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Lieut.-Colonel P. Johnson D.S.O.

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THE USE OF TANKS IN UNDEVELOPED COUNTRY.

By LIEUT.-COLONEL P. JOHNSON, D.S.O.

On Wednesday, 8th December, 1920.

MAJOR-GENERAL SIR A. L. LYNDEN-BELL, K.C.B., K.C.M.G.,
in the Chair.

THE CHAIRMAN: Ladies and Gentlemen, I am very glad to see that there are ladies here to-night. I have no doubt that Colonel Johnson is very well known to most of you, but in case anyone is present who does not know him, I may say that Colonel Johnson has been connected with tanks ever since the earliest inception of the idea. He was in France the whole time. Most of his time was spent in designing new kinds of tanks; and in 1918, when it became obvious that the tanks we had were much too slow for the job, Colonel Johnson was put on to design a new tank. He designed what we now know as the Medium D Tank, which I think would undoubtedly have had a very decisive effect on the War, had it lasted a little longer. After the Armistice Colonel Johnson actually produced two or three experimental tanks which got up to a speed of twenty miles an hour. At the beginning of this year we thought it would be a good idea to send an expert like Colonel Johnson out to India, to find out how far the tank could be adapted to the country on the north-western frontier of India. He accordingly proceeded to India and stayed there for six months, where he had every opportunity of seeing how the tank would fare over various kinds of ground and under different kinds of climate. He also had the opportunity of seeing what was going on in connection with the frontier campaign then in progress, and he has some very interesting things to tell you. I do not propose to tell the story myself, and I will therefore now ask Colonel Johnson to read his lecture.

LECTURE.

1. In considering the use of tanks in undeveloped country I think we may exclude from consideration the improbable event of meeting an enemy which is a well-armed, highly-equipped, and intelligently-led European force. If we assume this, then it may be said at once that the enemy of the tank is physical geography. Mountains, forests, swamps and badly-broken ground, for the present, at any rate, are practically impossible of negotiation by any known type of machine. But these features, fortunately, are not the *general* characteristics in undeveloped countries. In India, Egypt, Mesopotamia, Canada, South Africa, etc., the average conditions are much more of the nature of rolling plains of grass, sand or silt. The general characteristics are such as to make the operation of tracked vehicles a relatively simple matter, because, short of the four major obstacles referred to above, practically any type of ground is negotiable by the modern tracked vehicle. Water obstacles, such as streams, rivers, or lakes occur with more or less frequency, and any machine unable to cope with such obstacles might in many circumstances be seriously handicapped.

2. The human enemy likely to be met with in undeveloped country is probably handicapped by lack of effective leading, organization, supplies of modern weapons, and means of communication: for instance, such an enemy is unlikely to possess effective or intelligently-handled artillery, the chief enemy of the tank in the Great War. It is still more improbable that such an enemy will be equipped with such modern weapons as aeroplanes, tanks, gas, anti-tank weapons, etc., or alternatively with the means of producing them. In a word, it is guerilla forces, and the general characteristics of such forces which will have to be taken into consideration.

If, as is more than probable, the most effective weapon possessed by such forces is the modern rifle, to which the tank is immune, we go back at once to physical geography as being the real enemy of the tank in undeveloped country.

3. It has been demonstrated by experiment that tanks can be produced which have the following characteristics:—

- (a) They can be made immune to machine-gun or rifle fire.
- (b) They can travel over suitable ground at twenty to thirty miles per hour, and can climb slopes up to forty-five degrees.
- (c) They can carry supplies necessary to maintain their crews in condition for a week, or a fortnight, if necessary.
- (d) They can carry weapons of offence up to and including field artillery.
- (e) They can travel without renewing their supplies of fuel or water for a distance of 300 to 400 miles, and, if special provision is made for it, these distances can be still further greatly increased.
- (f) They can be made to float and negotiate water obstacles such as streams, rivers or lakes.

It is not suggested that any machine embodying all these characteristics in anything like final or reasonably reliable form is yet in existence. The stage reached at the moment is that the possibility and practicability of such machines have been experimentally demonstrated. But between this stage and the production of the finished product a rather lengthy period employed in boiling down, perfecting, and testing details is inevitable.

