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W. L. Geddes

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Monday Evening, April 19, 1880.

COLONEL EDWARD H. CLIVE, Grenadier Guards, Member of  
Council, in the Chair.

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## ON "MANUAL" TRANSPORT.

By W. L. GEDDES, Brevet Major 53rd Regiment.

A VERY few years ago anyone venturing to lecture on "Transport" might have counted on being favoured with a very small audience. Now, in this respect all is changed, for we see the congenial subjects of Strategy and Tactics giving place to the eminently prosaic but much more important point, "How masses of men *on the move* are to "be supplied with the numerous articles necessary for a modern army "in the field." How important the subject has become is shown by large audiences eagerly following the most technical details. It may, however, be safely affirmed that it is not in details that the remedy for transport difficulties will be found. Numerous wars have shown us our weak points, and though it is our custom at the end of a campaign to scatter not only transport material, but also, in a great measure, transport experience, still we have not been inapt pupils, and we may boast that we have little to learn regarding organization. What is really needed is a new departure *in toto*, for as yet, whilst the rest of the Army is the pink of mechanical perfection, transport arrangements appear to carry us back to the times of Alexander and Darius, or to the time of our own Edward III, who according to Froissart was on one occasion followed by a train of 6,000 wagons, stretching upwards of two leagues.

The object of this paper is more particularly to examine that part of the transport question dealing with the carriage of those different "necessaries," which must always be within reach of the soldier, viz., food, ammunition, and intrenching tools, more especially as regards the transport of ammunition and intrenching tools on the field of battle; but in order to make this portion of a vast subject clearly intelligible to those who have not a technical knowledge of the subject, a general view of transport arrangements must be taken. By condensing and divesting the subject of all technicalities it is hoped that this "going over" well known ground will not prove altogether uninteresting. No better idea of transport arrangements and difficulties can be found, than that given in the following extract from Home's "Précis of Modern Tactics." "If an attempt is made to "realize what was happening when the Crown Prince's army advanced, "it will be found that long columns of men and horses were spread

"along the different roads, and that the trains of each corps were parked in rear, that is to say, the supplies of each corps were parked in rear.

"When each column halted for the night at the places indicated in the orders, the head of the column did not halt there with the tail spread along the road it had marched on, but each corps drew its tail up after it had more or less formed a line of battle. Thus the roads were cleared, and it then became possible for the trains to advance with food. But it is manifest that if the soldier having to march 12 to 15 miles, and starting at 4 A.M. and probably not getting settled into his bivouac until 3 or 4 o'clock in the afternoon, had to wait for his food until the train arrived, he would be simply starved.

"Therefore it follows that if troops are to be fed in the field they must carry rations with them, and the rations consumed during the day must be replaced by the train during the night, so that the men shall move off the following day with the same number of rations as previously. Soldiers, if they are not to starve, must carry rations. No one who has considered this subject will question the truth of these words, and it is essentially requisite that this absolute necessity be clearly understood by the men. A ration of fresh meat and bread put into a canvas havresack and carried in the sun for ten hours is not an inviting dinner, and the soldier often throws it away.

"The best food to carry is undoubtedly bacon, sausage, biscuit, rice, &c.

"One of the Prussian Army Corps drawn up on parade ready to march off, if inspected would have been found to have at least eight days' rations with it. These would be divided as follows:—One day's common ration for immediate consumption; three days' reserve rations consisting of biscuit, coffee, bacon, rice and salt. The five provision columns, viz., two for each infantry division and one for corps artillery and cavalry, carrying four days more, the meat being driven. The order to advance and leave the trains behind was perfectly feasible; the Army could exist for four days without seeing its train if necessary. But the moment the trains get the order to advance they move up at night and fill up the rations consumed by the troops, halting again when the troops advance.

"How are the trains themselves filled up? As far as possible magazines told off previously in the same order as the corps provision columns, are formed. These magazines are the reserves, of which the trains themselves are the expense magazines, and hired transport carriages to the number of nearly 600 per corps are used to haul up the provisions from the magazines to the trains and fill them up as they filled the soldier. It is manifest that there must be some limit to this operation. Assuming that the train can move one and a half infantry marches, the limit would be six days when the magazines must, if the Army is advancing, be moved to the front; this would probably be done by pushing up by railway from the great magazines of the country large supplies of food, &c., to fresh advanced magazines, which would then fill up the train, and this process would be repeated. This supposes nothing to be bought in'

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"the country or obtained by requisitions, but all brought from the "magazines."

From this description, terse, but with every word full of meaning, one point may be chosen for our purpose, viz., if soldiers are not to starve, they must carry rations.

