It was the intention of the late Major N. V. Lothian and myself to write a full history of the ambulance transport employed in all the theatres of the Great War, as regards both the means of transport and its organization, but Major Lothian's lamented death in Palestine and stress of work on my own part have prevented the fulfilment of this hope.

It will perhaps be most interesting if I select a definite campaign of the Great War waged in an undeveloped country, and describe the ambulance units as they arrived there equipped only for service in countries in which roads and railways were highly developed and how suitable transport was evolved for these units. I shall therefore select the campaign in Macedonia and when I come to deal in detail with individual types of transport I shall indicate other theatres in which they were employed during the War.

The greater part of the Macedonian Force landed at Salonika towards the end of 1915, the 10th Division being the first British Division to arrive from Gallipoli, in October; this was followed by five other British Divisions and a mounted brigade from the Western Front. The field ambulances of these Divisions were not equipped with pack transport but brought with them only the motor ambulance cars and horsed ambulance wagons which had been in use in France. It was therefore a surprise to find on our arrival that, so far as the British zone was concerned, there were only three main roads and these in so bad a state that they would quickly
Ambulance Transport in Undeveloped Countries

break up any motor ambulance car and be a source of the greatest discomfort to any wounded transported in such vehicles. Over the larger part of the area occupied by the Divisions there were no roads but merely rough mountain tracks made mostly by goats and sheep; on these neither ambulance cars nor wagons could be used. The only railway near our zone was on the left flank and in the early stages of the campaign was of no use for the evacuation of our casualties (see "Official History of the War, Medical Services, General History," Vol. iv, sketch map facing p. 75, showing medical arrangements for collection and evacuation of sick and wounded, Salonika, February, 1916). Such a situation in regard to ambulance transport can only have arisen through lack of knowledge of the nature of the country by those responsible for despatching the divisional medical units, and I therefore stress the importance of having a medical branch of the intelligence section of the General Staff responsible for collecting all information which might affect the organization and administration of the medical services in possible theatres of war.

In Macedonia luck favoured us. After the 10th and the two French Divisions withdrew from the Serbo-Bulgarian frontier and we took up a defensive position on the Lembet hills surrounding Salonika, we were unmolested by the enemy, except from the air, until the summer of 1916, and therefore had ample time to improvise suitable forms of ambulance transport and to experiment during exercises with troops on the hills which we held.

The Director of Medical Services of the Salonika Force quickly grasped the situation and invited all medical units, particularly of Divisions, to improvise suitable ambulance transport, and an exhibition and demonstration of the various devices was eventually held in January, 1916. Many interesting and ingenious types of transport were produced, and from these, in February, 1916, the Director of Medical Services drew up a provisional scale of transport suitable for a field ambulance—

(a) Combined wheels and pack.

3 motor ambulance cars.
3 light-horsed ambulance wagons.
60 mules with cacolets.
60 mules with litters and travois.
6 mules with two-wheeled stretcher carriers.
12 man-handled mono-wheeled stretcher carriers.
86 ambulance stretchers (including a reserve of 50).

(b) Wholly pack.

27 mules with universal riding saddles.
60 mules with cacolets.
15 mules with travois.
6 mules with litters.
6 mules with two-wheeled stretcher carriers.
5 spare mules.
74 ambulance stretchers (including a reserve of 50).

These provisional establishments were modified from time to time, particularly in regard to cacolets and travois, as experience was gained in the use and in the construction of the different types of transport and also in order to meet the
differences in the terrain, which was hilly in some Divisional areas and flat or undulating in others, but without puka roads and apt to be swampy. A.Ds.M.S. of Divisions were therefore given considerable latitude and used their discretion as to the proportions of the different types of improvised transport to be employed in their respective areas, for success in evacuating casualties depended on having a sufficiency of types of transport capable of being used efficiently on the prevailing routes of evacuation.

When we moved forward from the Lembet hills in the Salonika hinterland, to the line extending from the Vardar to the mouth of the Struma, each field ambulance was allotted, in addition to the improvised ambulance transport, ten light ambulance wagons, but as there were many situations in which these could not be used, they were held as a divisional reserve and issued to units when necessary. During battles ambulance cars were allotted by Corps to Divisions when the latter were in positions where they could use them.

From the end of 1916 to the close of the campaign in 1918, the British Army front extended from the mouth of the Struma River at Stavros Bay to the Vardar River—approximately 90 miles. For part of this time we had six Divisions, but on the transfer of the 10th and 60th Divisions to Palestine, only four Divisions and the 228th Brigade were left. The 27th Division, of which I was Assistant Director of Medical Services, held for the greater part of the time a frontage of approximately 35 miles, extending from the mouth of the Struma to Orljak Bridge on the Salonika-Seres road—a vast frontage compared with that held by a Division in France (see sketch map showing scheme of evacuation from XVIth Corps, Sept., 1917, summer positions, "Official History of the War, Medical Services, General History," Vol. iv, p. 139).