4. A short specification for the chassis of a tank for general purposes in undeveloped country would be roughly as follows:—

- (a) In general design it would follow very much on the lines of existing mechanical vehicles of the armoured lorry type, but would, of course, be fitted with tracks instead of wheels.
- (b) It would have a maximum speed of not less than twenty miles per hour, and should be capable of maintaining an average of eight to ten miles per hour for long distances.
- (c) Without any special arrangements, it should have a possible circuit of action of 200 to 300 miles.
- (d) It should be capable of floating on water, and of propelling itself against a stream, travelling at three or four miles per hour.
- (e) It should be tropical-weather-proof.
- (f) Its weight laden should be in the neighbourhood of six tons, this figure, of course, varying with the type of body work and the load carried.

5. In considering the types of body work required for such a chassis it should be borne in mind that the object should be to produce a sufficient variety of types to ensure that all the functions of an expeditionary force necessary to subdue an enemy can be performed. If this is not done, the necessity at once arises for the co-operation of other arms with a mobile tank force, which co-operation, as will be seen later, can only result in limiting the effectiveness of such a force.

The types of machines required, therefore, are as follows:—

Machine gun.
Trench mortar.
Supply.
Tender.
Signal.
Ambulance.
Artillery.

6. The functions of the machine-gun type would primarily be to engage the enemy with machine-gun fire whenever opportunity offered. Damage to enemy material possessions, such as flocks and herds, might also be effected by this machine, and it might also be required for patrol and communication work.

The functions of the trench-mortar type of machine would primarily be the destruction of enemy material property, in the shape of towns, villages, etc., and possibly the shelling of bodies of the enemy in

otherwise inaccessible places should targets offer. A 6-inch trench mortar with fifty rounds of ammunition is a perfectly feasible outfit to carry on such a machine. However solidly constructed, the destruction of any villages by such machines at point blank range would be a comparatively simple matter.

The functions of the supply machine would be to carry ammunition, fuel, etc., and to maintain the tank force in effective operation where necessary for longer periods than the supplies carried on the machines themselves could make feasible. These supply machines would normally be equipped to carry about three-tons load; the vital parts of them would be armoured, to obviate the necessity for their protection when passing through enemy country, and, for the same reason, they would be normally equipped with, say, one automatic rifle. Alternatively to a load of supplies, such machines could be arranged to carry a load of twenty to twenty-five men: this would, however, only be in the event of the lengthened occupation of a portion of an enemy country, when personnel other than the crews of the machines might be required for such work as the formation of a camp, base or strong point.

The functions of the tender machine would be to render first aid to any of the other machines in difficulties, to remove or modify, by means of explosives, tools, etc., carried, any obstructions hindering the progress of the column, and to carry out, with a specially-trained crew, any material destruction to enemy property which might be considered desirable, and which might not in special circumstances be possible to effect with any of the other machines.

The functions of the signal machine would primarily be for communication, command and direction. These machines should be capable on the move of receiving wireless messages from aeroplanes. They should probably be provided with a light telescopic mast, hoisted from the inside when stationary, from which wireless messages could be sent back to a base several hundred miles away. Simpler forms of communication, such as flags and audible signals, would probably be used by these machines for communicating directions to the other machines of the column.

The functions of the ambulance machine are obvious. In a force composed entirely of protected and armoured tanks operating against guerilla forces the casualties resulting from enemy action are not likely to be heavy. Casualties from sickness, however, and other causes, must be provided for, and a certain number of ambulance machines are doubtless essential. In such a machine fitted with a compensating spring track the degree of comfort available far exceeds what is possible with a well-sprung wheeled ambulance on indifferent roads, and the rapidity with which sick and wounded could be brought back to a base would be invaluable.

The functions of the artillery machine are fairly obvious. They would supplement the work of the trench-mortar machines where it might be found impracticable to bring these within point blank range of a position required to be shelled. The weapon carried would probably be limited to an 18-pounder gun, or 4.5 howitzer: any larger

or heavier weapon would affect the ability of all the types of machines to move and operate as one unit. It is essential for this purpose that every type of machine must have similar characteristics in the matter of speed, circuit of action, mobility, etc.