This *personal* carriage of rations is most important to any army, but as yet with us this point has not received the attention it deserves.<sup>1</sup>

Not for want of warning, however, for more than one savage foe has shown us that "Manual Transport," or, in other words, the ability to dispense with the train for a certain time, means mobility. How often may be asked have golden opportunities of striking decisive blows been lost because a lumbering train has not been got together, or when got together has been simply able to crawl.<sup>2</sup>

It is evident we cannot afford to keep up the disciplined body of men, supplied with the necessary "plant," requisite for modern European warfare, as the conditions under which we usually fight are different from those of civilized nations. Transport with European armies means roads, supplemented by rivers, railways, and canals, a rich country, large populations, and abundant supplies; with us, in nine cases out of ten, transport means a barren and unknown country, with no roads. In Europe some estimate may be made of the difficulties to be encountered, but with us it is always more or less a leap in the dark. Nothing exemplifies this more than the examination of the different methods of carriage used in our past wars. Elephants, camels, horses, mules, bullocks, horse and mule carts, wagons, bullock carts, carriers, &c., have all served their turn. Of all these methods perhaps pack transport, with us, has the preference, simply because

<sup>1</sup> The knapsack reserve in Russia consists of three days' biscuits at 1·8 lbs. for each day, and a two days' reserve of salt,  $\frac{1}{2}$  lb., consequently a weight of 5½ lbs. In Germany the soldier also carries a three days' reserve, but this reserve consists not merely of bread or biscuits, but of several necessary requisites, viz., groats or rice, salt, coffee, and, if possible, of dripping and salt meat. The daily ration in war consists of (a) 1½ lb. bread or 1 lb. biscuit, (b)  $\frac{1}{2}$  fresh or salt meat or  $\frac{1}{2}$  lb. dripping, (c)  $\frac{1}{2}$  lb. rice or groats, (d)  $\frac{1}{2}$  oz. salt and  $\frac{1}{2}$  oz. roasted coffee. If no meat is issued, the ration of bread is increased to 2 lbs. Consequently the knapsack reserve of the German soldier (three days' portion) weighs 6·3 lbs. if the bread ration is in biscuit, if of baked bread the weight is increased to 7·8 lbs.; if no meat is issued the knapsack reserve weighs 8·55 lbs. This is called the "iron ration," because it is only to be expended by order of the Army Corps Commander. The "iron ration" must not be increased beyond a three days' supply.—(Colonel Hazenkampf, Russian Guard Corps.)

<sup>2</sup> At Umbeyla a rapid advance at first might have interfered with the rising of the hill tribes, but there was no proper transport. Hence the troops were delayed and the numbers of the enemy greatly augmented. In the Waikato campaign in New Zealand, after the skirmish at Kohera, the troops remained for fifteen weeks without making a forward movement, though the enemy's advanced posts were only three miles off. Again, in Ashantee our movements were slow. Had our small army been able to push on to the capital immediately after the arrival on the Prah of the envoy from Coomassie, there might have been no fighting at all, and the King, unable to assemble his men in time, would have no doubt agreed to the terms Sir G. Wolseley proposed before attacking his army at Amoafu. Here, again, want of sufficient transport delayed the troops and a rapid advance was impossible. The Zulu War is another example of lost opportunities directly traceable to transport difficulties.—("Studies in Transport," Major Furse.)

pack animals are not necessarily confined to roads. But of all transport this is acknowledged to be the most difficult to arrange; it has, besides, the great disadvantage of lengthening the column considerably on the march. Taking the mule as the representative of practical pack transport, two mules will carry from 320 to 400 lbs.; these require a man to look after them. Next come "carriers;" these have often proved their worth and even devotedness; they can follow the troops anywhere, the great objection being the small load each man can carry, rarely exceeding 40 lbs.; they occupy a large space on the march, and also require strong escorts. Camels can carry from 300 to 400 lbs., are easily fed and managed, but are difficult to transport by sea, and are delicate animals. Pack bullocks will carry about 160 lbs., and move at the rate of 2 miles an hour; they soon fall into bad condition if not supplied with abundance of food and water. Elephants are particularly useful, carrying 1,200 lbs. with a pace of  $3\frac{1}{2}$  miles an hour, but it is needless to say that their numbers and sphere of usefulness must be limited. Wheel transport is of course the best, as it at least doubles the carrying power. Thus two mules will carry from 320 to 400 lbs., but the same two animals will draw in a wagon a load from 800 to 900 lbs.; but wagons mean roads, and heavy wagons good roads.

Now let us pause a moment and overhaul our deductions. First. We find that transport may be divided broadly into two parts, viz., the train which accompanies the army, and the transport that draws the supplies from the grand magazines to fill the trains and expense magazines.

Secondly. We may assume that though hired carts, animals, and drivers may do the rough work of filling expense magazines and the train, that the train should be a disciplined body with the very best plant.<sup>1</sup>

Thirdly. That the conditions under which we usually fight do not admit of our keeping up in sufficient numbers the disciplined train which European warfare demands.

Fourthly. That the soldier must carry rations; theoretically speaking the more he can carry the greater his mobility. Taking the question of the personal carriage of rations first, we find that science has in this matter come to our assistance, for by depriving the different articles of food of the water they contain a marvellous reduction of weight is arrived at. Admiral Selwyn clearly explained this in this theatre in June last, and I will take the liberty of using his own words. "We are all aware that a very large proportion of the weight of every article of food arises from water. I am able to put before you the fact that you can diminish the weight of all food necessary to be carried by an army, its horses and men, down to one-sixth of what is at present carried, and that with perfect facility. The result of this will be that instead of 52 rations weighing 160 lbs.,

<sup>1</sup> Such undeniable military authorities as Napoleon, the Duke of Wellington, Sir Charles Napier, &c., have all been in favour of a disciplined military transport.—(Furse.)