Before the final offensive, the 27th Division took over a sector west of the Vardar, which was hilly country with few roads, and successfully fought the first battle in the operations which brought about the final victory over the Bulgars (see map of medical situation, Doiran front at time of final operations, "Official History of the War, Medical Services, General History," Vol. iv, facing p. 144).

I will now describe the different forms of transport employed:—

I.—Carriage by Man.

(1) Hand-carriage without apparatus (pick-a-back, etc.).—This method was not extensively used as the voluntary assistance of unwounded men was not merely discouraged but forbidden and actually punished. It affords, however, a means of bringing back casualties from difficult positions (e.g., Indian Frontier picquets), which is not to be neglected, especially when prisoners are available, or when stretchers cannot be used or have run short. R.A.M.C. Training deals at some length with different methods under this heading, and I will not take up time by describing them.

(2) Hand-carriage with apparatus.—(i) By stretchers. As these are the most important part of the apparatus for transport of casualties I will emphasize one or two points in regard to them:—

(a) During the late war various special types of stretchers were devised which doubtless served a useful purpose during trench warfare. They can, however, never replace the standard Mark II stretcher and it is essential for general purposes that
there should be but the one standard pattern of stretcher which will fit accurately on to or into all the various contrivances used for transporting casualties.

(b) The vital importance of an adequate supply of these stretchers, not only in the country where operations are taking place but also conveniently situated to Divisions and with ample arrangements for transporting them to R.A.P.'s and A.D.S.'s.

(c) The necessity for a sufficient number of contrivances for adjustment to stretchers to enable suitable cases to be carried in the Fowler position or with head and chest or leg raised. For the last, iron suspension bars fit on to the stretcher and to these Thomas’s splints were attached.\(^1\) For the Fowler position or raising the head and chest we improvised in Macedonia very simple contraptions of wood and canvas, which are easily understood from a study of fig. 1. The lower portion is kept in position solely by the patient’s knees, and the support for the chest by a strap fastened round the stretcher.

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\text{FIG. 1.—Patient in Fowler position on improvised back and knee rest.}
\]

(ii) By dhooly.—This was the favourite method of transport in India some years ago, and was much used on the N.W. Frontier for long carries, but has now been replaced by a stretcher carried on the shoulders. There are occasions, however, when narrow and precipitous paths render carriage by two bearers impracticable. One must then adopt the dhooly—its swaying motion is, however, not pleasant.

A simple pattern consists of a 15 ft. pole from which the stretcher is suspended by its slings. The pole is supported by cross bars set at such an angle as to permit four bearers to walk virtually in file.

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\text{II.—Transport drawn by man or animals.}
\]

The two-wheeled stretcher carrier.—In the early stages of the war this, in the form of the carriage, ambulance stretcher, Mark I, was used chiefly, if not solely, in hospitals. A number of different varieties of this carriage were used later, the best known being the Brook-MacGormack, the Furber and the Miller-James, and, while they all served their purpose, the one that proved most useful for the

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\(^1\) See figure, "Suspension apparatus for fracture cases of lower extremity," "Official History of the War, Medical Services, General History," Vol. iv, p. 563.
evacuation of casualties across country was the Brook-MacCormack, chiefly because the other two varieties had pneumatic tyres which burst or punctured. Repair outfits were not usually available when wanted, and even if procurable, it was not easy or pleasant to mend a tyre under fire, possibly in the dusk and in a quagmire.

The Brook-MacCormack, i.e., the official "Carriage, ambulance stretcher, Mark I," proved most useful and comfortable, and was used extensively in Macedonia, South Russia and elsewhere. Each field ambulance in Macedonia had an official allotment of six Brook-MacCormack stretcher carriages and six mules for drawing them, and a number of regimental medical officers improvised similar contrivances to which they harnessed small ponies or donkeys, which were fairly easy to procure and which fed themselves on the country (fig. 2). These carriages are provided with struts to prevent the stretcher from tipping over when the carriage is at rest or when being unloaded. The wheeled stretcher carrier has the following advantages:

![Fig. 2.—Mule harnessed to carriage, ambulance stretcher, Mark I.](http://militaryhealth.bmj.com/)

(a) It is comfortable either in hills or in valleys where narrow paths, unsuitable for ambulance cars or wagons, exist. It can also be used with comfort in undulating pathless country when the surface is not rough.

(b) When man-handled it saves man-power, as once loaded one man can push or pull it with ease.

(c) It economizes energy expenditure, a factor of importance not always appreciated by military commanders. In saving energy it also diminishes the risk of heat stroke or heat exhaustion amongst stretcher-bearers.

(d) If the distances to be covered are not too great, man-handling is all that is necessary, so that it saves time in harnessing up animal transport.

(e) It is easily adaptable to mule or pony draught by fitting it with ash shafts, 2½ in. by 2 in. thick and curved outwards at the ends. These shafts are also convenient for man-handling. As these carriages were chiefly used in war theatres where pack saddlery was at hand, the common method of harnessing was to combine breast-strap draught with suspension by tugs. Some units preferred improvised wooden swingle-trees and ordinary draught harness.