7. In considering the question of co-operation between tank forces and other arms, the function of an army operating against guerilla forces must be borne in mind. It will doubtless always remain true that the main objective of any force must be the defeat of the enemy forces in the field, but it does not follow that this end is best achieved by direct attack upon these forces: it may be best arrived at indirectly, as by an attack upon the enemy's brain, or organizing forces, or on his morale, or material possessions, or supplies. In guerilla warfare we must presume that the enemy is largely without a brain to attack, and that whatever weapons are employed the best indirect method of reducing the enemy's morale and power to sustain the conflict will be by material damage to his resources. Whatever weapons are employed the chief feature of guerilla warfare, perhaps, is the ability of the enemy to disperse to places difficult of access for an organized force, thus making the actual and direct destruction of the enemy force in the field a matter of extraordinary difficulty. These difficulties increase in direct proportion to the size of the attacking force, especially if such force is dependent upon animal or human muscular power for its means of progression and maintenance. It is contended that a mobile column of tanks will have a greater opportunity of directly destroying the enemy forces in the field than a comparatively immobile and, of necessity, much larger force of infantry, cavalry, artillery, etc. But, as in guerilla warfare, the chief means of reducing the enemy to terms must be the indirect method of material damage to his resources, the main comparison between a mobile tank column and an expeditionary force composed of infantry, cavalry, artillery, etc., must be based on the capacity of either force to effect material destruction. In this respect the tank force has every advantage in speed, ease of manoeuvre, ability to maintain itself for long periods in enemy country without communications, and thus in its ability to work material destruction.

Any attempt at co-operation between the mobile tank and infantry or cavalry will merely produce an ineffectual mixture, possibly, in some ways, increasing the effectiveness of the infantry, but hopelessly limiting the capacity and scope of the tanks: for infantry to co-operate with tanks, for instance, the pace of the machines must at once be reduced to, say, three miles per hour, giving the enemy ample warning of the approach of the forces, and ample opportunity to disperse or escape.

There is only one existing arm with which a tank force can effectively co-operate, and that is the Air Force, which co-operation can only increase its effectiveness by providing it with extended vision and improved facilities for communication. In all probability the operations of a mobile tank column should be entirely directed from the air.

8. In one sense the foregoing does not mean that tanks will replace other arms. It can equally well be argued that the other arms are

retained, but their effectiveness is increased by the substitution of protected machinery of movement for unprotected muscle. Because an 18-pounder gun, for instance, is mounted on an armoured caterpillar machine it does not mean that artillery as a weapon is discarded, but merely that its effectiveness is enormously increased by the substitution of the engine for the horses and the caterpillar track for the wheels.

9. The composition of a tank mobile column, and the method of its use in a punitive expedition against guerilla forces in undeveloped country, would naturally vary considerably with the conditions.

In the early part of this year I had the opportunity of visiting the forces operating in Waziristan, and as an illustration of the substitution of tanks for other arms the following table shows an imaginary tank force intended to operate over the identical route taken by our forces in Waziristan and intended to accomplish precisely the same ends. The number of machines estimated for total fifty, made up as follows:—

Type.	Number Operating.	Number in Reserve.	Totals.
Machine Gun ..	8	4	12
Trench Mortar ..	8	4	12
Supply . .	6	4	10
Tender . .	4	2	6
Signal	2	2	4
Ambulance ..	4	2	6
			50

No artillery machines were thought to be necessary for the objectives to be attacked. Details of this imaginary force are as follows:—

Machines.		Crews.		M/c Guns.		Auto. Rifles.		Trench Mortars.		S.A.A.		Trench Mortar Bombs.		Capital cost of equipped Machines.
Type.	No.	Ea.	Tot.	Ea.	Tot.	Ea.	Tot.	Ea.	Tot.	Each	Total	Ea.	Tot.	
Machine Gun	12	3	36	2	24	—	—	—	—	10,000	120,000	—	—	Average say £3,000 each.
Trench Mortar	12	3	36	—	—	1	12	1	12	2,000	24,000	50	600	
Supply ...	10	2	20	—	—	1	10	—	—	2,000	20,000	—	—	
Tender ..	6	6	36	—	—	1	6	—	—	2,000	12,000	—	—	
Signal ..	4	3	12	—	—	1	4	—	—	2,000	8,000	—	—	
Ambulance ..	6	3	18	—	—	—	—	—	—	—	—	—	—	
	50		158		24		32		12		184,000		600	£150,000