"we shall bring them down to 27 lbs.,<sup>1</sup> and this will solve a very large portion of the difficulty. I should like to correct a mistake made in the House of Commons, where it was stated that the 'erbswurst,' was simply peaspoup. The 'erbswurst' is something more than that; it is a carefully prepared chemical food in which every element necessary to support human life is properly proportioned, and its 'keeping qualities are absolute for any number of years.'<sup>2</sup> So far as regards food, the soldier would have little to complain about even if forced to carry a week's supply; but unfortunately modern warfare has insisted on other loads being added to the already crushing weight on the soldier's back, viz., extra ammunition and intrenching tools. It is useless to shirk the question by supposing that "fire discipline" will compensate for want of ammunition, or that "toys," such as short-handled spades usually are, will do duty for serviceable intrenching tools. Since the introduction of the breech-loader, the rapidity of aimed fire has increased four or five fold, and we can hardly close our eyes to the fact that the adoption of a system of long-range firing is only a question of time. Captain Needham in his lecture—"Lessons from the late War"—speaks of "the imperative necessity under cotemporary conditions of warfare, of utilizing the power of firing at long range conferred upon infantry by improvements in the weapons they carry."

Rapidity of fire simply means great expenditure of ammunition, but when this rapidity is combined with a deliberate commencement at 3,000 paces, the expenditure will be simply enormous; but this is not all, excitement, panic, exhaustion, and the thousand and one unexpected incidents of a battle all go towards emptying the ammunition pouch. Statistics on the expenditure of ammunition must necessarily be deceptive *unless every unit* (whether this unit be a battalion, company, or section) be accounted for—not only as to the number of rounds it has fired in the action, but the time it was firing, the number of separate attacks made or repelled, and the average distance from the enemy. It is evident that by lumping the whole expenditure of ammunition in an action, and dividing by the number of men present, an absurdly low average would probably be obtained. Such statistics can have but little practical value except to some official dealing with the question of the general supply of ammunition. To the general public such figures are often absolutely mischievous. We are told that in the engagement on the Bistritz, the 1st Army Corps fired 12 rounds per man, *but in one battalion*, and here is the point, the expenditure was six times as great, and in some companies even greater. The only lesson to be learnt from such an example, if lesson it can be called, is that every company should be supplied with ammunition in sufficient quantity to bear the whole brunt of a battle. The Turks were most prodigal in their fire; they were also successful in

<sup>1</sup> All Officers and other soldiers when in the field draw the following rations daily:—1½ lb. of bread or 1 lb. biscuit, fresh or salt meat 1 lb., coffee ½ oz., tea ½ oz., sugar 2 oz., salt ½ oz., pepper ⅓ oz. When troops are marching or doing hard work, ½ lb. more should be added to the meat ration.—(Sir G. Wolsley.)

<sup>2</sup> See Journal, No, 102, page 815.—Ed.

supplying themselves with ammunition, and they produced some astonishing results. Instances occurred where battalions fired per man as much as 400 rounds in 48 hours, and even in skirmishes of an hour's duration, 50 or 60 cases often lay by the dead. The Turks carried little but ammunition and food, so each man managed easily to take 100 to 120 rounds about him, and each battalion of 600 men had 30 pack horses, carrying 60,000 rounds. This was the secret of their success. The pack horses were led in action by men of each battalion in rear of the shooting line with wonderfully little loss, and could go anywhere. Major Fraser in his "Gold Medal Essay" says, "That the Russians in the last campaign had cut down their regimental transport to twelve ammunition carts for three battalions, and on *several occasions* they ran short in action—notably in Krudener's attack on Plevna, in which a portion of the ammunition column had stuck at Bulgareni; so that in *four hours* the men had fired all they had. Nor was this an isolated case, for Zeddeler tells us that generally the trains had great difficulty in getting within reach of the troops, and he speaks of the absolute impossibility of supplying ammunition without pack horses."

Again, the Prussian Guard advancing to attack St. Privat lost some 6,000 men in ten minutes. The lesson here is not altogether tactical; for it shows the amount of ammunition that must have been expended in that short space of ten minutes to effect such results. The difficulty in getting at the ammunition when the pouches were empty, might have been, and probably was, the cause of the Isandula disaster. Let us imagine a company detached from the main body, surrounded by a determined fanatical enemy in overwhelming numbers, bringing up fresh men as each attack was beaten back—three shots per minute would empty the men's pouches of the regulation allowance of ammunition in less than twenty-five minutes. Comment is needless. When a large army takes the field against a comparatively equal foe, military science demands that there should be supports and reserves to the fighting line, and by relieving or reinforcing the fighting line by fresh troops any deficiency in ammunition may be corrected. But in our wars with semi-barbarous people, we are often obliged, on account of our great numerical inferiority, to place all our men in fighting line, which has to take care of itself without any hope of assistance. These considerations, and the possible adoption of "repeating arms," as advocated by many, all point one way, viz., that there must be no dearth of ammunition. "Fire discipline," which is presumably the modern phrase for musketry instruction, simply means the feeling of security men have when they are conscious of being well armed and know how to use their weapons, but this feeling of security must necessarily be lost if any doubts arise as to the sufficiency of the ammunition. How much ammunition our soldiers should always have at hand is a question of the utmost importance, but double the present regulated amount would hardly be excessive.<sup>1</sup>