While one muleteer and one R.A.M.C. orderly are necessary for a single carriage on the move, one orderly can look after a number of carriages when in convoy.
Ambulance Transport in Underdeveloped Countries

(f) When mule or pony drawn, these carriages can move at three miles an hour across country.

(g) It is easy by means of iron-tibbin bands, canvas and mosquito netting to improvise covers and thus provide protection against the elements and mosquitoes during transit on such carriages (fig. 3).

Disadvantages of the wheeled stretcher-carrier are:

(a) It cannot be used over very rough country or in deep mud.

(b) It cannot be used with mules, close to the enemy in zones of active enemy action.

The mono-wheel stretcher carrier.—Various types of mono-wheel stretcher carriers were devised, mostly from old cycle or motor-cycle wheels. These were useful in economizing energy and personnel in France when employed in evacuation trenches, against the walls of which they could be supported when at rest, but, they had disadvantages for use in open country where they were difficult to balance when loaded and very apt to skid, particularly on the sloping mud tracks in Macedonia.

The fact that the Director of Medical Services, Salonika Force, included twelve in the transport of each Field Ambulance was due to the efficient way in which these contrivances were demonstrated at the exhibition already referred to, and as the result of an over-optimistic report rendered to the D.M.S. by a Field Ambulance Commander.

Skis.—Although I have had no experience in war of the use of skis for ambulance transport, I have used them in peace time for the transport of injured in snow, and they were commonly used in the war by the French and Poles.

Carrying a stretcher, they provide a very comfortable and easily pulled contrivance in countries under snow. Figs. 4 and 5 show two suitable designs.

III.—Animal transport.

(A) Wheel-less animal transport.

(1) Riding animals.—Lightly wounded cavalry may proceed on their own mounts to a dressing station, but apart from this it was found necessary in Macedonia to make a definite allotment of twenty-seven mules, with universal riding saddles, to each field.
ambulance working on a pack basis, and these proved most useful in bringing in lightly wounded.

In hilly country and in valleys where mud was deep and long distances had to be covered, A.Ds.M.S. of Divisions often found it advisable to discard the cacolets in all their field ambulances and use the cacolet mules as riders for bringing in wounded. I will refer to this later. Equipped with universal riding saddles and one mule in four with a pack-saddle for kit, these mules ensured the rapid evacuation of numbers of lightly wounded men in convoy who would otherwise straggle back irregularly and under no supervision. One muleteer can take three loaded animals linked in series and one R.A.M.C. orderly proved sufficient to accompany a convoy of such cases.

Riding mules and ponies are also a recognized form of transport on the Indian frontier in situations where there are no roads, and were used in Waziristan in 1919-20, where there was a L. of C. eighty miles long, quite unfitted for wheeled transport.

(2) Animals bearing cacolets and other carrying devices.—In certain theatres of operations in the Great War where wheeled transport was impracticable, efforts were made to utilize animals carrying sitting and lying cases. In Macedonia, at the exhibition of improvised transport, in January, 1916, various devices were tested, particularly two large panniers slung on the sides of a pack mule to support a stretcher athwart the saddle. The expenditure of considerable ingenuity in the construction of light brackets and in the balancing and fixing of the loaded stretcher showed that over short distances such a method of transport was quite possible, but the anxiety of the patient precariously perched on the mule, the sway and tendency to slip, and the risk of the stretcher being caught among trees, led to the abandonment of the idea. Equally unsatisfactory were other devices, such as attempts to support the stretcher
lengthwise along the back of the mule. The only feasible means involves bilateral suspension, thus lowering the centre of gravity and providing balance.\(^1\) The French have long used such apparatus both for lying and for sitting cases.

The cacolet was adopted when the going was suitable as the principal means of evacuating sitting cases in Macedonia, sixty mules, each carrying two cacolets, being the establishment for a field ambulance, whether on wheels or pack. The cacolet was also used in Palestine, Russia and elsewhere.

The cacolets are fixed to the ordinary mule pack-saddle and are skeleton apparatus which unfolds to form a seat with foot rest on each side of the mule, the seat facing the mule’s head. Both cacolets must be occupied to give balance. Each mule requires a muleteer, but one R.A.M.C. orderly suffices for five loaded mules. The motion is not unpleasant, but the strain on the mule is great and a special type of mule is required for success. A suitable mule will carry two 10 st. men, without kits, for five miles across fairly level country. A kit mule is required for every three loaded animals. In organizing cacolet convoys relay teams every five miles are essential. On steep hill tracks and in deep glutinous mud the mules proved unequal to the work. In such situations we stored the cacolets and converted the mules to riders thus halving the carrying capacity for sitting cases.

The mule litter and travois.—A contrivance was evolved and selected as the standard pattern in Macedonia which served either of these purposes and was designated a “litter travois”. Of all the apparatus used in the War for the transport of casualties, excepting only motor ambulance cars, the litter, the travois, and finally the combined litter-travois showed, perhaps, the most remarkable development. Our Army training manuals devoted but a few brief paragraphs to these devices, nevertheless, the extent of their use in various theatres of war (Macedonia, Palestine, Russia, etc.), their remarkable convenience and their ability to convey casualties in comfort along narrow tracks winding through hills and ravines, over broken stony ground, and through deep mud, all characteristic of the Salonika hinterland and over which ordinary wheeled transport could not be used, and over much of which even the modern six-wheeler or caterpillar would be useless, render it imperative that they should not be overlooked as valuable forms of ambulance transport in undeveloped countries, and I trust that this paper may at least prove useful as a record of these particular forms of transport.