The method of operation of such a force would be : Firstly, careful aeroplane observation of the ground to be traversed. Secondly, advance by the column, keeping in constant touch by aeroplane and wireless with the base, to the objectives, which were in this instance the principal villages of the enemy tribesmen. Thirdly, the destruction of the villages and fortifications at point blank range by the trench-mortar machines. And, fourthly, the threat to destroy other villages, and the destruction, if necessary, of crops, herds, cultivation, and irrigation systems, all of which could be effectually accomplished by such a column. Time, I am afraid, prevents going into much further detail as to the operations of such an imaginary force, but it is asserted with confidence that such a force could do all these things with ease, rapidity, and practical immunity. The operations outlined would have taken about five days, instead of the best part of a year, and the cost would have been a mere fraction of the expenditure involved in the actual expedition.

10. The common objections to the use of tanks for guerilla warfare may be summarized as follows :—

That the enemy will not attempt to oppose the machines, or offer themselves as targets, but will disperse to inaccessible places. I think the answer to this objection is that it equally applies to any force that is obviously superior to the enemy. If, on the other hand, the attacking force is only equal in strength to, or weaker than, the enemy, the ambushing and destruction of the force is a probability and has been the fate of many punitive expeditions.

Another objection raised to the use of tanks against guerilla forces is that because the enemy will disperse on their approach, and that they can therefore only effect material damage to his resources, an independent force of tanks must fail to bring about a successful termination of hostilities. The answer, I think, is that against guerilla forces it is agreed that the chief function of the machine will inevitably be the destruction of enemy material resources, but that no conceivable force of any description can do any more. If an enemy in undeveloped country declines to accept combat, then no practicable force of any description can make him do so, and, possibly, short of the permanent occupation of the territory, the control of the frontiers, and the prohibition of the manufacture or importation of arms, nothing will effect a settlement excepting the indirect method of material destruction of his resources. As an illustration of this, the closing stages of the war in South Africa and punitive expeditions on the Indian Frontier might be taken as examples; gas and aeroplanes were unknown in the days of the South African War, and I believe gas has never been used on the Indian Frontier, both would doubtless help, but gas in sufficient quantity to be really effective in thoroughly destroying the enemy would, even if practicable, be an impossibly expensive method of killing off the entire population. Aeroplane bombing has also been demonstrated under such conditions to be very expensive and largely ineffectual. Therefore, the objection that tanks cannot deal with guerilla forces by directly defeating enemy forces in the field applies with equal or greater force to other arms.

Objection is raised to the use of tanks on the grounds that though, if co-operating with other arms, they might be of assistance they would be an additional expense which might or might not be compensated for by bringing hostilities to a speedier close. The answer to this objection is, I think, that, for the reasons given previously, co-operation with other arms should never be attempted, but that, used independently, the economies can be so enormous as to be hardly comparative.

Particular objection to the use of tanks was repeatedly made to me when studying the question in Waziristan. I was repeatedly told that unless tanks could negotiate hills they would be of no avail. The country, as many of you doubtless know, is very hilly or even mountainous, the routes through it being confined to the narrow valleys formed by the beds of streams and rivers from which, as a rule, the hills rise precipitously on either side. It may be said at once that whatever may be in store in the future no conceivable tracked vehicle can at the present time negotiate the precipitous sides of the hills, which are the chief feature of the country. The answer to this objection I found to be that for a tank force to do all that can possibly be accomplished by a force made up on existing lines, there is not the slightest necessity to attempt to negotiate the precipitous hillsides referred to. On the present system a force operating in Waziristan advances into the country along one or other of the river beds, and the force itself makes no attempt to scale the heights—small parties are sent out on to the hillsides to establish picquets for the sole purpose of protecting the column from sniping while passing along the river bed. The only difference between the tank force and one organized in accordance with custom, is that these picquets are no longer required—all that it amounts to really is that the armour plate of the machines is an effective substitute for the picquets, and this means an enormous saving in energy and life. It was found in the latest expedition into Waziristan that the casualties arising from the establishment of the picquets were very much higher than in previous expeditions; the reason for this being given as due to the fact that the enemy were much better equipped with modern rifles. When the time comes, as it must do, that the enemy is completely armed with modern rifles, or even machine guns, the arrangement of picquets along the line of advance of a column will become almost impracticable. While it is agreed, therefore, that it is quite out of the question for a tank force to advance into such a country as Waziristan by any other route than the valleys or river beds, this can be no valid argument against the employment of it because no other force can do anything more, or in practice ever attempts to. As regards the valleys themselves the modern tank can negotiate them with far greater ease than any type of force yet used on the Indian Frontier, the river beds in fact make, on the whole, an excellent roadway for tracked vehicles.