<sup>1</sup> General Zeddeler points out the absolute necessity of largely increasing the number of ball cartridges available in the Russian Army during action, and which, it may be remarked, is much the same as in our own. He strongly insists on the advisability of giving to the men from the outset a greater number of rounds, sug-



The necessity for having a sufficient number of intrenching tools always present with the men is now generally admitted, but this is no new idea. Napoleon said: "There are five things from which the soldier must never be separated, viz., his gun, his ammunition, his knapsack, his rations for four days, and an intrenching tool." We often read in military history of villages being taken and retaken several times in the day; these are the moments when success may be secured by being provided with intrenching tools. Captain May, in the "Tactical Retrospect," says: "The engineer, in virtue of the character which is particular to his branch of the service, may hold an equilibrium in military operations. He may render the success gained by an impetuous attack secure by quickly throwing up field-works behind the attacking force, and in the same manner stop a retreat by hastily constructed intrenchments." But hastily constructed intrenchments do not require the skilled labour of the engineer; such works could be as well done by the supports and reserves of the fighting line, or even by a portion of the fighting line itself, provided always that the troops had had instruction in making simple fortifications. Home gives an instance where there was no tactical connection between the works and the troops. At Konigratz "the Austrians appear to have thrown up a good many intrenchments by the engineers, but the corps and division leaders knew nothing of these works, or of the exact positions they were to hold. They extended far beyond the position intended, and the commanding engineer, riding round some hours after the battle had begun, found there were no troops near the works at all."

Such a mistake could not have happened had it been the business of the troops themselves, or a portion of them, to help to construct the works they had to defend. Again, quoting May and Home: "Not only were the pioneer duties of the Prussian Army admirably performed, but the *true spirit* of the use of field engineering was in many cases seized." One remarkable instance was at Mars-la-Tour. Early in the day the Prussians gained possession of Vionville. The instant the infantry got in, two companies of engineers, supplied with six wagons of tools, were pushed on. They were charged by a regiment of French hussars, and lost some of their wagons and a section of one of the companies, but the remainder got into the village, and so strengthened it that all attempts made to retake it, failed. Here not only have we an example of the use of intrenching tools near at hand, but also a pretty plain lesson that they should actually accompany the attack. What might have been the result had the hussars succeeded in capturing all the wagons, instead of some? Speaking of the same battle, Home says: "The want of tools was sorely felt all along the French line, from the fact of the tools not being in the front, but in

gesting that each man might carry 105 rounds, viz., 60 in his pouch and an additional 45 in his haversack. But at the same time, recognizing that there is a limit to the burden which it would be wise to impose upon a soldier, recommends a corresponding diminution of his general equipment. He advocates that the first or immediate reserve of small arm ammunition, viz., 25 rounds per man, be carried on pack animals, the second or larger reserve in carts or wagons.

"the rear. No one who examines the history of this battle but must feel that had fortifications been used to support the troops with judgment, a different result might have followed."

Now, when theory and practice both agree as to the value of intrenching tools up at the front, how, it may be asked, is it that they are seldom to be found when wanted on an emergency? The reply is simple and conclusive—the question how tools are to be carried has never yet been satisfactorily answered. In Prussia it appears that certain battalions carry short-handled tools, but these necessitate the digger working on his knees. Long-handled tools, on the other hand, are apt to hamper the soldier and prevent the free use of his weapons. We may, therefore, assume that if a soldier has to carry an intrenching tool as part of his personal equipment, it must necessarily be a short-handled one.

The different methods of carrying tools are (Brialmont):—

In the United States, the tools of each battalion are carried in turn by the men of two companies at a time, thus making the carriage of the tools an irksome and disagreeable duty. It is not very difficult to imagine that under these conditions many would be deficient after a long march. In France, long-handled pioneer tools, weighing about 4 lbs., are carried in rear of regiments. Rogniat wished to give pioneer tools as a *mark of distinction* to two picked companies in each battalion.