I do not know when litters were first devised but I understand that travois were first used by the North American Indians who, in moving camp, used the tent poles as travois on which they carried their tents and baggage and on which they themselves rode. A mule-litter is a contrivance carried between two mules, while a travois is similarly constructed, harnessed to a mule in front but with the rear ends of the poles dragging along the ground. (Figs. 6 and 7.)

During the War the early patterns of litter and travois devised were similar to those figured in R.A.M.C. Training and were made from young trees and other local material. Later, bamboo types were tested but proved too fragile, perhaps owing to the issue of bamboo of inferior quality or the wrong kind. Tube iron structures were then adopted and though durable and reliable were too heavy. Finally, after all the varieties and patterns had been thoroughly tested and considered, a standard

\(^1\) "Official History of the War, Medical Services, General History," Vol. iv, figs. on pp. 595-6.
type made of stout ash was selected. The parts were supplied by Ordnance and were assembled by the field ambulance personnel. The final scale per field ambulance was forty; they could be used either as litters or travois and were therefore known as litter-travois. For these the allotment of mules was sixty per field ambulance, and as two mules were required per litter, and only one per travois operating over fairly easy undulating ground, they could be employed, twenty as litters and twenty

![Image](https://example.com/image1.png)

**Fig. 6.** Shows litter harnessed up. Litter is the correct length of 19 ft., but is the present cumbersome pattern composed of two long poles on each side.

![Image](https://example.com/image2.png)

**Fig. 7.** Shows the 19 ft. litter being used as a travois, and also shows sunshade and mosquito net on stretcher.

as travois, but, as the manner of their use depended on local terrain this was left to the discretion of Divisional A.Ds.M.S. or field ambulance commanders.

The factors in the construction of the litter-travois which greatly affect the comfort and utility of this apparatus are as follows: To be efficient a litter must be simple, light but strong, as short as practicable, easy to harness and capable of rapid release. In the type finally adopted in Macedonia each bearer-pole consisted of two halves joined by steel bands and bolts. This entailed assembling the parts at the field ambulances. The junction is a source of weakness, and, where the ends overlap, there is unnecessary thickness and weight at a point where there is no excessive
Ambulance Transport in Undeveloped Countries

strain. With the assistance of an R.E. officer I worked out the reactions at different parts of the apparatus when fully loaded as a litter and as a travois. As a result I strongly advocated, and still recommend single ash poles 19 ft. × 3 in. × 3 in., tapered to 2½ in. × 2½ in. at the ends from points 6½ ft. (front) and 7 ft. (rear) from the ends (fig. 8). If bamboo is used, it must be male bamboo and must not be worm-eaten, sun-dried or cracked. The ends should be rounded off on the inside to avoid cutting the mules and the front ends slightly bent outwards like the shafts of a dog-cart.

**LITTER**

Such single poles when loaded with a stretcher carrying a man of average weight and his kit (i.e., 248 lbs.) have a factor of safety of 5 with a dead load and 2½ with a live load and vibration, which is ample.

The cross bars which support the stretcher should be of the same material as the poles, 2½ in. × 2½ in., and are secured to the bearer poles by ½ in. steel bolts. Two loops of ½ in. steel are bolted through the rear cross bar, and under these the rear handles of the stretcher are passed in order to keep it securely in position. They are not required on the front cross bar, as the stretcher runners abut closely against it. Two ¼ in. round steel stays are required between the lateral poles, just

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**Fig. 8.**

Detail of attachment to pack saddle.
beyond the cross bars; these stays keep the litter steady and prevent those lateral and swaying movements which tended to make the first devised litters uncomfortable conveyances for wounded.

A \( \frac{3}{4} \) in. steel bar 1 ft. long is bolted through the shafts; this bar carries the chains by which the litter is suspended to the pack-saddle and at both ends of it are \( \frac{3}{4} \) in. movable steel hooks to which the breast-collars and breeching-chains are attached when the mules are inspanned. The suspension chains should be leather-covered to the extent of one foot to prevent destruction of the pack-saddle by friction; the uncovered links enable the litter to be adjusted and the stretcher kept level on steep inclines. The ring which secures these chains to the bar and the bar itself should be kept well greased to enable free play to take place along the bar.

The chains from the breast-collar and breeching—which act as the traces—should be leather-covered half way from breast-collar and breeching to prevent chafing of mules.

Steel runners 15 in. long by \( \frac{1}{2} \) in. thick may be fitted to the ends of the rear shafts to protect the wood should the litter be used as a travois. Wooden runners can also be easily improvised and secured in position by tibbin bands and these were preferred by many. It is essential that the upper ends of these runners should be flush with—and should not project from—the under surface of the poles to which they are attached, otherwise they are liable to pick up and cut ground telephone wires. A swingle tree attached to the front cross bar is essential to prevent lateral movement which is so uncomfortable to a patient.

