Right Hon. Sir John Pakington, Secretary of State for War, to inquire into the general question of hospital conveyances, particularly as to the several kinds of vehicles most suitable for meeting the exigencies of modern warfare, and the proportions of each kind. The committee obtained sanction to procure some of the vehicles most recently contrived on the continent for the transport of sick and wounded soldiers, in order to observe and practically test their respective merits. Among other conveyances, patterns of the two wagons which gained the prizes referred to in the page above quoted, viz., Baron Mundy's and the Rucker wagon modified by Dr. Evans, of Paris, have been ordered and are to be subjected to trial. It is hoped that the action of this committee may lead to some improvements in the matériel of the British service destined for the transport of sick and wounded in time of war.

NOTE 6; p. 456. TRANSPORT OF WOUNDED ON PRUSSIAN RAILWAYS.

The following is a translation of the Prussian regulations relative to the transport of sick and wounded soldiers on railways, referred to in the note on page 456.

ORDER, issued by the PRUSSIAN MINISTRY for WAR, on July 1st, 1861, relative to the TRANSPORT of SICK and WOUNDED SOLDIERS on RAILWAYS.

A.—WAGONS.

I. *Slightly wounded.*

§ 1. For the transport of slightly wounded, as, for instance, those suffering from injuries to the upper extremities, who can, with more or less assistance, get into the wagons by themselves, and who are able to sit upright, compartments for first, second, and third class passengers are to be made use of. In this case no special management or particular contrivances are necessary, but care is to be taken that an injured limb is not placed on the side near the door, but towards the interior of the wagon, so as to enable the patient to lean comfortably on his sound side in the corner of the compartment.

First and second class wagons are chiefly to be used for officers and for those men who require most care; third class wagons for slight cases.

II. *Severely wounded.*

For conveyance of severely wounded, and of those whose lower extremities are injured, luggage vans are to be made use of. These vans have high solid side walls, but in fine weather the tops may be open.

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The patients are put into the vans on straw mattresses, with straw pillows fastened to them. These straw mattresses are furnished on both (long) sides with three strong loops of hempen band, such as is used for girths, through which two poles of about eight feet each in length are passed to form a kind of stretcher. If there is not a sufficient number of straw mattresses or straw sacks available, these temporary stretchers are only to be used for carrying the wounded into and out of the vans, and loose straw or hay is to be put into the vans themselves. Of course great care is to be taken not to set the vans on fire.

§ 3. In each of the luggage vans of the usual size (20 feet long, 7½ feet wide) there will be room for seven or eight more or less severely wounded.

[A sketch is here given to explain the distribution of the seven or eight wounded men in the van. Six are placed in a direction corresponding with the length of the van, three litters side by side being at each end. One or two litters, according as seven or eight patients are to be carried, are placed transversely in the centre of the van, spaces being left between them and the ends of the other litters which are laid longitudinally.]

Vans of a different size must be arranged in a different manner, but still somewhat analogous to the plan just given. The feet of the patients are to be placed towards the centre. The space unoccupied by patients is reserved for the attendants, and can be made use of for the various manipulations necessary during the transport. In case of need one or other of the patients may be moved, on his mattress, towards the centre, to give more room on the sides.

B.—ATTENDANTS.

The numerical strength of the personnel for attendance is left to the decision of the principal medical officer, depending on the available number. As a rule, however, for every 100 severely wounded 13 to 15 vans will be necessary, with one or two medical officers, two first-class orderlies, 13 hospital orderlies, *i.e.* one orderly at least for each van. These attendants are to be taken from the vacating field hospital.

The employment of soldiers of the sanitary companies in lieu of hospital orderlies is advisable only in such cases when they are sure during the time of transport and of their return not to be required for their special vocation, *viz.*, the conveyance of wounded from the battle field to the place of first surgical assistance.

Where there is only a limited number of hospital orderlies at hand the more slightly wounded soldiers will have to take charge over their more severely injured comrades, especially over those placed in passenger compartments.

But whatever scarcity there may be of attendants, no train of sick and wounded is permitted to start unless accompanied by a medical officer and one first-class hospital orderly.

It will be found useful to employ the same orderlies over and over again, to give them an opportunity of gaining experience in this kind of transport.

C.—PRECAUTIONS DURING TRANSPORT.

§ 5. (a.) The vans occupied by severely wounded are to be near the middle of the train, where there is less jolting and vibration.

(b.) The transport to take place as rapidly as possible.

No stopping except in extreme cases, or for the purpose of taking in drinking water, or to enable patients to obey the calls of nature or to clean utensils.

(c.) The windows on the lee side to be kept open for the supply of fresh air, and (as in the case of luggage vans) for light.

(d.) The medical officer to be furnished with all necessary apparatus for bandaging, stopping hæmorrhage, &c., and with the principal medicines and comforts. At each halt the medical officer is to inspect every van and to give his orders. The orderlies have to give the necessary stimulants, water, &c. to the patients, and to assist them in the execution of their natural functions. For every 100 patients will be issued five bed pans, 16 urinals, 15 water jars, 15 mugs, 15 spoons (for medicines).

(e.) The orderlies, &c. will have to obey all special instructions the medical officers shall think necessary. In cases of severe hæmorrhage or any accidents requiring immediate interference, they will cause the train to halt by means of a signal flag with which each wagon is supplied.

D.—DRESS OF PATIENTS DURING TRANSPORT.

§ 6. The dress of the patients is to be as complete as possible, leaving off, however, everything inconvenient. Great coat and forage cap will take the place of helmet and tunic. There ought to be a supply of woollen blankets for cold weather or special cases. All clothing and accoutrements not worn by the patient during the transport are in charge of the attendants.

§ 7. (Only of local importance).

E.—CONCLUSION.

§ 8. The companies and station masters at the terminus to be communicated with previous to the departure of the trains, so as to enable them to take the proper measures for receiving the wounded, unloading them without delay, and sending the attendants with all their stores and utensils back immediately to be available for another batch.

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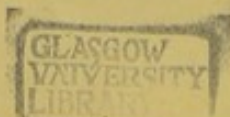
Printed by GEORGE E. EYRE and WILLIAM SPOTTISWOODS,
 Printers to the Queen's most Excellent Majesty.

For Her Majesty's Stationery Office.

[13009.—400.—2/69.]

[P. 1931.—500.—2/69.]

14 DEC. 1869







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