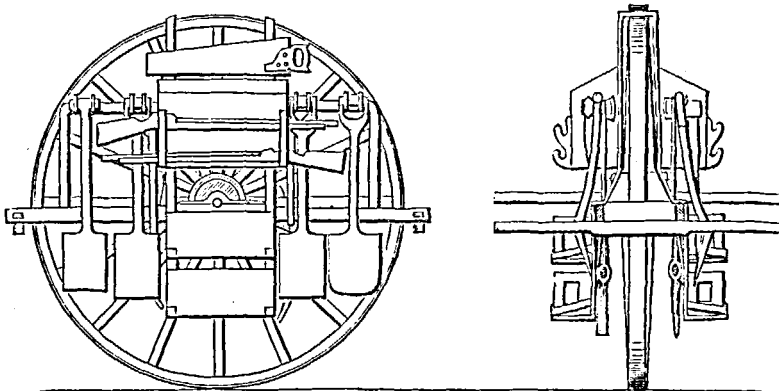
Brialmont himself supposes that either all the soldiery should be furnished with tools weighing about 2 lbs., or else the men in the front rank only should be provided with them; but, on the other hand, Captain Kouropatkine, of the Russian Staff, whose experiences of the late war must give great weight to his opinions, has expressed a very decided opinion against giving tools to the men themselves to carry. The first thing he notes which a man throws away when he becomes distressed, or when he wishes to go forward more rapidly, is his intrenching tool, and therefore, if these are given to the men, they are very likely not to be forthcoming when they are wanted.

There is one other weight to be considered, viz., water. The Turks had a pack horse for water for each company, which enabled them to fortify and hold positions which they must otherwise have abandoned. Thus the Russians, for want of water, had to abandon the great Yagni hill after they had captured it. At Zevin, too, Russians left captured trenches to get water, and Skobelow's forethought in detailing "water parties" for the working and attacking columns at Loftcha and Plevna is remarkable.<sup>1</sup>

Modern warfare demands that the soldier should have ammunition in plenty, food, intrenching tools, and water constantly with him, but human nature revolts against being thus heavily weighted, so it is not surprising to hear that the campaign of 1877-78 is remarkable for the disuse of the knapsack. The men carried three to six days' biscuit, and a bag or bundle of clothes, but the distances to be traversed in attacking works is now so long and the effort so great that the troops constantly throw away everything, and then there is a risk that, after

<sup>1</sup> Major Fraser, "Gold Medal Essay."

a successful assault, they are unable to exist on the captured position. How are these antagonistic necessities to be reconciled? On the one hand, if the soldier does not carry the several articles mentioned, he is but half armed; on the other, if he does carry them, he will be either exhausted or be tempted to get rid of what he considers superfluous weight as soon as the great fatigue of an advance under fire begins to tell upon him. The conclusion is obvious. Spare ammunition, water, and tools must be carried for the soldier by men who will not hesitate to take their charge into the fighting line; in other words, trusty comrades, specially detailed for this honourable duty, must be ever ready to supply the wants of their fighting brethren, either in ammunition, food, or water.



Side elevation.

End elevation.

Scale  $\frac{1}{4}$  of an inch = 1 foot.

I have now the honour to submit to you a design for an "ammunition and intrenching tool carrier," which I confidently believe will compete favourably with the mule as a military carrier. As you will perceive from the diagram, the principle is to have a single wheel of large dimensions, surrounded by a yoke, on to which the several articles are attached. A slight examination of the "model" will show the extreme simplicity of the machine, and will save me a somewhat difficult explanation. The wheel made for me for experimental purposes was defective in some minor details, but I satisfied myself that, with a load of 400 to 500 lbs., it had a very easy draught on a good road, three men being necessary to work it. These three men are amply sufficient on any road which may be deemed fairly passable, but when required to leave the road to follow a regiment in any tactical manœuvres, an extra man must be tackled on. Four men will be sufficient for any ordinary rough cross-country work. There is, however, room for six men to tackle on, and on one occasion on the "Fox Hills," I had to use this number; but this was an exceptional case. The equipment of the carrier, subject to modifications, is 4 picks, 4 spades, 4 shovels, 2 saws, 2 axes (felling), 2 hatchets,

4 regulation boxes ammunition. I propose that one of these "carriers" should be a part of the equipment of every *half* company. Thus a company (say, 100 strong) would go into action with serviceable intrenching tools for 24 men, and a reserve of some 50 rounds per man.