When transporting wounded on travois over uneven country, it lessens shock if the rear end of one of the travois poles is 18 in. shorter than the other. This difference in length enables the ends to glide more easily and smoothly over bumps, thus avoiding sudden jars. A travois so made cannot be interchanged for use as a litter. The most suitable length for a travois is about 16 ft., and while it is possible to use a 16 foot litter, 19 ft. is a more suitable length.

To protect patients from weather and insect pests, covers are required for litters and travois. A suitable cover is made of canvas or ground sheet material fitted over a wooden frame or one made of tibbin bands. The stretcher on a litter is naturally horizontal on level ground and on steep inclines can be kept level by lengthening the front suspension chains of the litter.

With travois it may be necessary to suspend the front handles of the stretcher in leather or rope loops under the anterior cross bar, but, with the 19 ft. travois this is not usually necessary.

The litter load per mule is roughly 200 lb., made up as follows: Litter 60 lb. (approximate), two pack-saddles 106 lb., stretcher 30 lb., man 154 lb., and man’s kit 50 lb.; total 400 lb. With the correct type of mule this load, although heavy, can be successfully carried over long distances as the mules have a rest when returning with the empty litter.

The following views as to the advantages and disadvantages of litters and travois in undeveloped countries are my own and are based on four years of close observation and tests of these contrivances in the Balkans and Russia; my preference for the

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1 "Official History of the War, Medical Services, General History," Vol. iv, figs. on pp. 592, 593, 594.
Ambulance Transport in Undeveloped Countries

litter over the travois is shared by other officers who had much experience of these forms of transport in Palestine.

(1) A travois used over level or slightly undulating grass land is as comfortable as, perhaps more comfortable than, a litter and can proceed at 2½ miles an hour.

(2) Over level or undulating country a travois requires only one mule and one driver, whereas a litter requires two of each. Under such conditions travois show a marked saving in men and animals over litters and with an equal number of men and animals have a double carrying capacity.

(3) With the above exceptions, which are limited to special conditions of ground and country, I consider the litter much superior to the travois for the following reasons:

(a) The litter is undoubtedly the most comfortable form of transport over rough or hilly country, lacking in roads, and covers on an average three miles an hour.

(b) The loaded weight, 400 lb., being shared by two mules never proves excessive.

(c) The litter is virtually independent of the nature of the ground; wherever mules can find foothold there a litter can go. Mud and dust make little difference. Slopes are easily taken by two mules and there is no real difficulty at corners with a driver to each mule.

(d) Telephonic or telegraphic communications are not affected.

Disadvantages of travois.—The main disadvantages are:

(a) They cannot be used in hilly country or where there is much undergrowth, nor can they be used on the sides of hills because of the lateral slope given to the stretcher and the resulting discomfort to the patient and difficulty in keeping him on the stretcher.

(b) On steep inclines two mules are essential and hence there is no saving, as compared with litters, in animals or drivers.

(c) On dry and dusty surfaces the patient is covered with dust stirred up by the runners.

(d) They interfere with communications by picking up and cutting ground telephone and telegraph wires: This risk is particularly great in the dusk or when it is dark.

(e) Unless wide wooden runners are supplied they cannot be used in deep mud.

(f) Over rough stony ground they jolt even when one pole is longer than the other.

(g) They are very difficult to steer on sharp curves in steep gullies as the mules tend to plunge up the steep bank and the travois is swung straight across instead of round the corner, with much consequent danger to the patient. To prevent this a drag rope with a man holding on to it is essential.

(h) The steel runners, except when used on soft and fairly flat surfaces, quickly wear out.

(i) Without a swingle·tree attached to the front cross·bar an unpleasant lateral movement is experienced by the patient.

Ambulance transport drawn or carried by camels.—In Palestine camels were used for cacolets, travois and litters. The camel cacolets were of two kinds, one similar to the mule pattern and the other resembling a cot instead of a chair. The travois and litters were of bamboo and longer than the mule patterns; they were not provided with the devices used in Macedonia to prevent lateral motion, etc.

Kujawahs are hammock-like contrivances carried lengthwise on either side of a camel. They were used in Palestine during the War and have for many years formed the principal method of ambulance transport for lying cases on the Indian Frontier where the lack of roads in many places renders normal modern ambulance transport unsuitable. In Waziristan, in 1919-20, a large force entered

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1 "Official History of the War, Medical Services, General History," Vol. iv, figs. on pp. 598, 599, 600.
2 Ibid., Vol. iv, figs. on pp. 601, 602.
the country and there was a line of communication some eighty miles long unfit for wheeled transport of any kind. Casualties were evacuated by hand-carriage, riding ponies and mules and camel kujawahs, the great bulk being evacuated by kujawahs (in India there are also special bearer units, 500 strong, and hand-carriage by these bearers was used for the most severe cases). The kujawah is not ideal for transporting casualties; one G.O.C. reporting on it in 1919 described it as "still in use in India although barbarous and out of date, having been condemned by Field-Marshal Joshua at the battle of Jericho!" Nevertheless, after carefully considering the local conditions he had no alternative to suggest!