II. For practical purposes and for considering comparative costs it will be useful perhaps to divide the tanks into two broad groups—fighting machines, and supply machines. To compare fighting machines on an economic basis is extraordinarily difficult; it is also

complicated by the necessity for comparing them tactically if we are to arrive at the true measure of their comparative effectiveness. If, on the other hand, we compare supply machines with the present method of supply in undeveloped countries it will, I think, be a simple method of illustrating the comparative effectiveness of the mechanical fighting machine and the muscular one. Existing methods of supply are almost infinitely varied, of course, and for this reason, and because I have a number of reliable figures, I have based the comparison on data derived from the Waziristan force. Transport on the Indian Frontier has always presented enormous difficulties, but as far as the methods and material available at present are concerned it is probable that it is worked as efficiently and economically as is practicable. It is obvious that a pack animal of some sort must be the basis of comparison; the animal used in Waziristan was the camel, which of all pack animals is probably the most efficient when working under conditions suitable for it. If any accurate comparison between the cross-country supply machine and the camel is to be made, the method of comparison is most important. For example, in normal peace conditions the camel feeds to a large extent on the country through which it travels, obviating the necessity for fodder being any appreciable portion of its load. In times of war and in enemy country the camel is dependent, however, on fodder carried, and the distance over which it can operate becomes very restricted. It cannot be said, I think, that the conditions as regards supply which obtained with the Waziristan force were in any way peculiar or exceptional, and therefore the actual figures and distance form a basis for comparison which probably cannot be bettered. The line of communications for the Waziristan force really started from the broad gauge railhead at Darya Khan, a distance of about 120 miles from Khaniguram, but because it would have been impossibly inefficient to pack transport for this distance, the line of communications for the first 80 miles consisted of a motor road, and light gauge railway, built, of course, at enormous expense for purely military purposes. The last 40 miles of the line of communications from Khirgi to Khaniguram being through enemy country and up the bed of a river pack transport was inevitable, and camels were used for this section, the camel load being 400 lb., and the daily consumption of fodder being 22 lb. The work required to be done by these camels was the maintenance of about 6,000 troops at Khaniguram; the number of camels employed was 7,383, these camels consuming over 72 tons of food a day, and because of the necessity to protect this line of communications, approximately 23,000 troops and personnel for working the camps were distributed over the 40 miles. Had this work of maintaining 6,000 troops at a distance of 40 miles been undertaken by a suitable cross-country supply vehicle carrying 3 tons, the number of machines required would have been ten, and the daily fuel consumed would have been about 200 gallons of petrol, and not a single man of the 23,000 troops on the line of communications would have been required.

So much for the economies which can be effected in the supply organization. The total economies if both supply and fighting services

are mechanized can be inferred, I think, if we remember the figures for the Waziristan Expedition. It absorbed along the last 40 miles only of the line of advance, that is, *excluding* the base at Khirgi and the 80 miles line of communications to Darya Khan, nearly 30,000 troops, over 7,300 camels (these eating food to the weight of over 72 tons daily), and the preparations and operations occupied the best part of a year. What the cost was I do not know. I asked for figures at Simla but I did not get them. It must, of course, have run into many millions of pounds. I suggest that a mechanical force such as I have outlined of fifty tanks could replace this unwieldy bulk of unprotected muscle, could do all that was done by the infantry, and much more besides if necessary, and that the active operations at any rate would have been over in a few days.

DISCUSSION.