It has been objected that the use of such vehicles would necessitate the withdrawal of eight men per company. My answer to this is that this "withdrawal" is more nominal than real. The men are there; their arms are handy, and at any moment they can take their places in the line, leaving the "carrier" to shift for itself; *it cannot run away*. Some modification of the tactical arrangements of a company would be necessary, so as to enable the "carriers" to be with the supports. But it is as giving mobility to the company, the natural unit in our Army, that the "carrier" would be found so useful; but in this case two extra carriers would have to be attached to each company, to carry food, water, &c. A company thus equipped would be complete as a moveable machine, as well as a fighting one. At Isandula, we hear of a company being detached and never being heard of again. We can hardly doubt that, with intrenching tools ready at hand, and plenty of ammunition, such utter obliteration would at least have been prevented. Often have such detachments to be made by our small Army. With "carriers" properly found with food, ammunition, and intrenching tools, a company would be ready in five minutes to move anywhere, and exist for a lengthened period. It is not difficult to picture what advantages might be gained and what tactical and strategical points seized by an army whose units possessed this mobility. As for the company itself, having been in possession of the tools as a part of their equipment, and thoroughly taught their use, being separated from the main body would be of little consequence; in a few minutes an intrenchment would be made, a few hours longer this would be converted into a formidable work; if the stay was to be lengthened, arrangements would be made for constructing huts or shelter. The soldier of the present day is quite intelligent enough to do all this, if he is only taught how to do it. But to return from conjecture to fact. We have the opinion of an experienced Russian General that it is impossible to supply troops in the field with ammunition without pack horses. This will give the "carrier" a standard for comparison; two mules will carry from 320 to 400 lbs.; one "carrier" will carry from 400 to 500 lbs. The mule or horse requires food, may be restive or sick, and is liable to be killed. The "carrier" has none of these disadvantages. The mule requires an attendant, and, in the field, probably two; the "carrier" requires four, but whilst the mule attendant or attendants must necessarily be non-combatants, those of the "carrier" can always take their place in the fighting line. Now let us look at the "carrier" in another light, viz., as a means of ordinary transport. The light frame-work for the tools would be replaced by a leather bag or netting, capable of containing various stores. Human carriers, probably coolies, would be used for this purpose. Here, again, we have a standard for comparison. The load for a human carrier is from 40 to 50 lbs.; generally the lesser weight.

The mechanical "carrier" will increase the human carrier's transport-power from 50 lbs. to 100 lbs. *at least*. With ordinary vehicles of two or more wheels a single "wheel" can only compete in the matter of mobility, but this is all-important for military work. The "carrier," for instance, could move along a slope which would infallibly upset any ordinary carriage.

A very serious item in the manual transport question is the carriage of the soldiers' clothing. As "valise equipment" is at the present moment under the consideration of the authorities, it may appear out of place to offer any remarks as to how the soldier should carry his kit, but I submit that knapsacks, valises, &c., are "peace baggage." Something infinitely more simple must be carried in war. The kit must be cut down to absolute necessities—say a change of clothes all round, with perhaps the addition of a Guernsey or other warm substitute for the tunic or serge. Now we have been told that the campaign of 1877-78 was remarkable for the disuse of the knapsack, and that the men carried a bag or bundle of clothes; but how this bag or bundle was carried has not been clearly explained. However, it is not difficult to imagine such a bag or wallet. A strip of waterproof, say, five and a half feet long and a foot and a quarter broad, is doubled along its length, closed at the ends and along the side, with the exception of eighteen inches left open in the middle for purposes of packing, in fact nothing more than an enlarged old-fashioned purse. It is surprising how much can be crammed into this apparently small receptacle, and, comparatively speaking, how easily the things are carried. This is due to the weight being supported on the top of the shoulder. This wallet is easily transferred from shoulder to shoulder, thus enabling the man to ease his shoulder when tired or hot. I would also ask, Have the improvements in waterproofing received the attention they deserve? Waterproofs are warm, comparatively light, and are absolutely necessary for those who have to sleep on the ground, and, above all, *easily packed*. The prejudice that waterproofs are not healthy may be right or wrong, but what can be worse than a sodden felted garment with no chance of drying it? The infantry soldier's great coat is heavy, not easily packed, and when wet, dried with difficulty. Is it hard to conceive that a waterproof cape or coat, supplemented by a Guernsey for heat, would not be more serviceable in the field than the present time-honoured garment?

I will now ask permission to be allowed to wander from the subject of manual transport for a few minutes to say a few words on military railways. In bringing up supplies, railways cannot be surpassed, for not only can large loads be carried, but supplies are not consumed *en route*, as in all other modes of transport. Colonel Hazenkampf, speaking of the Abyssinian campaign, brings this consumption *en route* vividly before us, and concludes thus: "The distance from Coomailo " to Magdala was in all 370 miles; had the English had to penetrate " more deeply into the interior, a time would eventually have arrived " when no transport would have ensured their supply, as everything " would have been expended on the road by the bearers, the pack " animals, and their drivers."

To us belongs the honour of being first in the field in the endeavour to construct a railway during a campaign for purely military purposes, but neither our Crimean experiences nor those in Abyssinia in railway construction, can be considered satisfactory. As for the line destined for Ashantee, it was never even landed. It may, however, be somewhat consoling to our *amour propre* as a railway-building nation to know that the one purely military railway constructed by the Germans at Metz was a decided failure. Is it presumptuous in an "outsider" to suggest that heavy earthworks require time to consolidate as well as time to construct, which at once puts such constructions out of the sphere of military usefulness? A railway without earthworks or cuttings, easily and quickly constructed, easily repaired when destroyed, and proof against tropical rains, would be an untold boon to our Army.

Gentlemen,—Being purely a regimental Officer, it was with much diffidence I offered to lecture on so technical a subject as "transport," more especially as my audience would probably contain many Officers with large practical experiences, whilst I can claim but a limited theoretical knowledge. My object has been simply to lay before you the train of reasoning which induced me to design a mechanical substitute for a pack animal, but in doing so I trust I may have opened up a much larger question, which may be thus epitomized: "Have we ever 'rightly tried by *mechanical means* to reduce the number of 'mouths,' 'human and animal, which follow and hamper our armies?"