The chief objections to the kujawahs are that the paces of a camel are uncomfortable and with the harness in common use it is hard to ensure that the kujawahs keep level or do not fall off. Kujawahs are suspended from hooks attached to a frame which fits over the saddle or "palan." As these hooks are easily broken off a strap is commonly passed over the kujawah and under the camel to make the kujawah more secure. The saddle on which the frame rests keeps in position because it fits the camel's hump, the only girth is a rope. With kujawahs the patient is much inconvenienced when the camel kneels for loading or unloading. This can, however, be overcome by having platforms built at staging sections at C.C.S.'s, to enable loading and unloading to be done with the camel standing. These platforms are built in duplicate with a space between them sufficient to allow the camel to pass. The platform must be high enough, 4 ft. 3 in., to make loading easy by resting the kujawah frame on the platform with the camel standing, and the steps must be wide to facilitate taking the stretcher up to and down from the platform, which is 4 ft. 6 in. wide and 8 ft. 6 in. long. The camels are rather shy of these platforms until they get used to them. The maximum camel load is 400 lb., so a camel must be considerably overloaded when carrying two men of 11 st. each with their kit and the kujawahs.

Other forms of wheel-less animal drawn transport—sledges—have a definite value where snow or even mud militates against the use of wheeled vehicles. In campaigns in the far north either dogs or reindeer are used as the motive power, but where snow is not continuous these animals are not likely to be available and the ever useful mule usually provides the traction. During the War sledges were chiefly used for ambulance transport in North and South Russia. For certain mountain positions in the Caucasus I found them to be the only practical means of transport. Where dogs (fig. 9) are used in the snow, as in North Russia, light skeleton sledges are adopted, but when using mules and especially in mud, a stouter form of sledge is desirable. It has a swingle-tree fixed to one end for harnessing to the mule, which is provided with a kicking-strap and is guided by ropes from the rear. One muleteer and one orderly are required. Sledges are not practicable on very steep or sloping tracks with sudden bends. Over flat country however they may frequently be linked in pairs or they may be trailed behind other draught apparatus to carry kits.¹

(B) Wheeled animal transport.

The heavy ambulance wagons (Marks V and VI) are not suitable for use under conditions with which I deal in this paper.

¹ "Official History of the War, Medical Services, General History," Vol. iv., figs. on pp. 604, 605.
Ambulance Transport in Undeveloped Countries

The light ambulance wagon (Mark I) taking two stretcher or eight sitting cases (six inside and two outside), proved most useful under certain conditions as it could be used wherever limber tracks or roads existed, indeed, wherever a field gun could go a light ambulance wagon could go. We used them extensively in Macedonia.

As at present designed they have, however, certain important structural defects which detract from their utility and comfort when used across country or on rough roads and which necessitated frequent visits to the repair shop. These defects are capable of remedy and are briefly as follows:—

1. **Forecarriage** (fig. 10).—(a) The straps and bolts marked "A" are too small and too close together, and are constantly breaking. They should be made the same size as those marked "B" and should be the same distance apart. (b) The spring has too much play and over rough roads breaks the securing plates, straps and bolts. From the same cause the tyres of the front wheels are frequently ripped off, owing to the wheels scraping the under surface of the footboard when a loaded wagon is being turned.

![Fig. 9.](image)

2. **Perch.**—The perch is much too weak and is constantly breaking where the rear bolt of the front stays penetrates it. The front and rear stays should be continuous, and the perch should be fitted with an additional channel iron extending from front to rear axletrees.

3. **Brake.**—(a) The brake shoes should be free so that their full surface will touch the tyre when the brake is put on; at present only the lower part touches. (b) If one tyre is new and the other worn, the brake acts on the new tyre only. (c) An adjustable brake is required.

4. **Rear springs.**—When the brake is put on, the body goes forward and, as a result, the rear springs are pressed backwards out of position and break.

5. **Water Tank.**—The rod which secures the tank is not strong enough and shakes out on rough roads, the tank falls off and is not infrequently lost.

The ambulance tonga—drawn by two bullocks or mules—was devised by Major-General Hathaway and the late Captain Noake. It is very suitable for ambulance transport where other forms of wheeled animal-drawn transport cannot be used.
with comfort. The tonga is hung low, is very difficult to upset and carries four sitting or two lying cases.\footnote{Ibid., Vol. iv., fig. on p. 616.}

The desert ambulance cart.—A two-wheeled hooded spring cart with a spring bottom and drawn by four mules, was found useful in Palestine, as the wheels, fitted with metal tyres 12-in. wide, do not sink in the sand.\footnote{Ibid., Vol. iv., fig. on p. 613.}

Other forms of horse-drawn ambulance transport.—The G.S. wagon, the limbered wagon and the Indian A.T. cart can all be fitted up to serve as ambulance transport in emergency; also various forms of country carts, but, as ambulance work is not their normal function I will not take up space with a special description of their uses.