LIEUT.-COLONEL C. F. H. GREENWOOD: Colonel Johnson has told us of the advantages that would be gained by the use of tanks and the large numbers of men that would be saved. He said that it would only take 150 men to run 50 tanks. I am sure that cannot be all the men that would be employed, and I think it would be very interesting if Colonel Johnson would tell us how many men there are *behind* each tank. At the lecture given here last week Major-General Burnett-Hitchcock told us that the average field gun, although it required a crew of only four men to actually fire it, had 54 men *behind* it to enable the gun to be worked—bringing up ammunition and so forth—and in a similar way I think it would be rather interesting to know how many men there are behind each tank. From what I saw of the tanks two or three years ago there seemed to be enormous camps and very few tanks. The tank camps were much more luxurious than any infantry camps; they seemed to contain a much larger proportion of well-paid staff sergeants and such like, but there were very few tanks. I think Colonel Johnson must have some particulars which he has not told us. It was very interesting to hear the optimistic views the lecturer has with regard to the tank, and I have not the slightest doubt that a lot of good will come from the tanks in the future, but I had the unfortunate experience to be what was called a P.B.I., and I know that at High Wood the tanks were unfortunate; it was their first appearance. At Cambrai it could be seen that the tanks did most wonderful things, but the unfortunate part was that after they had gained ground they were not capable of holding it. The question we have to consider to-day is whether in Waziristan and other parts they would be capable of holding ground if they took it. The only other time I came across the tanks was in front of Ypres in wet weather, and there again they did not help things very much. If Colonel Johnson could give us a few more details about the number of men that are required behind the tanks it would be very interesting information.

MAJOR-GENERAL SIR CHARLES DOBELL: I do not know whether I understood the lecturer correctly, but I think he began by saying that Canada, South Africa, Palestine and Mesopotamia were undeveloped countries in which we would only be likely to meet a comparatively badly-armed enemy. I am inclined to think that is a bold statement. If ever we are so unfortunate as to have to fight in Canada we shall find that the enemy will be well armed. During the late War we had artillery against us in Mesopotamia and Palestine, and also in the third Afghan War of last year; in South Africa, too, we might conceivably be opposed by artillery. I therefore think the lecturer's assumption is rather too general. As regards the use of tanks in frontier operations, I am sorry I had not the pleasure of meeting Colonel

Johnson when he was in India, as I commanded in the Khyber from May, 1919, until January of this year. I really do not think that in that country tanks would be of much use. We went right through the Khyber to Dakka, in Afghanistan, in May, 1919, and we certainly had to attack the enemy in positions against which infantry only could operate. The lecturer suggests that columns do not have to attack occupied positions in such warfare. At the Bagh Springs, near Landi Kotal, the enemy held a position early in May, 1919, and the infantry were obliged to turn him out. That is typical of the procedure in all mountain warfare. I think tanks could be very usefully employed in frontier warfare to provide covering fire. By virtue of their armour they could come into action in comparatively exposed positions; but they could not, as a rule, approach the enemy's position. There is one more point I should like to refer to. I have never been to Waziristan, but I know the rest of the frontier fairly well, and I cannot imagine the tanks going up to Khaniguram and effecting the surrender of the enemy, unsupported by infantry, nor do I think that the tribesmen would ever let them come back. It is all very well to say that they would be able to go up the river beds, but I think the roads and the tracks would have to be improved before they tried it.

BRIGADIER-GENERAL KIRKE, C.B., C.M.G., D.S.O. : I do not think we ought to try and damp the enthusiasm and the optimism of the lecturer, because without enthusiasm and optimism there would not be any progress. The hypothetical scheme which he has outlined to us to-night is really based on two assumptions: firstly, that we shall have a tank which is capable of doing the work which he has suggested; and, secondly—the point which Sir Charles Dobell has referred to—that material damage will bring about the surrender of these particular people. I should think, from all the accounts of the operations I have read, that the latter assumption is probably very doubtful. I have always understood that it is necessary to kill a certain number of tribesmen before they find the game is not worth the candle. One point on which I agree with the lecturer is, that the tank will probably be able to exert a far greater material effect than aeroplanes appear to have done, for I understand that the aeroplane bombing was comparatively ineffective. The lecturer's proposal for an all-tank expedition really is that tanks shall in themselves combine the functions of all arms. I am not prepared to say that this may not be possible in the future, but until it is definitely proved by the production of a tank which can do all the various things he suggests, I think it will probably be wiser to stick to what we have always been taught, namely, that success is only achieved by the co-operation of all arms. The lecturer has quite frankly stated that at the present time he has not got a tank which can do these things, and that it will be some time before such a tank is produced. I suggest, therefore, that we must keep a very clear distinction in our minds between facts and fancies, because the expert enthusiast is always rather apt to confuse what he hopes to do in the future with what he actually can do at any particular moment.