Major TRUELL, 53rd Regiment: I have not had the opportunity of reading Major Geddes's interesting paper this evening; but having received a note in reference to it, I thought I would attend. He has told us quite truly of the great necessity of getting ammunition into the first line. I have studied the subject, but find it full of difficulties. From Colonel Baker's account of the war in Bulgaria it appears that the plan of each regiment having its own mule transport for spare ammunition worked well; but the system entails a man to look after the mule and also food for the animal to be carried, which is apparently what Major Geddes wants, if possible, to avoid. I think his machine ought to be tested at the Aldershot field days, but I fancy mule transport most practicable.

The CHAIRMAN: The subject on which Major Geddes has read his paper is a most interesting one. The carrier appears to have many valuable qualities, and to be calculated to render efficient service to an army operating in a district where roads are scarce or of bad quality. Up to the present time, the only means of transport that have received consideration have been baggage animals, two-wheeled carts, and wagons; and I believe this is the first occasion when manual power has been suggested as a means of supplying an army with its necessities. If any gentleman would like to offer some remarks, I think it would be for our advantage as well as for that of the Institution, and for the good of the Service.

Major TRUELL: I should like to ask Major Geddes how he means to work his wheel along a footpath with a very severe slope, such as a mule could travel on with a fair load?

Major GEDDES: In the first place the wheel carrier has to be made of large dimensions. It is bound to be 6 feet, in order to clear the ground with the two ammunition boxes. If you were to put two wheels, the machine would be heavy, and you would not be able to carry more. It could not go through a less space than 3 feet, but no inclination that I know of will affect its stability.

Major TRUELL: I have been informed that in Abyssinia they had to unpack mules because they got to such narrow places that they could not pass. Can you get the axle suited to pass such places?

Major GEDDES : It could be taken out like the axle of any other wheel.

Major TRUETT : You could take it out and get the carrier through ?

Major GEDDES : Yes.

General Sir HENRY W. NORMAN, K.C.B. : I am quite sure that all present have been interested in, and have received instruction from, Major Geddes's paper. His invention is, to me, quite a novelty. The only occasion I can call to mind on which any sort of hand cart has been used in war was in the China War of 1860, in which, I believe, a considerable number of wheelbarrows of the country were used. Perhaps some Officer here present may have seen this wheelbarrow transport. I have heard that the Chinese coolies who worked the barrows showed great resolution and endurance. No doubt Major Geddes's invention would be useful in some cases, though there must be circumstances in which it would be impossible to use it. I should think that in a mountainous country, many hills would be too steep to allow of its use without the aid of an excessive number of men, and it would be difficult to move it along rough narrow mountain paths, while we know that mules and even elephants can follow troops over very difficult ground. Major Geddes's invention, of course, is intended to bring up to the front line a supply of ammunition and food, and will in no way meet the great difficulty respecting transport for an army in the field so as to maintain the troops. As has been justly said in the lecture, in European warfare there are usually railroads, large towns, a considerable population everywhere, and plenty of food. In the countries in which our troops have of late years served in the field, there are usually few inhabitants and very little in the way of provisions. Everything has to be carried for the troops, and if anyone can devise means for the ready transport with an army of say a fortnight's full supplies, so as to make the troops independent if their communications with the base are temporarily cut off, as sometimes occurs in India, a very important problem will have been solved. Recently there has been something written of an army crossing a desert and carrying, besides its provisions, water for several days. Few people, I suspect, have calculated the enormous amount of water that would be used daily by an army and its transport cattle. A march of any duration is, I think, quite impracticable, unless water is to be found on the road. Something in the nature of what Major Geddes has described would, no doubt, be very useful for an army in many parts of the world, and I am sure we are all obliged to him for his paper. I would wish, before sitting down, to say a word about concentrated foods, which have been alluded to in the paper. I have read lately a good deal about the use of this sort of food, and I see a medical friend of mine present who could give valuable information respecting it ; but so far as I have been able to ascertain, this food is rather valuable to supplement the ordinary ration, or to make up for a deficiency in it, or for the sick, than as an entire substitute for the ordinary ration. Indeed, it seems doubtful whether troops could possibly march for more than a day or two if provided only with concentrated food.

Major-General BURROUGHS, C.B. : With regard to the remarks of the previous speaker, it appears to me that Major Geddes's invention is not intended by him to be a substitute for the ordinary transport train, but as a very valuable supplement to it. No machine yet invented can do everything. No animal can go everywhere. Nor does the inventor of this machine profess to be able to do everything with it. As he has so lucidly explained, the principal object of the carrier is to supply the fighting line from its supports and reserves with ammunition and intrenching tools ; to supply, in fact, a want, how best to supply which, is now puzzling the heads of soldiers of all nations. As Major Geddes has told us, the carrier does not eat, it cannot run away when its services are most required, and the men with it are always available for the fighting line. It seems to me a most simple and useful invention, and the only wonder is that it has never been thought of before. It strikes me it could be utilized in very many ways. For instance, those who have served in India know that bodies of troops in that country are always followed by water-carriers, either carrying skins of water on their own backs or driving a bullock with water-skins suspended across its back ; and all will remember, when parched with thirst, how sickening, instead of refreshing, a draught of such tepid water was. The carrier could be laden with water-skins, and these could be kept cool by any of the many appliances for keeping water cool so well known in hot countries, and