\textbf{Transport animals.}

The mule has proved its value in war—hardy, patient, sure-footed, hard working, and (despite the exceptions which have sullied its fair name) lovable. There are few places, even the most difficult of access, where a mule cannot go safely. For its services in Macedonia in carrying our wounded and our food supplies we owe it much gratitude.

For a long time the ambulance mules were trained and tended by R.A.M.C. men who were subsequently replaced by Cypriot muleteers but not, in all cases, to the gratification of the R.A.M.C. personnel or the mules! There is much to be said for the association of bearers with the ambulance transport animals and it is a moot point if training in animal management—more particularly mule management—and the essentials of pack and draught saddlery would not be worth while in rendering

\begin{figure}[h]
\centering
\includegraphics[width=0.5\textwidth]{ambulance_wagon_mark_1.png}
\caption{Ambulance wagon, Mark I. Suggested alterations and additions to fore-carriage.}
\end{figure}
Ambulance Transport in Undeveloped Countries

R.A.M.C. personnel independent in emergencies such as often confronted us during the War.

Mules must of course be carefully trained for ambulance transport. The majority are easy to train though some are fractious. On the whole they take kindly to litters and travois after a brief training with unloaded apparatus; at first a little puzzled, they soon settle down to them. Even if they try to bolt they usually set off in different directions and soon stop. With sympathetic, permanent drivers, they are very docile. The best type of mule for litters, travois and cacolets is the thick-set animal about 14 to 15 hands and not the largest sized mule. One of the drawbacks to mule transport is the amount of forage which it is necessary to carry for the mules.

The camel is also most useful for ambulance transport as it is easily trained and docile except when "musht," when it will readily bite, and few things are more horrible than a camel bite. In Arabia I have seen many cases of limbs bitten off by "musht" camels; a jagged stump is left which invariably suppurates. The chief disadvantage, however, of camels for ambulance transport is the discomfort to the patient caused by their gait, and by their way of kneeling and rising. Unlike the mule, the camel is easy to feed and will go for long periods without food. In this respect it is an economic form of transport; furthermore, it can carry two lying cases at one time in kujawahs.

Horses and dogs need no comment.

IV.—Motor Transport.

(1) Road. (a) Four-wheeled ambulance cars.—In Macedonia the only motor ambulance transport which we could use in the forward areas was the light Ford ambulance car, and its use was restricted to positions where roads of some kind existed. Even the main road of evacuation (Salonika-Seres) from the Divisions in the Struma valley to the base hospitals was so rough that for a very considerable time the unfortunate casualties were transported in the returning lorries of the supply columns for 70 kilometres or more and suffered great hardships in consequence. Later, when this and other main roads had been repaired, properly organized motor convoys using heavy ambulance cars were available and conveyed casualties, either from forward C.C.S.'s or field ambulance main dressing stations situated near the main roads to base and L. of C. hospitals.

(b) Six-wheeled ambulance cars.—With the development of the six-wheeled ambulance car it will now be possible to traverse roughish country on the plains where only the mule and other improvised transport, already described, could be used during the War. It must not be forgotten, however, that there were many situations in the hills where no six-wheeler could go and even on the plains a journey over rocks is no joy to a patient, even in a six-wheeler, and I have not yet seen one tried in deep glutinous mud such as we so often met with in Macedonia.

My chief criticism of the six-wheeled ambulance car is the fore and aft vibration when moving fast on a road and the fact that across country its pace, with comfort, is limited to 4 to 5 miles an hour.

I am glad to see in a design recently exhibited at the War Office the replacement of the canvas rear curtain by doors. This will prevent the patients being smothered in dust as heretofore. In the new car the exhaust heating can be cut off when
required, an important improvement for hot countries. An arrangement by which the upper stretcher carriers can be lowered for loading is also a great advance on the existing designs.

(c) The motor ambulance coach or charabanc.—I could never understand why so little use was made of this vehicle during the War. While with the 7th Division in France, I applied for three of these vehicles before every big battle in which the division was engaged, but never once were my requests granted although I am certain that no other conveyance would have helped so much to achieve the two essentials in dealing with battle casualties in forward areas, viz., their rapid and comfortable evacuation from the battlefield to a medical unit where they can receive adequate treatment. The lowness, carrying capacity and comfort of motor coaches render them eminently suitable for ambulance transport wherever good roads exist and enemy's fire permits. For sitting cases, and if converted to take stretcher cases, they would have been a god-send, not only in France, but also in Macedonia in 1916. They are much superior to motor buses which were used in France.

![Image of stretcher and medical unit](image_url)

**FIG. 11.**

(2) Railway. Decauville railway coaches (fig. 11).¹

When we arrived in Salonika there was only one broad-gauge railway serving the British zone and that was on the extreme left of a 90-mile front. Before the campaign was finished we had constructed many Decauville railways which served different areas and proved valuable in the evacuation of casualties. The small trucks could take four stretcher cases and a train of ten trucks could be drawn by mule teams or by an engine extracted from a Ford car.