LIEUT.-COLONEL P. JOHNSON, in reply, said: Colonel Greenwood raised the point about the crews totalling 158 men for 50 tanks. Of course, that does not include the men behind. As I expected, we have got back again to the Mark I machine. There must be a number of people present who saw Marks I to V machines operating in France, who also observed the large numbers of men who had to be maintained behind the lines in order that the machines should have a chance, perhaps once in two or three months, of going into the fighting line. That position was perfectly appalling: few have any idea of what it amounted to. The Mark IV machine, which was that used at Cambrai, could not be relied upon to do more than twenty miles without a very considerable proportion of its transmission being completely renewed. Every time the machines were to be used the

final drive had to be renewed to ensure a life of twenty miles. It could then be relied upon to go into the fight and do twenty miles running, but that was all. In the Mark V machine the cost of spare parts alone for 1,000 miles of running was between £7,500 and some larger sum, or between, say, £7 and £10 per mile. This figure does not include the cost and work of putting the parts into the machine—it is merely the cost of material. The immense amount of labour, personnel, and organization thus required gives one an impression of hopeless inefficiency, and that is absolutely correct. If we had nothing better now than the machine used in France we could give up the idea of tanks altogether. But the advance made, experimentally, at any rate, since those days has been extraordinary. I regret that there is no time to go into the subject at length, but the machine I roughly specified as suitable for cross-country supply work or fighting purposes in undeveloped country can be taken as having approximately, if not actually, the degree of reliability, ease of repair, and so on, which applies to an ordinary motor lorry working on a road. That is the sort of comparison you have to make now. As regards rear organization, there must naturally be a considerable number of men. I do not suggest that an expeditionary force of 50 tanks could be run by the 158 men required in the machines themselves. I daresay there would be several hundreds at the back of them, and others farther back still, perhaps. Sir Charles Dobell raised the question of the machines meeting a highly-organized and thoroughly-equipped enemy. I purposely at the beginning of the lecture excluded that point from consideration because the subject would become too complex for a short lecture. If gas, aeroplanes, anti-tank weapons, and so forth, have to be considered, the proposition becomes entirely different. Specifications and ideas would have to be altered, and it is altogether a much bigger question than that dealt with. I referred to Canada as being an undeveloped country only in the sense that it is not well supplied with means of communication and in no other sense. Regarding the reference to the Indian Frontier, I followed the route of the Force advancing to Khaniguram, reaching there three or four days after the column first arrived, and I think I am correct in stating that the route was exactly as it was when the column passed over it, the river bed had not been altered or modified in any way. Now I believe there is a motor road very nearly up to Khaniguram, but it was only being thought about in February last. That river bed is a perfectly impossible proposition for a Mark I or Mark V machine weighing 30 or 35 tons, but I am not suggesting anything of the sort. When I refer to the tank now I mean a machine which has been demonstrated experimentally to be practicable, not to any actual machine in existence at the moment. General Kirke referred to the actual killing of the tribesmen. Nearly everybody I met on the frontier assured me that it was necessary to kill the tribesmen in order to effect the settlement of any tribal war. From discussions, and such statistics as I was able to collect, however, I formed the conclusion that the tribesmen only accepted combat when they wished to do so. That only on those occasions when the tribesmen thought they had a chance of getting some rifles, or killing some of their enemies, did they ever attack the forces advancing into Waziristan, and only on those occasions was there any opportunity of killing them. These conditions, I think, must always govern guerilla warfare. Up to the time I left Waziristan, when operations as far as Khaniguram was concerned were finished, I understood that the final estimate of the casualties to the enemy was 1,000 killed. But I was assured at Khaniguram that this was an exaggeration by about 50 per cent. I should say that the Waziristan expedition attained its ends, not by the killing of 500 men, but by destroying the material possessions of the enemy, by occupying the country with immunity, and thus establishing a sense of hopelessness in the tribesmen. With regard to the possibilities of the tank for India, I was asked at

Simla when some of them could be out there: I replied that it was possible in three years if they were pressed for. What I have visualized will not come about soon, but possibly in the next twelve or eighteen months something tangible will be in existence. The principal features of the machine have been experimentally demonstrated, and it is only a matter of the sometimes arduous boiling down of details to get practical results.