which it is not possible to carry out when it is conveyed on the back of a broiling bheestie (or water-carrier) or of a sweltering ox. The carrier, trundled by coolies or the native labourers of the theatre of war, could be laden with the field kits and day's rations of the fighting men, and could follow them almost anywhere troops are likely to go. For very special cases, special means must of course be adopted. If, as has been stated in the public papers, the troops at Isandula fired away all the ammunition they carried, if each company had been followed by two carriers laden with spare ammunition, as suggested by Major Geddes, the disaster could hardly have occurred; for the same papers say, that the Zulus were just wavering and about to fly, when they perceived that our soldiers' ammunition was exhausted; this emboldened them to press on and overwhelm their adversaries by sheer force of overpowering numbers. In fact, it strikes me that the carrier could be put to very many uses. Its construction is most simple and inexpensive; it does not eat, it can go almost anywhere, and it appears to me to supply a much needed want, and to be a very valuable supplement to existing means of transport.

The CHAIRMAN: In the first place, I think it is one of the most valuable privileges of this Institution, and one it is most jealous of, that it enables the members to discuss new inventions which cannot be discussed in any other place in London. There is no other place, as far as I know, where any Officer who has an invention beneficial to the Service will obtain such a hearing as he will get in this theatre.

I will now ask your leave to make a few remarks upon the invention under consideration, expressing first our thanks to Major Geddes for his very lucid paper. The general principles of this carrier seem to me to be very sound. Never having seen it in operation, I know no more of it than any other member in this theatre, and of course it is not intended to replace pack animals or wheeled carriages, but only to supplement the means of transport that we now have in the Service. I understand that these carriers are to be kept as a part of the regiment equipment, to be brought into use when regiments take the field, and to be applied to the carriage of food, ammunition, intrenching tools, or other stores in places which cannot be conveniently reached by our ordinary means of transport. The necessities for troops in the field may be limited to food, water, intrenching tools, and ammunition, but the last may be said to be the most important. The Turks at Plevna obtained great credit for the organization by which they were able to supply cartridges to the troops in the advanced positions, by means of pack animals; and this has led many persons to the opinion that the distribution of ammunition can be better made in this way than by our system of two-wheeled carts. But it must be recollected that a stationary camp like Plevna, with its communications always open, affords facilities for such a service, which in all probability will never recur. Major Fraser, R.E., has shown in his essay how the Turks contrived to keep up an almost continuous fire by day and night; and when the camp was taken, boxes containing 100 or 200 cartridges or cases were found by the side of the rifles, the whole of which had been brought into camp by convoys of pack animals, and distributed by the same means. But this will not necessarily prove that such means are the best, though they were successful until the time when the investment of the camp was completed, and the supplies stopped. Similarly, the best mode of supplying intrenching tools has yet to be elaborated. Major Geddes has stated that Captain Kouroupatkine, a Russian military critic of eminence, has expressed a decided opinion against supplying the men with intrenching tools, which, the Captain states, are the very first articles that the soldiers throw away when advancing, and when required they are not forthcoming. I did not know that Captain Kouroupatkine had expressed such an opinion. I do know that the Russian soldiers had no intrenching tools when they were required, but I did not know that they formed part of their soldiers' equipment. When the Russian Army first took the field, I believe, no tools accompanied the troops. Later, when the want of them was felt at the attack on Plevna, the tools were brought up in wagons, and distributed in the field to the troops. In theory, they should have been collected after the intrenchment was completed, replaced in the wagons, which again would convey them to a more advanced position. It is needless to say that this was never done, and when the troops advanced again the tools were deficient, having been left in rear of the previous



entrenchment. My own opinion is that every soldier should carry his own spade or pick, and when he came to know its value, he would take care to keep it by him. I must apologise for having digressed from the subject of Major Geddes's carrier, but I have done so because the system of his invention is to carry certain articles necessary to troops for the men, and to distribute them in the field; whereas I hold that all necessities should be carried by the men themselves, and that the rest of the kit should be carried for them. I believe this is the German system. But, nevertheless, the description of articles carried on the carrier will not affect the value of Major Geddes's invention, which is to supplement horse and wheel transport by these carriers moved by manual power; and I hold that, subject to their having stability, and a stability irrespective of the load upon them, they would be most useful adjuncts to a battalion in the field. (To Major GEDDES: Has it been tried at Aldershot? Major GEDDES: I tried it all over the Fox Hills myself, but not with the battalion.) I trust that the military authorities may be induced to consent to two or three of these instruments being made for purposes of experiment at Aldershot, where it would appear to be easy in a short course of trials to ascertain whether they would not be an advantageous addition to the equipment of an infantry battalion. I have, gentlemen, to request leave to be your spokesman in conveying to Major Geddes your thanks for his paper.