In the latter case a speed of eight miles an hour on the level could be attained. As the vibration of rigid trucks made them uncomfortable for serious cases, specially built covered ambulance trucks were made by the R.E. according to specifications drawn up by R.A.M.C. officers and ran with marked success as miniature ambulance trains. These trucks were covered, marked with the Red Cross and were fitted up (by means of old bed-springs) after the Brechot pattern

¹ Also diagrams ¹ Official History of the War, Medical Services, General History," Vol. iv., pp. 648, 650, 651, 652.)
Ambulance Transport in Undeveloped Countries

to carry two, or, in the larger trucks, four lying cases. Such trains were notable features in the evacuation scheme on the Struma valley front in Macedonia, where cases had to be collected from a distant flank and transported to the Central Salonika-Seres Road whence they were transferred to motor ambulance cars for conveyance to the base hospitals.

(5) Air. Aerial ambulance transport.

The more I know of war in countries like Macedonia, the more I am convinced of the importance and necessity of a definitely organized system of aerial transport for serious casualties.

We know the vital importance of getting cases of penetrating wounds of the abdomen—including wounds of the liver, bladder and kidneys; penetrating and perforating wounds of the chest; head wounds, and also compound fractures of the thigh—to a hospital where they can receive adequate treatment at the earliest possible moment, followed by prolonged rest. Yet to the end of the war such cases were often carried many miles in slow moving animal transport and over rough roads in ambulance cars and even in motor lorries, and by the time they reached hospital, if alive, they were often beyond hope.

It is just in countries of this nature, where fighting is not so intense, that suitable landing grounds for aeroplanes near the field ambulances might often be found, particularly for a machine like an autogiro which, in still air, requires no landing speed, or run, and a take off run of only 30 yards.

At a large medical staff exercise shortly before the onset of the Great War, when the Directing Staff from the Command explained how the wounded were to be brought back in the supply wagons and lorries, I protested that such a scheme would never work but was doomed to failure, and that the organization of motor ambulance convoys was essential. I was assured that the ambulance cars were quite unnecessary and could not be thought of! I had received similar rebuffs at other staff exercises in previous years when I had proffered similar advice—no doubt many others had a similar experience. Nevertheless, when I joined the 7th Division in France as D.A.D.M.S. I was fortunate, through explaining my views to a generous friend, to have two Rolls-Royce ambulance cars sent to me, via Dunkirk, for use in the Division. Needless to say they were invaluable, but were soon commandeered by A.H.Q. to help in forming a motor ambulance convoy for the Army!

History seems likely to repeat itself in regard to ambulance airplanes. I attended a medical staff exercise about three years ago, in which an armoured force made a wide raid, captured a bridge-head and left infantry to hold it. There were a good many casualties but no ambulance cars with the raiding force, and, to my mind, the correct way to deal with the serious cases was to get them back by ambulance airplanes, but, when I gave that as my solution of the difficulty, I was told to discard it from my mind as no aeroplanes would ever be available solely for ambulance work, they would all be required for fighting purposes!

The official solution was that the seriously wounded must be left with the enemy! Consider the effect of such a policy on the morale of the troops and on public opinion!

Unless more foresight is used, however, we shall doubtless do as we did in regard to motor ambulance transport before the Great War—neglect to organize aerial
ambulance transport until many valuable lives are lost and public opinion compels us to provide what is necessary.¹

Zones in which to use different forms of transport.—In deciding this never forget your object, which is to get the wounded man from the battlefield to a suitable hospital as quickly as possible and with a reasonable degree of comfort. You will therefore use your rapidly moving transport as far forward as the local conditions of the country and the enemy activities permit.

If you can find landing grounds for ambulance airplanes near your field ambulance main dressing stations and the enemy's air force and gunners are not too active, it is obviously desirable that serious cases of the kind already mentioned should be picked up there by the airplanes and transported direct to a suitable hospital, where such cases can get the rest necessary for their recovery, cutting out the C.C.S., which in mobile warfare is not a stationary unit.

In regard to other forms of transport, remember the onerous nature of a stretcher bearer's work. The rate of evacuation by this means varies according to a number of factors, of which the condition of the ground, the climate and enemy activity are the most important. Over dry ground and in otherwise favourable conditions one mile an hour is good going.

Therefore, in order to conserve the energy of your bearers and speed up evacuation as much as possible, use mechanical contrivances as far forward as the situation permits.

I am much indebted to Major-General Blackwell for kindly supplying me with information in regard to the transport employed on the Indian frontier, to the late Major N. V. Lothian for some of the illustrations, and to various others from whom I have borrowed photographs, also to Mr. Gibbs, photographer, Royal Army Medical College, for making the negatives.

¹ Since the delivery of this lecture and as a result of it, Lieut.-Colonel E. M. Cowell, D.S.O., R.A.M.C., T.A., who was present, has been in touch with various civil flying clubs and owing to his initiative, energy and keenness the organization of Voluntary Air Ambulance Detachments is now making considerable progress.