THE CHAIRMAN: Ladies and Gentlemen, I think you will all agree that we have had a most extraordinarily interesting lecture, and the comments that have been made upon it in the course of the discussion have also been very useful indeed. I think myself that Colonel Johnson has done very valuable service by giving us this lecture, because everything has to have a start. This is a highly controversial subject, and I must say I admire Colonel Johnson's pluck in taking it up. As General Kirke said, nothing is ever started until some enthusiast takes it up, and therefore I think we owe a great debt of gratitude to Colonel Johnson for starting this scheme. I am afraid, however, that I cannot altogether agree with the various theories that he has put forward to-day; in fact, I agree with very few of them. Certainly he has given us food for thought, which is a most useful thing, and also opportunities for further experiment. With regard to the second part of Colonel Johnson's lecture, in which he dealt with the question of the production of cross-country tractors for the purpose of supply, I think you will find very general agreement among us all. I think one of the chief uses we have to try and put the tank to is to try and make it of use to our soldiers at the present moment. The lecturer has very properly also tried to look into the future, but we have to look at the present, and we certainly can by inventing a proper cross-country tractor do enormous service to our men now. Anyone who has been on the north-western frontier knows that the trouble we experience there is far more due to the necessity of supplying food and ammunition than to merely fighting the enemy. I do not think anyone who has ever seen it is likely to forget the enormous columns of camels, mules and other animals which follow in the wake of an operating column. All these we hope to do away with, and if we can invent, as we hope to do shortly, a cross-country tractor by means of which we shall be able to bring up ammunition and food close behind the line, I think we shall have made a great step forward. I hope we shall be able to do it. I think that is the first thing we have to start with, and by slow degrees we may possibly, years hence, arrive at the ideal tank column somewhat on the lines which Colonel Johnson has visualized, although I do not think he will ever make the tank replace flesh and blood and the horse. Ladies and Gentlemen, I am sure you will agree with me in offering to Colonel Johnson a hearty vote of thanks for his very valuable lecture to-night.

The resolution of thanks was carried by acclamation.

COLONEL B. C. GREEN, C.M.G.: Ladies and Gentlemen, I am sure you would not like to depart this evening without according a very hearty vote of thanks to our Chairman, Major-General Sir Lynden Bell, for taking the Chair. We always appreciate and enjoy the lectures that are given here; whether we always altogether believe in what is said in them is another matter; and we also always enjoy the comments that are made afterwards by the Chairman. They are always comments which help to elucidate any points which the lecturer has not fully brought forward, and the Chairman always manages to bring out those points to our advantage. Although we may not be quite so optimistic as the lecturer with regard to the future of the tank, we all agree that the development of the tank is in its infancy. We look back to the early days of the motor car and to the first engine that was built by George Stephenson, and in view of what has happened since those times

we cannot help thinking what the future of the tank may be. Its possibilities apparently are enormous. A tank has not been developed yet which can help in a North-West Frontier expedition in the way suggested by the lecturer. I endorse the sentiments expressed by one of the previous speakers to-night (Major-General Sir Charles Dobell), having gone through an expedition on the North-West Frontier. In view of that experience I say that a tank would be absolutely impossible there. I allude to the Hanza-Nagar and Black Mountain Expedition, a good many years ago now. I also agree with the previous speaker, and disagree with the lecturer that you have always got to wait for the enemy to attack you there. My experience was that you have got to find and seek him out and get at him no matter what the cost is. I am afraid I am rather wandering from the subject of my proposition, which is to ask you to accord a very hearty vote of thanks to our Chairman for his kindness in occupying the Chair and for the remarks that he has made on the lecture.

The resolution of thanks was carried by acclamation.

THE CHAIRMAN : Ladies and Gentlemen, I thank you very much.

The meeting then terminated.